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Pollution inventory, pollution budget model, water quality model and scenario handling

Functional specification

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REPORT

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Abstract

This is the functional specification of a complete pollution budget model for water. A crucial improvement of this model is implementation of new pollution sources and modification of existing sources. The specification of a water quality model, based on the results from the pollution budget model is also included. The document is intended to give a cost and time estimate of the programming of the functionality it describes, and will be the guideline for implementation of the specified functionality. This specification shall also work as document scientists at NIVA can use during testing of the pollution budget model

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The ENSIS Group will forward future revisions of "Pollution inventory, pollution budget model and water quality model" to the users of this documentation. When requiring a revised version, a copy of this page should be enclosed.

[1] The handling of alternatives has been implemented in this specification (copy from specification deliverd 20.03.2002)

Preface

This is the functional specification of a complete pollution budget model for water. A crucial improvement of this model is implementation of new pollution sources and modification of existing sources. The specification of a water quality model, based on the results from the pollution budget model is also included. The document is intended to give a cost and time estimate of the programming of the functionality it describes, and will be the guideline for implementation of the specified functionality. This specification shall also work as document scientists at NIVA can use during testing of the pollution budget model

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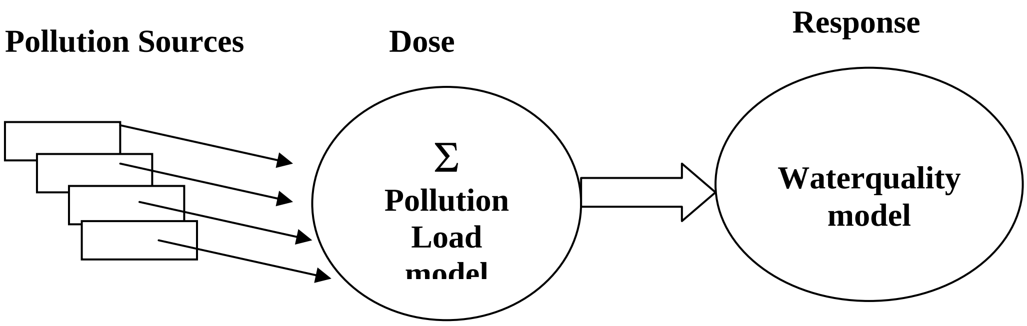
1 Overview of the specification and general improvements

1.1 The main content of the specification

This is a functionality specification of

1) Source extension and source modification of the existing pollution sources,
2) Complete pollution budget model for water to calculate the discharges from different sources, and
3) A simple water quality model taking into account simple retention calculation for rivers and lakes.



The pollution load model
The model include calculation of all pollution sources discharging to water recipients directly or to recipients through a municipal sewerage system. This model only consider the pollution contribution for each source until it reaches the recipients including calculations for retention on the way to the recipient, but it does not take into consideration the fate of the pollution in the water system (routing, decay, etc).

This means that the model does only calculate the pollution load to the recipient (the dose), and does not integrate water quality models for rivers, lakes or coastal are (the response).

A simple water quality model
This is a water quality model calculating the response of pollution discharges.

The idea of the model is to calculate the pollution load and concentration of specified polluting components in each river links and lakes defined in the model setup. An intermediate calculation for finding the concentration will be to calculate the water flow in each river link. For the lake, the total water flow from the river links linked to the lake in the upstream order will be needed for finding the resulting concentration.

The calculations of load (mass/time) and the concentration (mass/volume) in a river reach or lake is based on the discharges from the pollution sources in the area and hence the pollution load model described above. The output from water pollution budget model hence serve as an input to the ambient water quality model.

No routing of components or water shall be done in the model, meaning the "time-aspect" shall not be addressed. Only annually and monthly time step shall be allowed.

There shall be 4 tabs:
1. Input data and setup
2. Geography
3. Retention
4. Calculation

Extension of sources
The development of the model gives implications on other part of ENSIS, especially the parts involving the pollution sources and in some parts river links and lakes. Adjustment of existing sources and definition of new sources are thus a major part of this specification. In addition, other adjustments are proposed in order to enhance the reporting requirements which polluters are obligated to follow (this includes also municipalities) as well as the needs for pollution authorities.

General Implications

This functionality specification is based on the version of ENSIS available June 2001 (version 2.05, June 13).

All the new classes and properties shall be available in the import routine, export, report generator, etc. This is not further described, but is a consequence of the new data structure/data model the functionality specification gives.

All new geographical objects shall be available to be presented on map as ENSIS theme.

During the programming there should be a discussion about dividing in different modules according to different user needs (ex: different actors in the EU water framework directive)

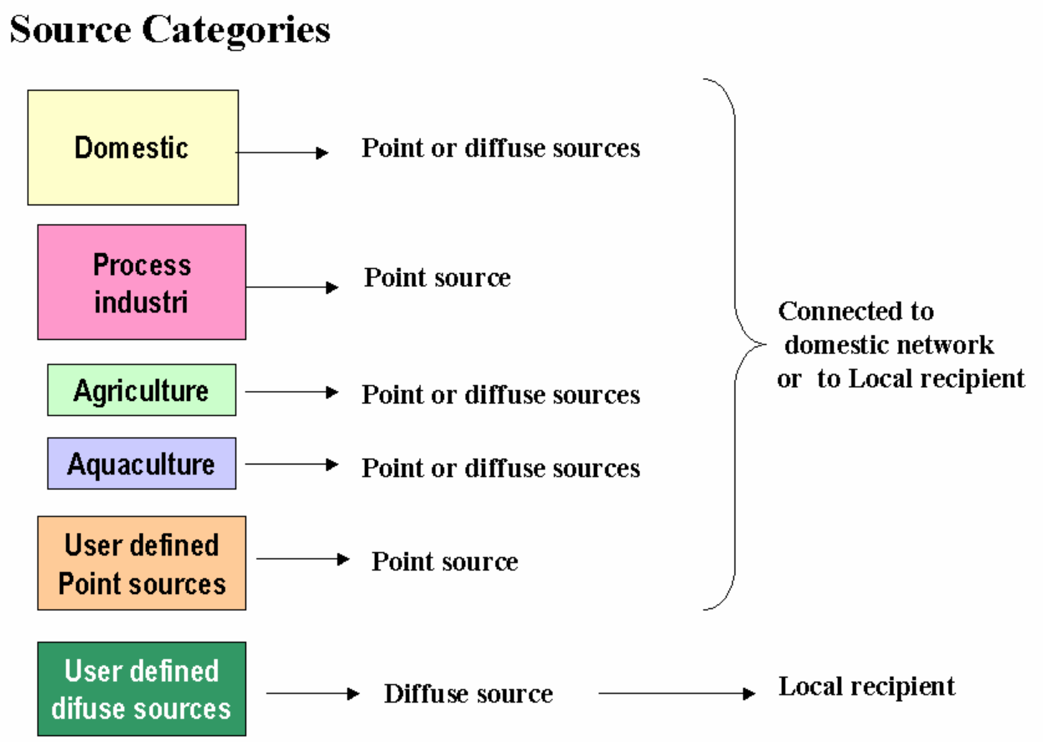
There are too much information in some of the forms. The GUI needs to be considered carefully during programming.

Some graphs and reports are not described. The remaining maybe similar to those already described. However it will be more efficient to have a close dialog between the programmers, NIVA and the users (i.e FMA in Telemark) during the finalisation of the programming in order to prepare userfirendly reports and graphs satisfying the user needs.

It is extremely important to receive the functionality in parts, in order for NIVA to test properly and to give feedback before it is to late. The testing will be considerable.

1.2 Overview of the pollution inventory module and vocabulary

The figure below gives and overview of the main source categories included in this specification.



The sources may be linked to Domestic network or might discharge to a local recipient without running through a municipal network.

If the source discharge to a municipal network the **collection point** is always linked to a **discharge location** which is equal to the **net node.** A net node is in general linked to a **municipal WWTP**, and then to a recipient through a **discharge pipe.** However, the discharge from the net node can be directly linked to a discharge pipe, meaning that there are "**no treatment**" downstream the net node.

If the source is not linked to a municipal network the collection point is linked to a discharge location equal to a nearby recipient.

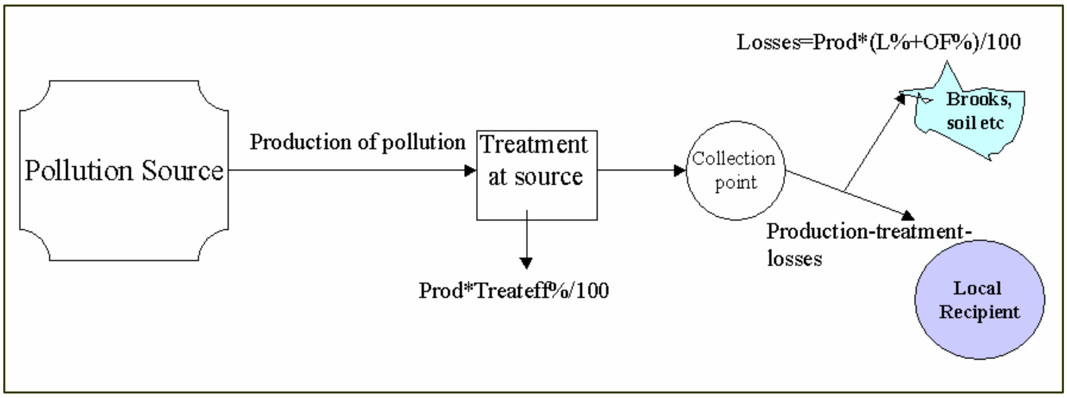
Diffuse sources except for urban run off are never linked to a Domestic Network. Otherwise all sources can be connected. However, point sources within agriculture and aquaculture are seldom linked to the network.

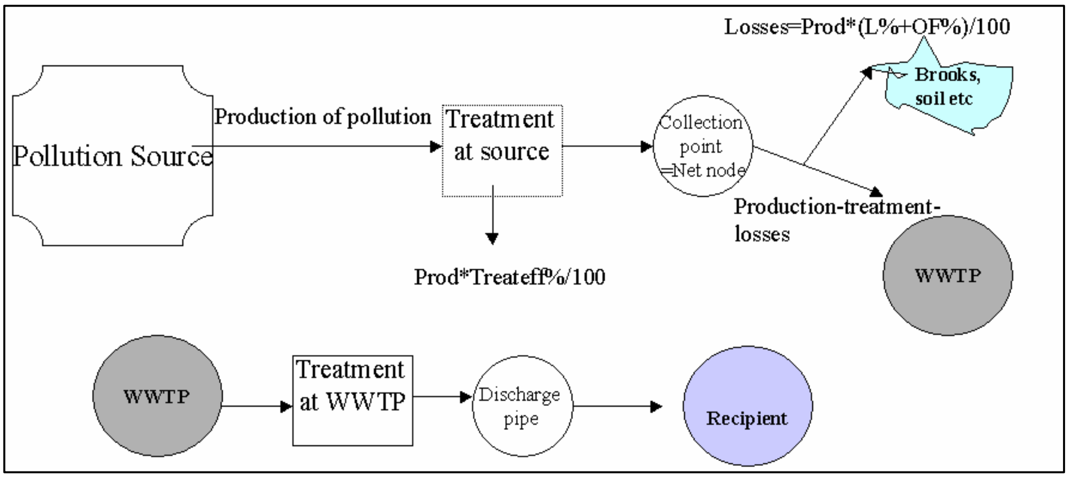
All sources to pollution may reduce their discharges to the final destination (local recipient or WWTP) due to **treatment at source** or retention i.e. through leakage or overflows.

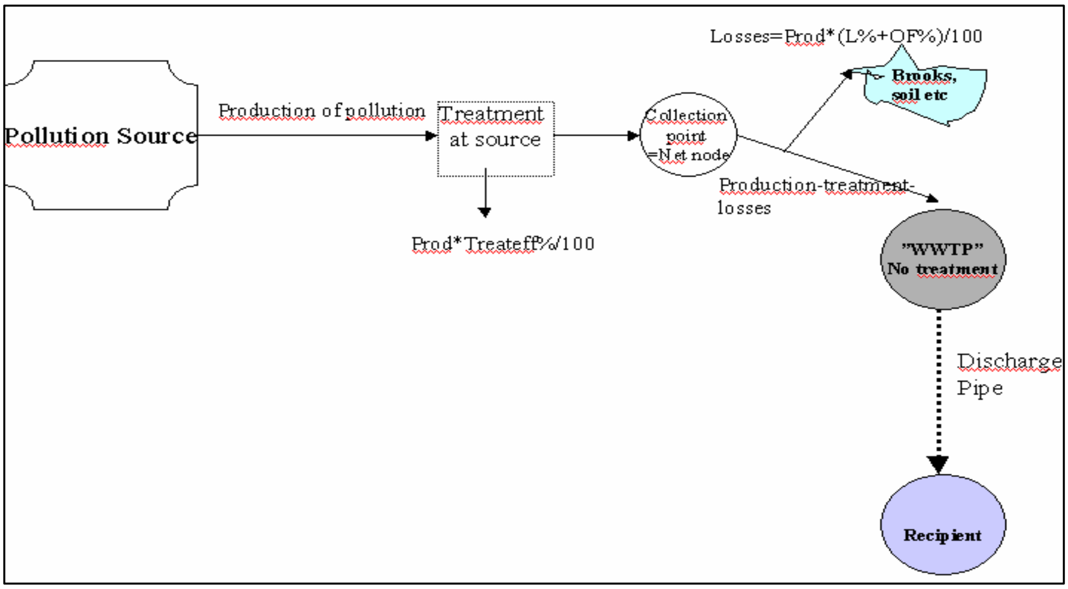
Leakage is always determined as a general loss figure on each source, while **overflow** might be a function of the source or a separate source to pollution (i.e. measurement exist for the overflow at network).

The figures below show

1) Pollution source which does not discharge to a municipal network,
2) Pollution source which discharge to a municipal network (Net node) and thereafter to a municipal WWTP, and
3) Pollution source discharging through a municipal network to a recipient through a discharge pipe[2].

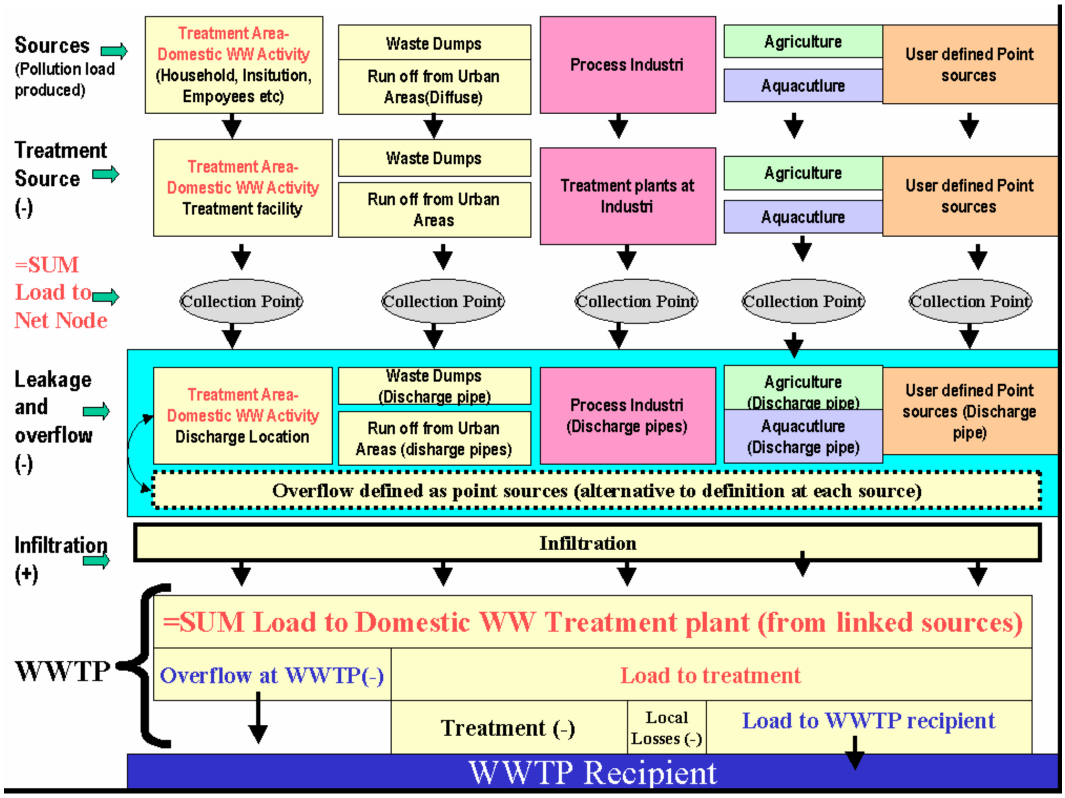


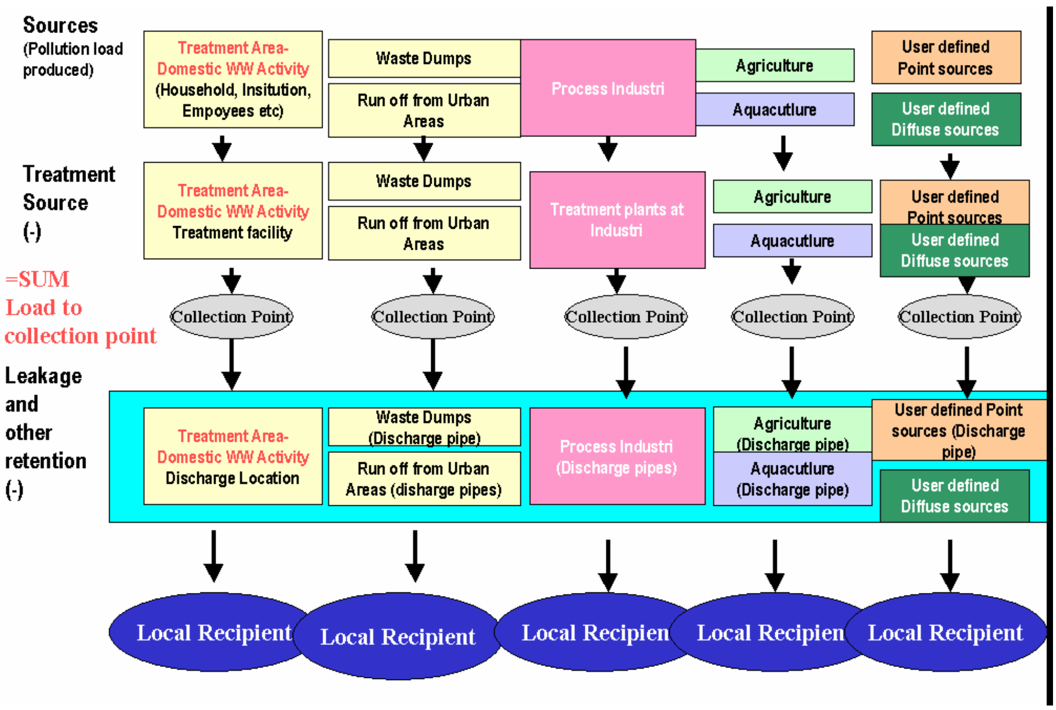




[2] In the application is defined to go through a fictive treatment plant a "WWTP" with no treatment.

The figures below show a detail picture of the flow diagram for different pollution sources depending on if these are connected (first figure[3]) or not connected to a municipal network (second figure).





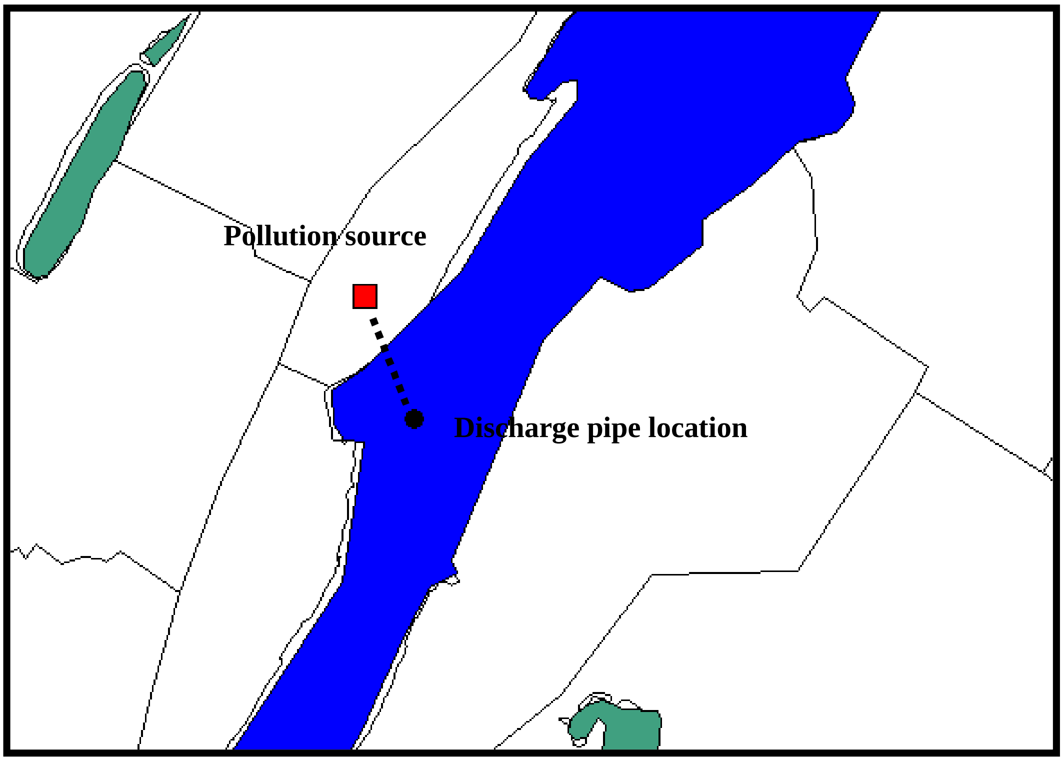
1.3 GIS

1.3.1 Themes and functionality

The new pollution sources shall be a standard GIS theme. It shall be possible to filter the type of source by use of the condition statements (ref GIS specification).

All pollution sources have now a geographical reference, either as point (wwtp, industry, points specified in this document), or as polygons (treatment area, diffuse source). All the sources can be linked to a municipal wastewater treatment plant (via net node) or to a local recipient. This gives a discharge pipe location of each pollution source that also can be presented on the map (or a distance from a collection point to the final destination). We want to add functionality that makes the user able to first switch on the pollution source, and then by for instance clicking the right mouse button on the pollution sources theme, add the discharge pipe location (the recipient point or net node). It shall also be drawn a line from the pollution source to the discharge pipe location.

<u>Example:</u>



The red square is the WWTP (pollution source), while the black circle represent the end of the discharge pipe (in this case the co-ordinates of the river node). The dotted line is automatically drawn when the user selects (right mouse button) to add this feature.

[3] If the net node is not connected to a WWTP the last part "WWTP" will not be relevant

In order to use the right mouse button and add the discharge pipe, the actual theme the user wants to add the discharge point/pipes for must be selected (ref the new GIS functionality).

GIS functionality like measure the distance and calculate the area should be implemented as described in the GIS chapter in the measurement specification.

1.3.2 View on map

There shall be implemented buttons for viewing geographical objects on the map all over the application, directly from the form that describes the object. This is today undertaken by the define geographical button today, and we want this to be consistent all over the application, meaning all geographical objects (also from the geography chapter in the measurement specification).

Also for all list of found items there shall be view on map functionality.

1.4 Graphics and reports

Graphics and reports have been implemented directly on the pollution sources and other places. Default graphs are suggested. However, wherever graphs are implemented it shall be possible to change the default graphs according to general graph functionality specified in the graphics chapter in the measurement specification.

Where report buttons are implemented it shall be a link to the report generator with the report already configured.

1.5 Document point

1.5.1 Menu

It is suggested to move the document points from the geography menu (as in the current ENSIS 2.05) to the report generator menu. This is due to the fact that these are reports with a geographical point and not a geography element.

Document point is general functionality and it is not necessary to read this chapter in order to understand the functionality around pollution sources.

1.5.2 Improvements

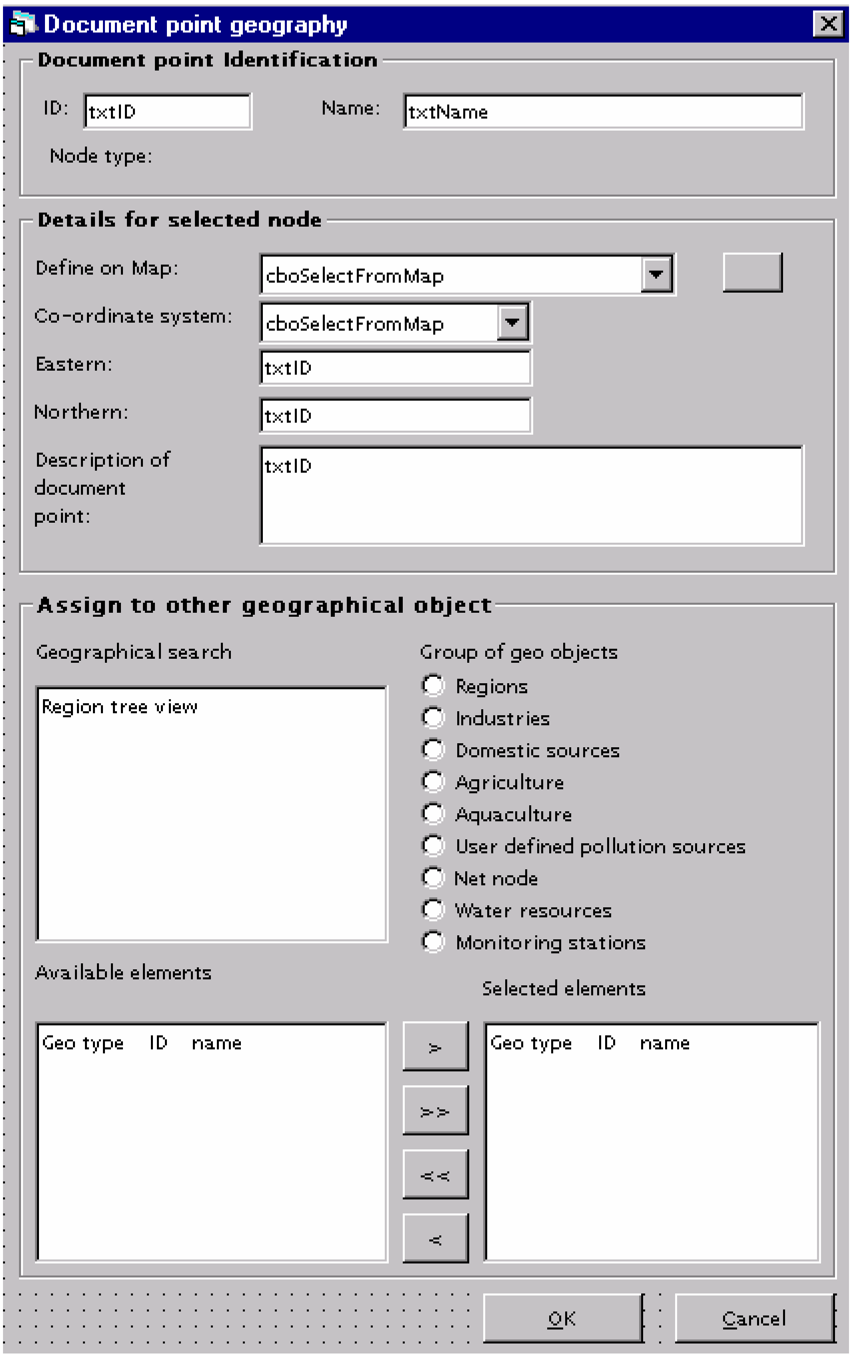
It shall be possible to associate documents directly to geographically objects. From all geographical objects (industries, lakes, wwtp, etc), there shall be a button called "View documents". This will start up the document point menu, with all document points and further documents linked to the geographical object the button is pressed from[4]. This view document button is also implemented for some lists.

It shall also be possible to store documents (i. e. preliminary reports or documents generated by the report generator) directly where they are created to document points and the geographical objects they are created from. For instance, it is specified that it shall be possible to make "an internal report" on each industry. This internal report can be stored from this place in the application with use of a "Save as" functionality. When the user presses the "Save as" button, different actions can take place:

- If the geographical object is already linked to one or several document points, the document (report) shall be stored directly when the user has specified a file name and path. If several point, the user must be asked to specify which point he want to save the document to.
- If the geographical object the report is created on is not yet linked to a document point, the user must be asked to do this.
- If not a relevant document point exist, the user must first create a relevant document point, then link the geographical object (i.e.an industry) to the document point, and then save the document itself.

The existing functionality of the document point shall be kept, but be extended to handle the described functionality. When the user opens up the document point (New / Edit), the form below shall show up.

[4] All geographical objects (also those not specif ied in this document) shall have a document button.



The upper part is similar to ENSIS 2.05. The part "Assign to other geographical object" is the extension. The idea is that this shall be used to link documents to geographical elements (specific lakes, wwtp, industries, etc)..

Geographical search: This shall be standard region tree view to be used for filtering out relevant objects within the selected region.

The geographical objects are split into the following stated below. It is also stated which objects that belong to the different groups.

Group name	Consists of water elements
Regions	Adm region, catchments, treatment areas and user defined areas
Industry	Industries
Domestic sources	WWTP, treatment areas, run off from urban areas, waste dumps
Agriculture	Point and diffuse source
Aqua culture	Aqua culture
Other pollution sources	Remaining pollution sources with geographical definition (aqua culture, user defined point and user defined diffuse)
Net node	Net node
Water resources	Lake, coastal object, river node, river link, river chain
Monitoring stations	Station

In both the list controls the following properties must be shown: Type of geographical element (lake, waste dump, etc), ID, name.

If the user wants to link the document to more than one geographical element, the already selected element must not disappear when a new option button (group of geo objects) is selected.

1.6 Improvements of report generator and the link to geographical objects

Templates
When the user creates a template in the report generator it shall be possible to link this template to a specific object (objects).

Link to report generator from geographical objects
From all geographical objects (where specified) there shall be a link to the report generator. If the user comes from a geographical object this object shall be marked in selection of class, and the available templates shall be those that have been linked to the source (specific item of specific data class). The user may apply a check box saying show all templates for project (independently if it is linked to the object or not).

Saving of reports to document points
It shall be possible to save the reports created by the report generator to the document points. This is already implemented in ENSIS 2.05.

1.7 New menu structure

This new specification will affect three main menu entries in present version of ENSIS, namely the Pollution sources menu, the model menu and the reports menu. The proposed new menu structure after implementing the new functionality is shown below. The menu entries marked with grey are look up tables (There shall be a horizontal line to separate inventories (registration forms) and look up tables). As this menu structure indicates, the new forms (registration of sources and look up tables) are invoked from several places in the application.

1.7.1 Pollution Sources

Module	**Main menu Item**	**Menu Items**	**Comments in relation to ENSIS 2.05**
Pollution sources	Industry	Water Sources	Existing entry but modified
		Industry Process type	New Name
		Type of Industry	Old Line of business
		Default production/consumption discharge factors	Modified
		Products	Existing
		Raw Materials	Existing
		WW Treatment method	Modified and moved from the WWTP menu
		Type of WW Treatment Process	Moved from the WWTPmenu
		Sludge Treatment Method	Moved from the WWTPmenu
		Type of Sludge Treatment Process	Moved from the WWTPmenu
		Type of solid waste	New look up
		WWTP Chemicals	New Look up
		Type of Sludge and solid waste disposal	New name
		Type of Industry Information	New look up
	Domestic Waste Water	WW Treatment plant	Modified registration form
		Treatment area	Modified registration form
		Overflow at network	NEW registration form
		Infiltration	NEW registration form
		Waste Dumps	NEW registration form
		Run off from urban areas	Based on diffuse sources
		Net Node	Modified
		Building Point	New (delete old building point from the geography menu)
		WW Treatment method	Modified
		Type of WW Treatment Process	
		Sludge Treatment Method	
		Type of Sludge Treatment Process	
		Type of solid waste	New look up
		WWTP Chemicals	New look up
		Type of Sludge and solid waste disposal	New name
		Domestic Activity Type	New look up
		Treatment facilities	New look up
		Default domestic discharge factors	New look up

		Type of Domestic Activity Information	New look up
		Type of WWTP Information	New look up
		Source type	New look up
	Agriculture	Run off from agricultural fields	Changed name
		Point source	NEW registration form
		Area type	New look up
		Source Type	NEW look up
	Aqua culture	Aqua culture	NEW registration form
		Source Type	NEW look up
	Userdefined point sources	User defined point sources	NEW registration form
		Source Type	NEW look up
	User defined diffuse sources	User defined diffuse sources	Existing reg form
		Area Type	Existing
	Alternative	List of Alternative	NEW look up
		Alternative	NEW registration form

1.7.2 Model

Also the menu structure must be updated according to the new model functionality. Under the model menu entry, there shall be two new entries called "Water quality" and “Retention equations”.

Models		
	Water pollution budget >	Source composition
		Model scenario
		Model configuration
	Water quality >	Water quality model
		Retention equations
	Results	Water Pollution budget
		Water quality

1.7.3 Reports

Reports	Reportgenerator	Existing menu entry, but improved functionality
	Documents	Moved from geopgraphy menu and improved functionality
	Open reports	Existing menu entry and functionality

2 Existing pollution sources and creation of new sources

2.1 General changes

The existing water pollution sources (industry, waste water treatment plant, treatment area and diffuse sources) need to be adjusted to be able to run the pollution budget model and to satisfy more advanced requirements from the users. Where only slight changes are needed, new forms are not developed. The changes are in these cases explained in words.

Important general changes for each of the sources are:

- The medium is not relevant. All discharges from the pollution sources are linked to component. Which component which will show up for the treatment area, WWTP , the diffuce sources, etc is a function of the component definition[5].

- For each source it is possible to calculate the loads based on a free selected calculation period. The calculations are based on the same routines as in the pollution budget model. The pollution load figures which are calculated for each of the sources are not saved to the database, except for some calculation which represent "data" and not model calculations. The load figures on each source are used for reporting and analysis purposes.

- Measurements at the sources are not part of the measurement module, but are linked directly to the sources (the source is the "station"). However the same functionality shall be available.

- Each pollution source (Activities defined under Waste water treatment area , Waste water treatment plant, Industry, Point source and diffuce source) should be linked /marked with an alternative. By default the source will be marked as base alternative. If there exists a base alternative and a new alternative is created based on the base alternative it means that the source is the same but that some of the properties have been changed. The base alternative is holding "true" properties. Another alternative could either be a manipulated source or a brand new source which is not yet build. There should be included an alternative combo box. Every source definition should have a link to alternative. In addition all search forms should include a search criteria alternative.

ID	**Name**	**Alternative**
222	Pollutionsource	Base alternative (true data)
222	Pollutionsource	Manipulated source – more pollution
222	Pollutionsource	Manipulated source - new location

[5] The component definition is global in ENSIS but i.e. if the user check measurement module, the user also has to check which medium, and measurement type the component shall be valid for. Otherwise there will be check boxes for industry module, WWTP etc. The new component definition is described in the Measurement_Part II specification.

- Each pollution source definition should have a **COPY** button implemented. If the user selects to coly the source, it means that the source is copied in to a new alternative. The user should get a new form that gives two options:1) copy all information into a new alternativ (and the user should select the new alternative name from a combobox or a tree view. The result should then be a source with the same ID and Name, but a new alternative name. All information given in the definition should be the same as before. The user should be able to edit the information given. 2) copy only ID and Name. The user should also here select the new alternative. Other information fields should be blank and the user has to give in the information.

- For each source (where relevant) there is a link to the report generator with the object already selected, and templates filtered.

- The possibility of drawing flow diagrams have been introduced and requires some sort of drawing "tool". To simplify, the user shall not be able to draw symbols, but only select from a predefined list containing a set of standard shapes/symbols. The names (i.e. process name) will be drawn on the diagram.

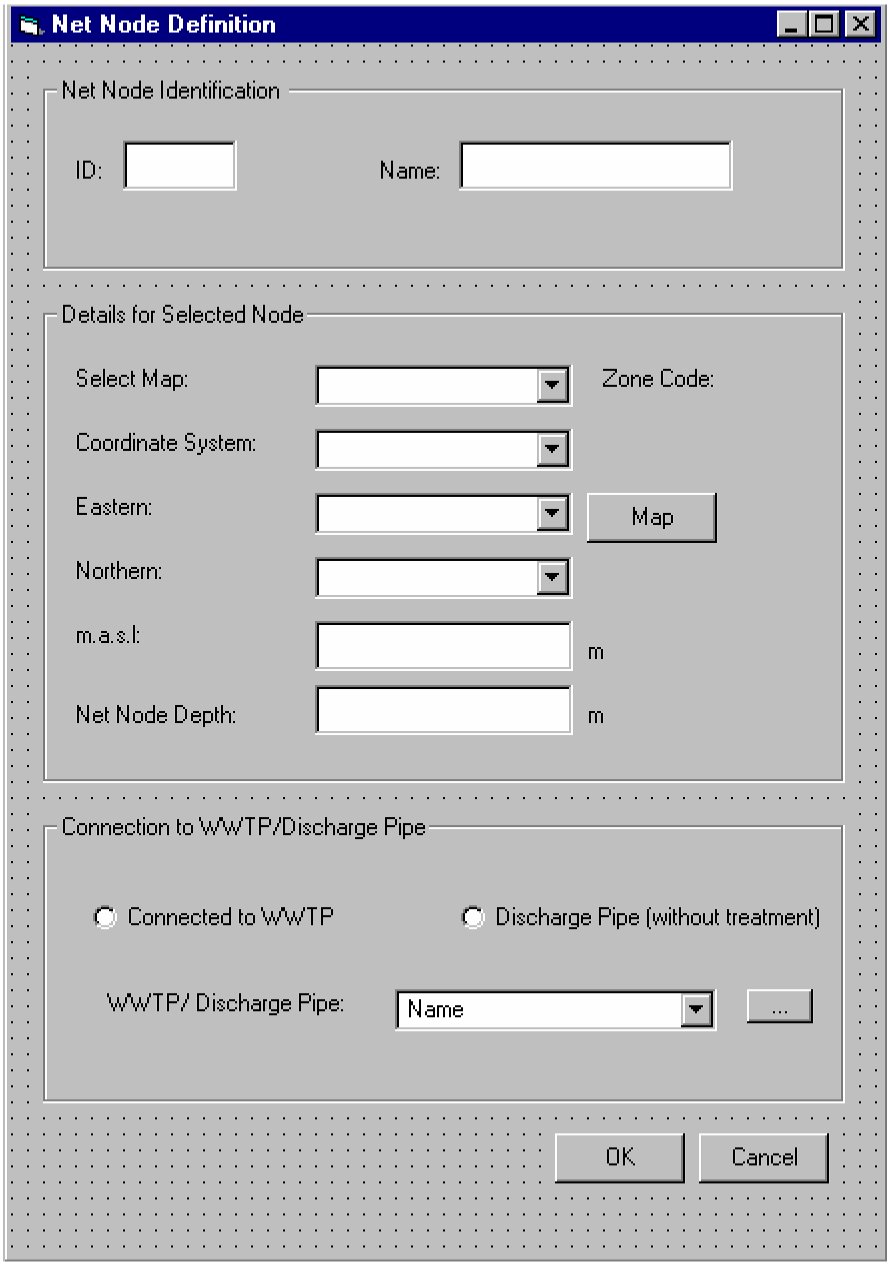
- The functionality to describe a pollution source within a category is always organised by TABS. The name of the source (i.e Oslo main treatment plant) shall always displayed in the heading of the TAB, and the forms opened from the tabs shall have the name in parentheses. NB this is not shown on the examples in this specification .

- Graphics has been suggested several places in the specification. These are default suggestion, however the user shall from these graphs have access to the graph tool where the type of graph and graph settings can be changed. The graphics are explained as part of the Measurement part II specification.

2.2 Net node

The net node is as described in the introduction, necessary in order to describe geographically the point where the pollution sources enters the network, and if the discharge is transported to a municipal WWTP or directly to a discharge pipe (without treatment at a municipal WWTP).

The existing functionality of the net node (ENSIS 2.05) has to be extended with the property to link a waste water treatment plant (WWTP) to the net node or to link it to a discharge pipe directly. By default the connected to WWTP radio


Net Node Definition
Net Node Identification
ID:
Name:
Details for Selected Node
Select Map:
Zone Code:
Coordinate System:
Eastern:
Map
Northern:
m.a.s.l:
m
Net Node Depth:
m
Connection to WWTP/Discharge Pipe
Connected to WWTP
Discharge Pipe (without treatment)
WWTP/ Discharge Pipe:
Name
...
OK
Cancel

button is selected, and the combo box shall list all WWTP registered in the project[6].

If the net node is only connected to a network with no treatment downstream, the user needs to select a discharge pipe directly. In this case only those discharge pipes which are connected to WWTP defined with "no treatment" will be listed[7].

2.3 Building Points

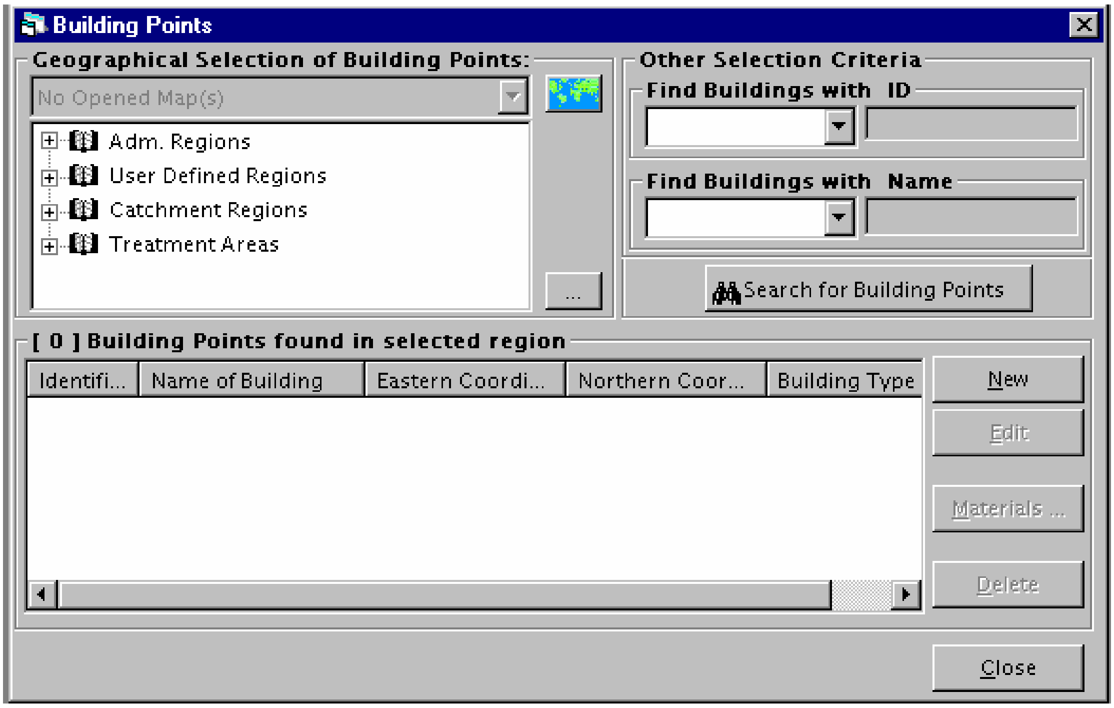
The building point may be used as part of the definition of several of the sources and are therefore explained before we start with the explanation of each of the pollution sources.

In ENSIS 2.05 building points exist as part of AirQuis. However, new data classes (and separate forms) must be created due to relative big changes. Also the building point definition should not be part of the geography menu, but the pollution sources menu.

[6] The idea of net node is only for the purpose of identifying the WWTP/discharge pipe the net node finally lead to (discharge to) in order to undertake modelling. There are no functionality in order to define the network between the WWTP and the net node. If such functionality is required in later ENSIS versions (among others to describe leakage with more accuracy) this can be implemented after the same principle as river links or possible with the existing functionality in Netopia.

[7] Whether or not a WWTP is defined as a real treatment plant or as a "WWTP" with no treatment is defined in the WWTP menu.

2.3.1 Search Form



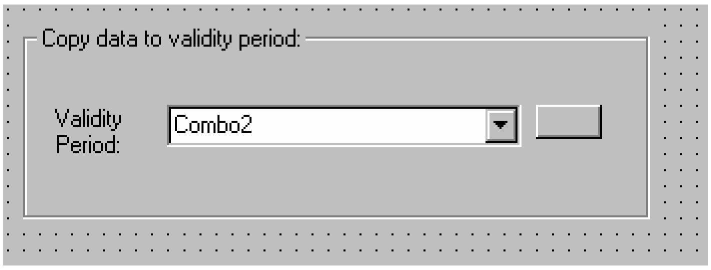
The ENSIS 2.05 search criteria form is shown above. The search Criteria shall be the same except that the fact that building type shall be a search criteria (organised in a treeview). If the user marks a parent building type as the search criteria, all buildings registered as this building type and children of the selected building type, must be found

The link to materials shall be removed.

Also it shall be possible to search for building based on building address or owners name, even though the building name probably will contain the street and street number.

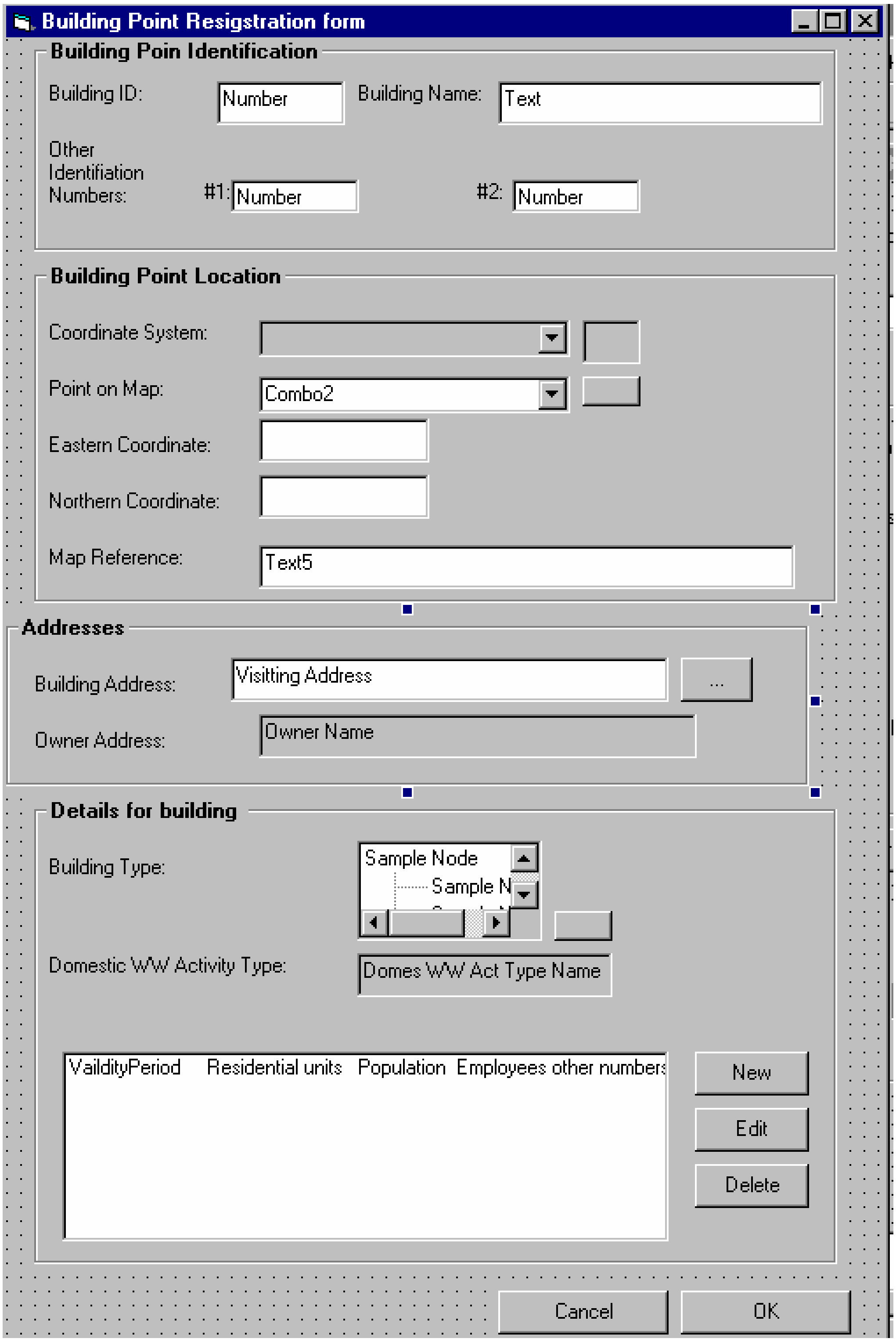
In addition there shall be a ”View on map” functionality and a copy data.

The “copy data” Function shall allow the user to copy the data which are dependent on the validity period (population, employees etc, see registration form below) to another validity period for all selected building points.



The view on map functionality allows the user to view the selection on the map as elsewhere in the application.

2.3.2 Building Point Registration Form



There shall be an Apply button on the form (not drawn).

The registration form for building points is built on the same principles as in the air module however some functionality is removed and the link to address information is added.

The building point identification allows the user to identify the Building point with id and name. The name will probably some how reflect the address. Also the user has the option to register other identification numbers (i.e. taken from national registries).

The location of the building point is registered as elsewhere in the application by pointing on the map. Also there is a map reference in order to refer the location to a paper map.

The address information is linked both to the address of the building and the address of the owner. For the building the visiting address will be referred and for the owner the owner name.

The owner name (last name, first name) is a consequence of the registration of building address, and will therefore be disabled and for information only.

The details for the building give the user the option to link the building to a building type (usually given by a national identification system). The name of the building type will be given in the treeview.

The domestic WW activity type (households, hospitals, schools, Industry etc) will be filled in as a consequence of building type (grey/disabled) or left open (grey and disabled) if the links between building type and Domestic WW activity type is not given[8]. The Domestic WW Activity type will be referred to by the name.

For registration of building type see below. (This is similar to the air module)

The Domestic WW activity type is used later when the user wants to convert from building points to Domestic WW activities.

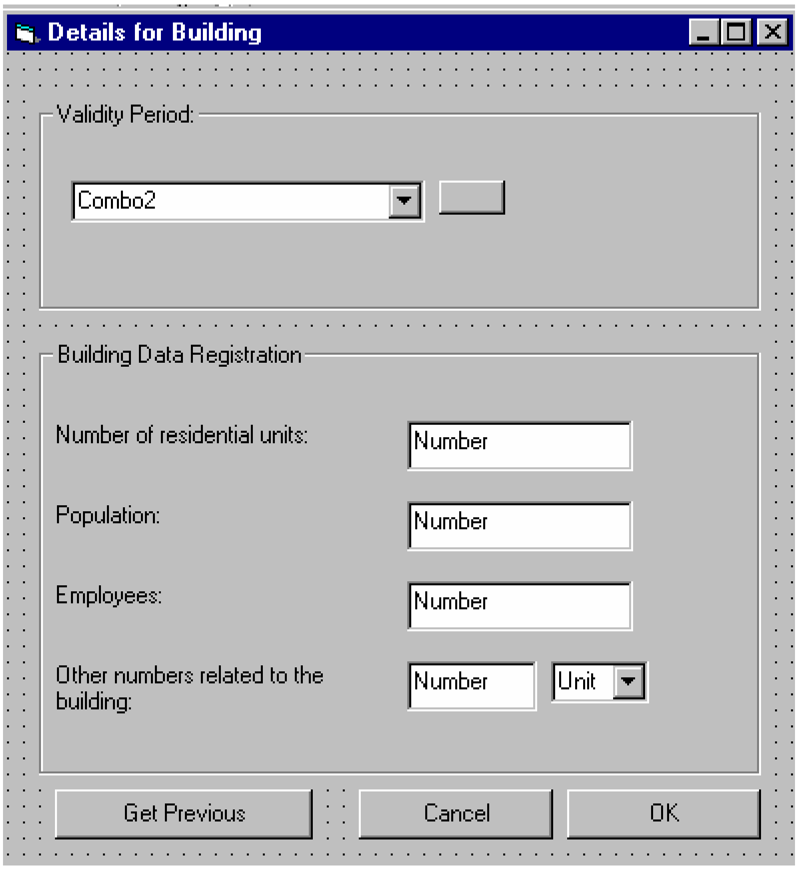
For each validity period defined for the building point data, the user may also fill in the number of residential units and population (relevant for building types which belong to residential categories). Also the number of employees may be filled in[9].

[8] The link between building type and domestic WW activity type is given when the user defines the Domestic Waste Water Activity type

[9] Even though the user has the possibilities to register number of employees at the process industry (which is only a subgroup of all commercial activities) and there is a link to industry from the building points (through the owner), the number of employees at an industry (which can consist of several buildings) must be filled in manually. Also when conversion to Domestic WW activities is used, the reference to building point and not to the industry from will be used.

Finally there are some activities that have employees, but also other numbers which are relevant. I.e if the user has registered schools, the user may fill in the employees and the number of pupils.

<u>Details for Building Data (new edit)</u>



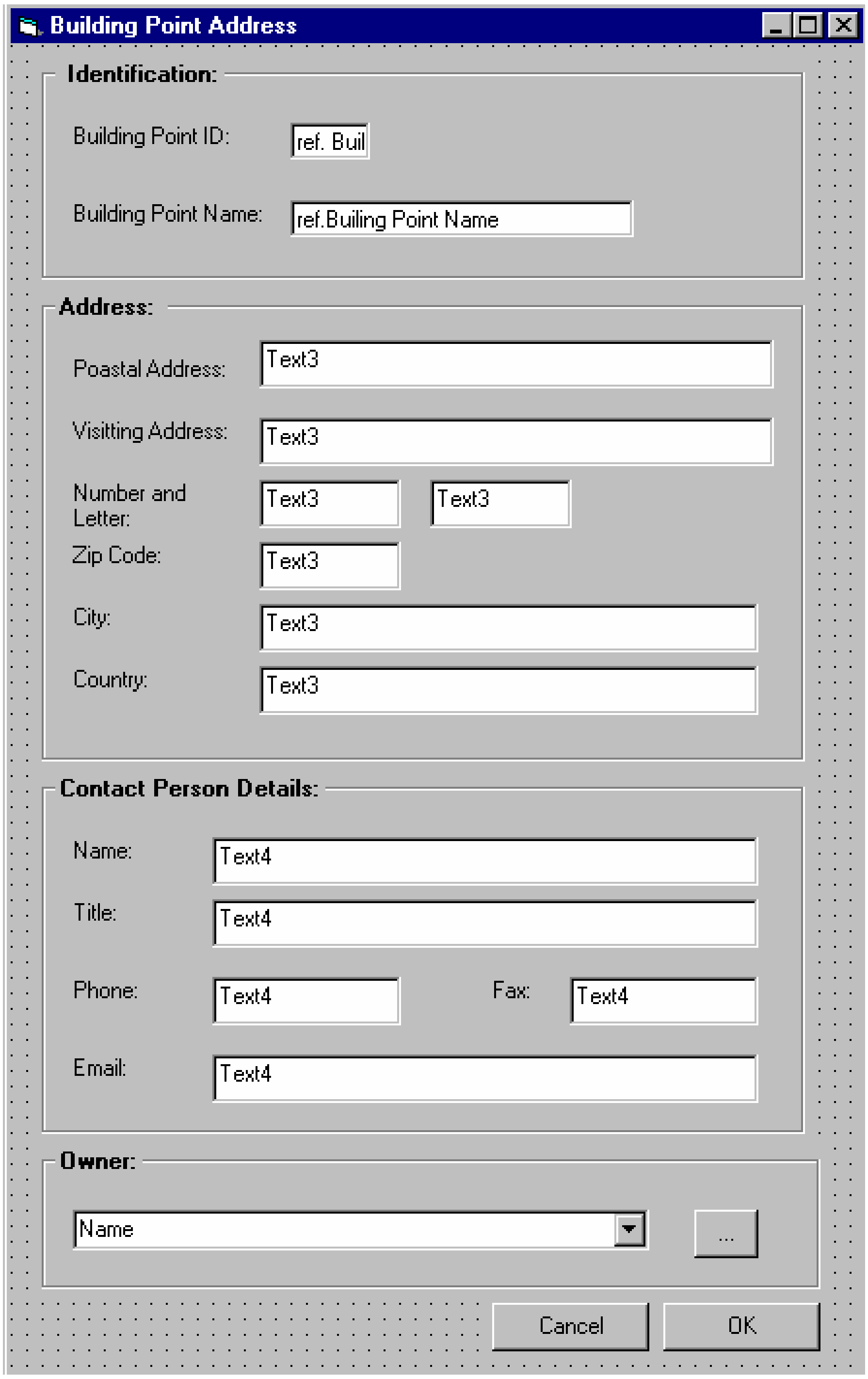
The units available for other numbers are of unit types derived from units of activity (PE, pupil, etc).

Get previous allows the user to copy data from the previously validity period defined.

2.3.3 Building point address

When the user enters the form to register the address, the building point ID and the Building Point Name will be filled in from the main registration form and the fields will be disabled. It shall not be possible to reach this form via the Addresses menu, but only accessible via the building point registration form.

There will also be a link to the owner in this form. The owners will be listed by name.

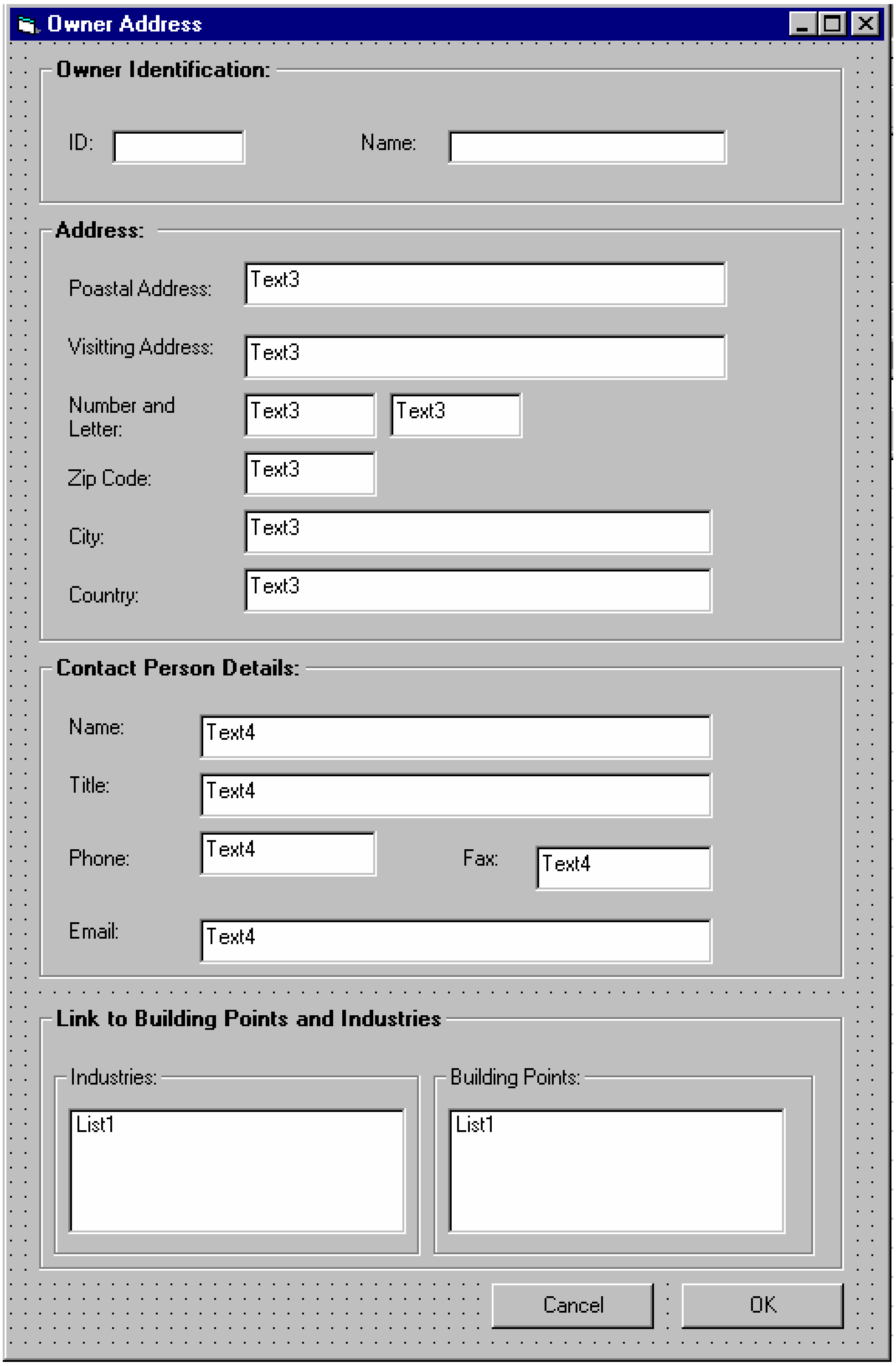


In other words, we think maybe the building point and the addresses information is stored in the same data class, since the ID and name are shared.

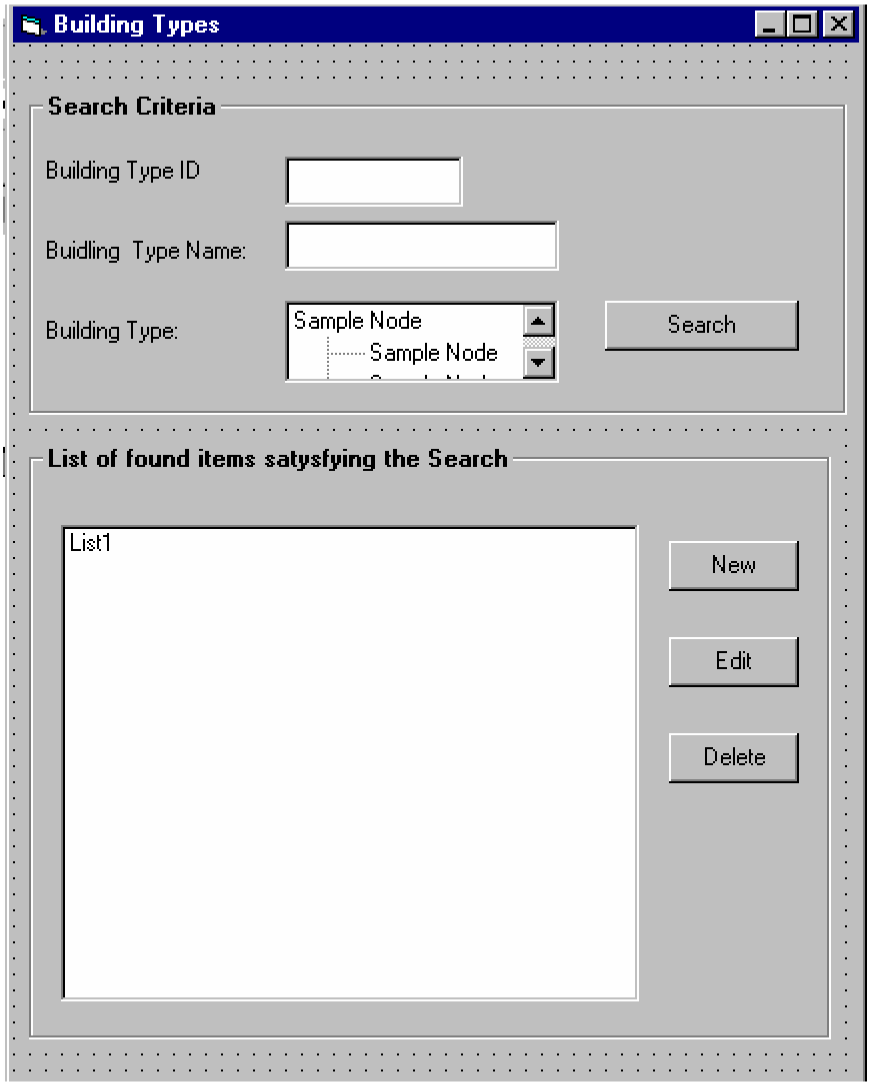
2.3.4 Owner Address

The owner address information is adjusted compared to the ENSIS 2.05 version.

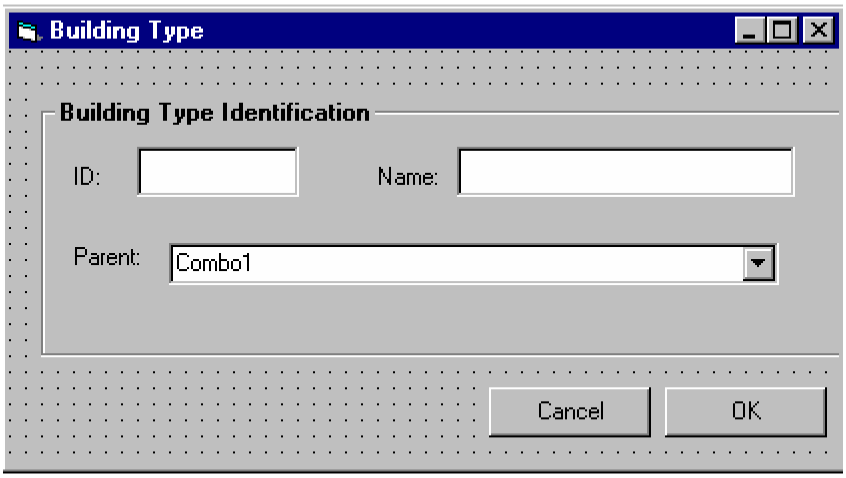
The link to building point and industries is for information only (the owner can be linked to several building points and industries) and a result of owner registrations done on building points and on industries (it will therefore not be possible to establish the link from this location in the application). The Building points and industries will be listed by ID and name in two separate list boxes. Double clicking on the items in the list box will lead the user to the registration form for industry and the building point.. Alternatively there may be a button go to links which will open two filtered lists; one for industry and one for building point. From these filtered list the user can search for further information (see how links function i.e. for stations).


Owner Address
Owner Identification:
ID:
Name:
Address:
Poastal Address:
Text3
Visitting Address:
Text3
Number and Letter:
Text3
Text3
Zip Code:
Text3
City:
Text3
Country:
Text3
Contact Person Details:
Name:
Text4
Title:
Text4
Phone:
Text4
Fax:
Text4
Email:
Text4
Link to Building Points and Industries
Industries:
List1
Building Points:
List1
Cancel
OK

2.3.5 Building Type



The user can search fro the defined builing types
The properties that shall be shown are Id, name and parent.

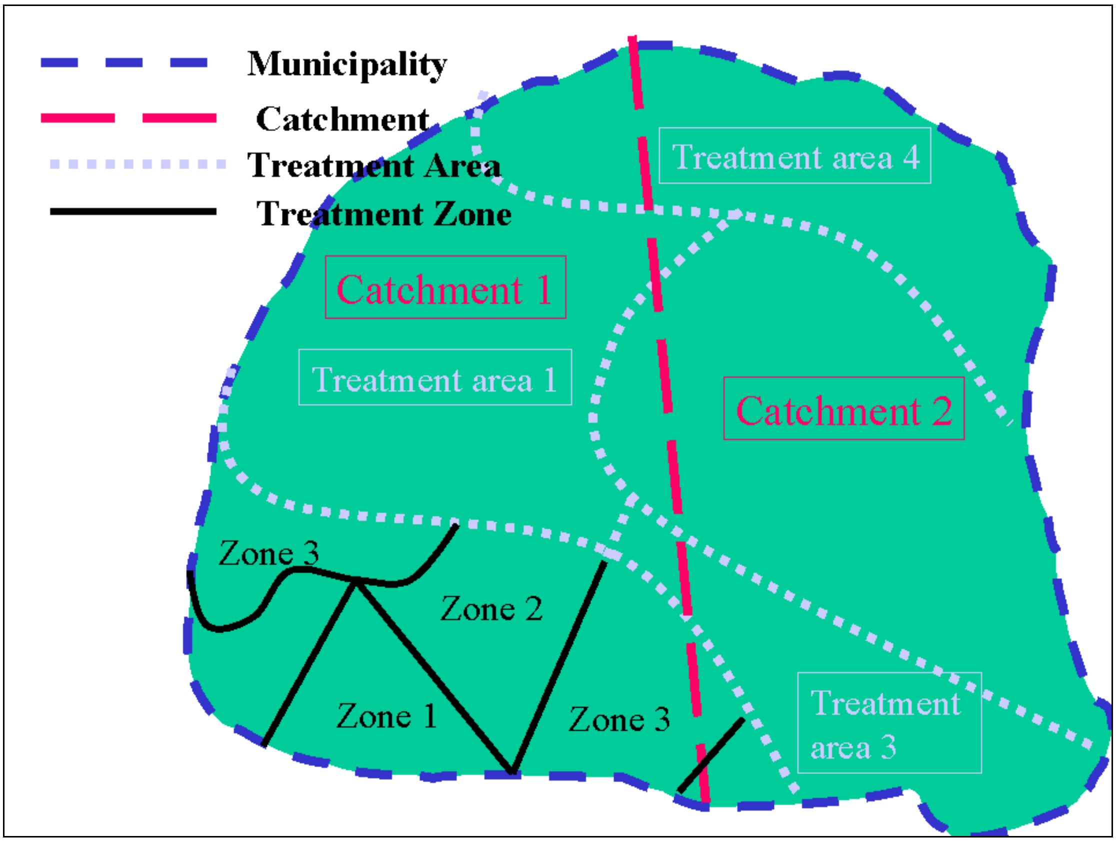


This is the registration form for the building type. It contains ID, name and the location in the tree view by identifying the parent.

2.4 Domestic Waste Water-Treatment Area

Domestic activity should in the following chapters be renamed to domestic sources.

2.4.1 Introduction



The user (and the programmer) should be aware of the function of treatment area in ENSIS. Treatment area is not a separate source, but a collection of several activities (several sources) which produce domestic waste water within an area, and which give contribution to pollution either through the domestic WW network (sources connected) or directly to local recipients (those sources not connected). Treatment area might be used to calculate present domestic load, but will in particular be relevant for calculating future scenarios.

The discharge figures are presented as mass pr time where the user can convert these to a common unit called person equivalent (PE)[10].

[10] Even the number of persons within a treatment area is converted to this equivalent. This is to reflect the fact that the discharge factors usually are representing a person per day and hence the number of people need to be reduced in order to account for that the persons are not 100% present in their homes but goes to school and work. The concept of PU=Person unit =person + person equivalents has therefore not been introduced. Also the domestic part of the

The unit type the PE is derived from is called “domestic activity unit”. It is used to construct the units for the domestic ww activities. The base unit from activity unit shall be called PE. The discharge factors given for a “PE” is the amount of pollution a person usually produce during a day. Typical other units with a user defined relation to the base unit PE are pupils, chairs, beds, etc. They all indicate an amount of pollution for a selected component

We think the unit type (domestic activity unit) and its base unit (PE) shall be pre-defined, to avoid unpredictable results.

A domestic WW activity (connected or not connected) always belongs to a domestic WW activity type. Examples of domestic activity types:

Households
Hospitals
Schools
Employees at Industry and other workplaces
Cabins
Hotels
Etc.

<u>Domestic activities connected to the domestic network:</u>
The production of pollution from the domestic ww sources (the discharges) are calculated based on the number of the activity and the discharge factors (given as default). The total load produced might be reduced on the way to the domestic WWTP through, internal treatment at the source[11], leakage or overflows. The loss through leakage is defined for the collection point linked to the activity as a general percentage figure. The loss through overflow may be defined as separate point pollution source (see new point sources definitions) or as for leakage as a general loss coefficient for each activity.

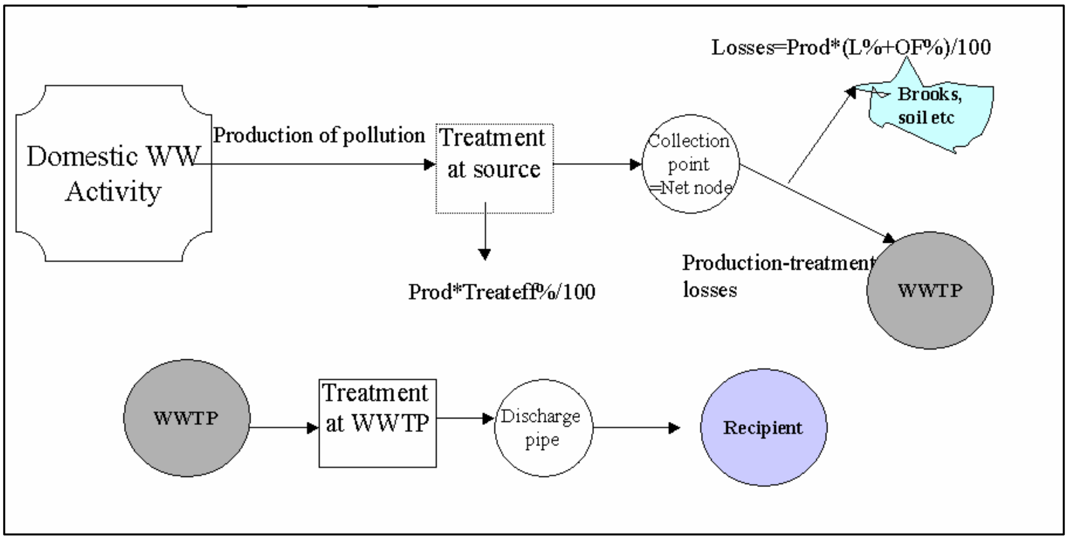
When calculating the load to the WWTP from the domestic activities within the treatment area, the user needs to decide if he/she should use overflow figures defined as separate sources or numbers given for each activity at the treatment area. Alternatively the user will consequent register loss figures through overflow as either a separate point source or as general figures. When the user goes to the WWTP(s) receiving waste water from the treatment areas he/she should be aware of that in addition to domestic wastewater identified by the treatment area, the WWTP receives wastewater from other point sources connected to the domestic network which is <u>not</u> defined within the treatment area but as separate sources (process industry, aquaculture, agriculture, leakage from waste dumps, or even infiltration which can be defined as other point pollution source etc).

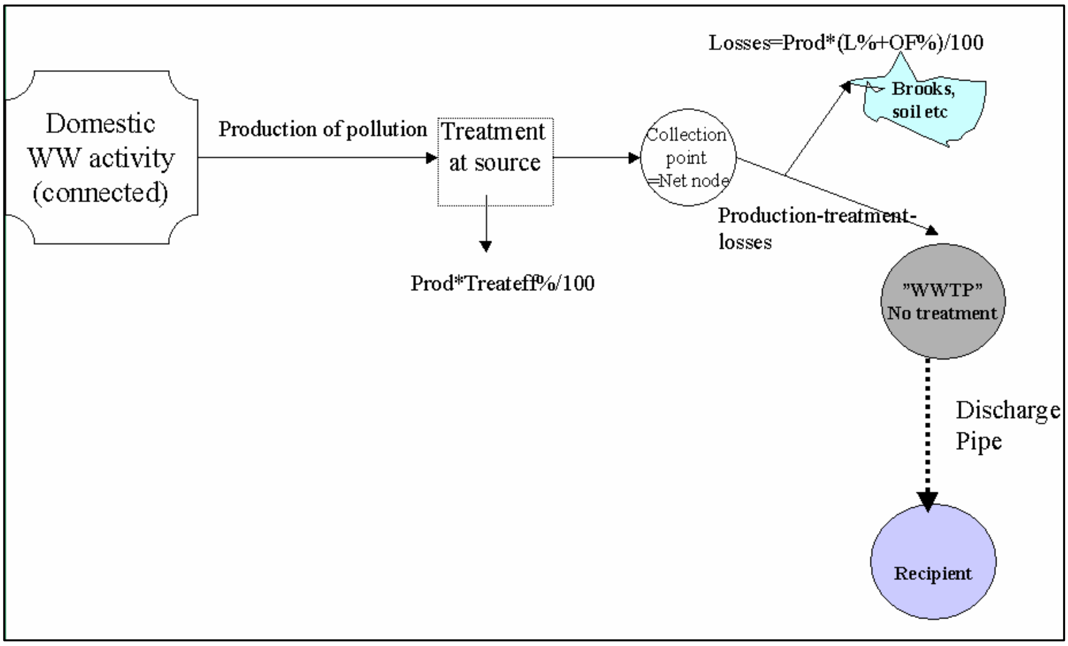
---

process industry connected to the domestic network may be converted to this unit. (see the WWTP module)

[11] Not common with internal treatment for domestic sources connected to the network, but can be registered if it is of relevance

The figure below shows a schematic overview of domestic activities **connected** to the domestic network (with and without a muncipal wwtp downstream[12]).





<u>Domestic waste water activity (not connected):</u>
Domestic WW activity not connected to domestic WW network may belong to several of the domestic activity types, however this group usually consist of household in rural areas, cabins or minor tourist activities. These activities are

[12] In the application there is actually defined a "WWTP", but which does not have treatment and which has a simpler registration form than a "real" treatment plant.

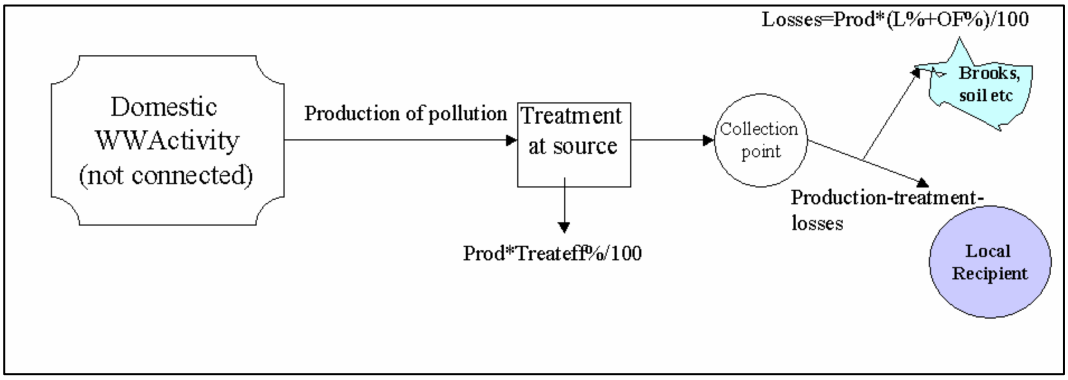
also registered at the treatment area, where the user can decide to what level of detail he/she wants to register the sources.

The user may for instance register these as a group of individual sources or register each source (i.e. each household representing one building point)

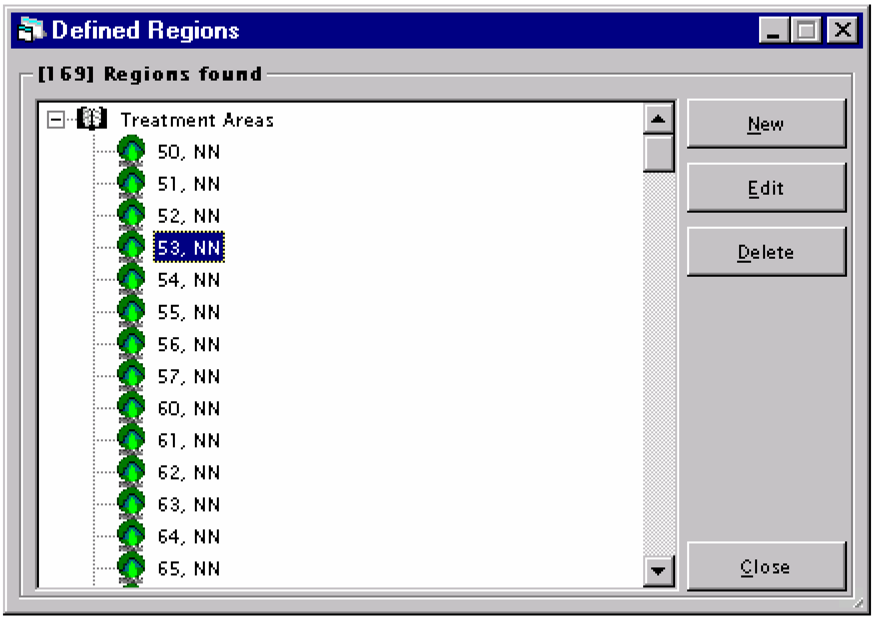
Typical for these sources is that they often are connected with some sort of small scale treatment plants/ treatment facilities like different types of tanks, controlled infiltration, micro treatment plants, etc. These type of treatment plant do have empirical treatment efficiencies connected to them which can be used in the calculation of discharges.

Sources not connected may also be registered with losses before the WW reach the local recipient. However for these sources Leakage might be interpreted to retention and overflow figures will only be relevant in some specific cases. For activities not connected it is only relevant to calculate overflows based on the general Loss figures (in %) given for an activity and not based on overflow measurements at the network.

The figure below shows a schematically overview of domestic activities **not connected** to the domestic network.



2.4.2 Treatment areas- remove from the geography menu



The treatment area functionality shall be moved from the geography menu. The treatment area functionality shall only be accessible through the pollution sources menu.

However, the treatment area might be listed in tree views with the other geographical areas such as adm region, catchment and user defined area, when these are used for search (**As in the ENSIS 2.05, but the 4 different areas should be separated in 4 classes).**

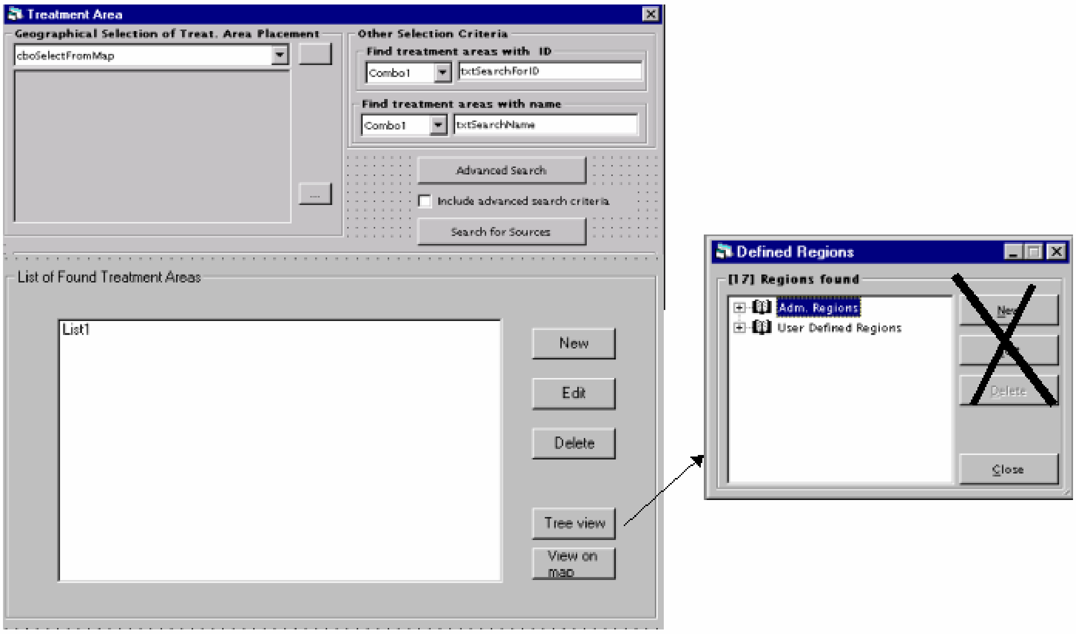
2.4.3 Treatment Area Main Form (adjusted search criteria)

As elsewhere in the application, the user will when accessing the treatment area entry get to the main form where the user may create a new treatment area, delete or edit and existing area and the data connected to it.

After the user has applied the search criteria the found items will be listed in a list as elsewhere in the application. The items will be listed by ID, code, name and parent region.

If the user applies the treeview button the user will be able to see the found items in a treeview. Only the found parents will be shown and the found items on a lower level will be active (the objects on a lower level which do not satisfy the search/is not part of the listed items will be disabled in the tree view). If the user marks one of the found items in the treeview the marker will jump to this item in the list.

The view on map will bring the user to the map, and the found items will be marked. Each level will be displayed with a separate colour. I.e the parent area of the with red and the treatment area (on a lower level) with pink.

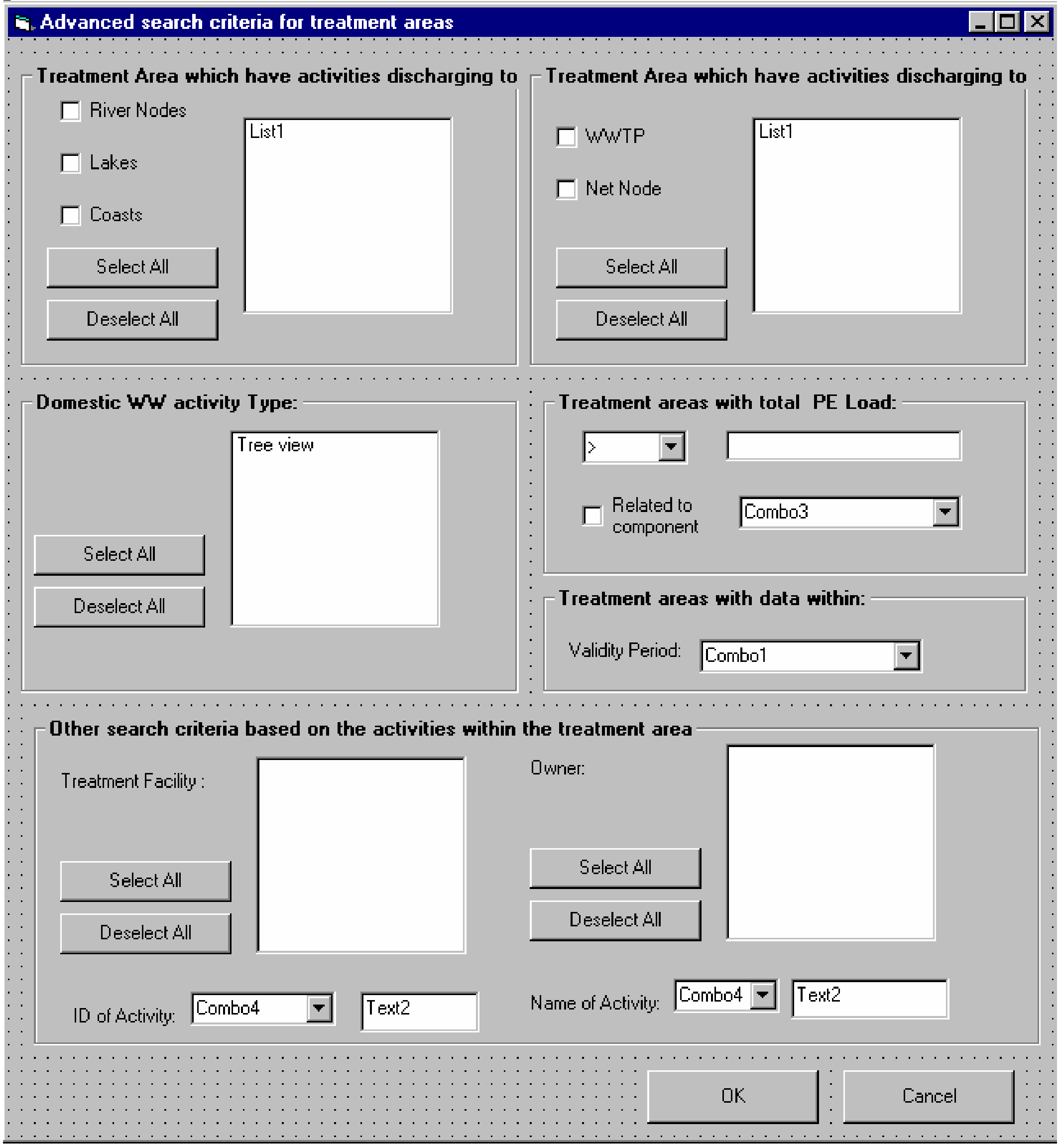


2.4.3.1 Search criteria for treatment area

Geographical search: As already implemented.
Search for ID: As implemented elsewhere in the application with Boolean search
Search for Name: As implemented elsewhere in the application.

2.4.3.2 Advanced Search criteria

The advanced search options will be limited by the geographical selection already performed in the main form.



Treatment areas which have activities discharging to

The list of recipient will be limited to those within the previously geographical selection. The system will search for those treatment areas which have activities connected directly to the selected recipients. The user should have access to the binocular functionality in order to be able to select more easily from the list which might be long.

Treatment areas which have activities discharging to WWTP and net node

The list of WWTP and net nodes will be limited to those within the previously geographical selection. The system will search for those treatment areas which have activities connected to the selected net node/WTTP.

Domestic WW activity type

All treatment areas with activities with the selected Domestic WW activity types will be found

Treatment areas with total PE load
It shall possible to search for treatment areas based on the information entered about PE for the whole treatment area. It shall be possible to relate the PE search to any component (as on WWTP in the ENSIS 2.05). A combo box listing the boolean operators >, <, =, >=, <= and “between” shall be implemented in the combo box. It shall be possible to do a general PE search independent of component or link the search to a component.

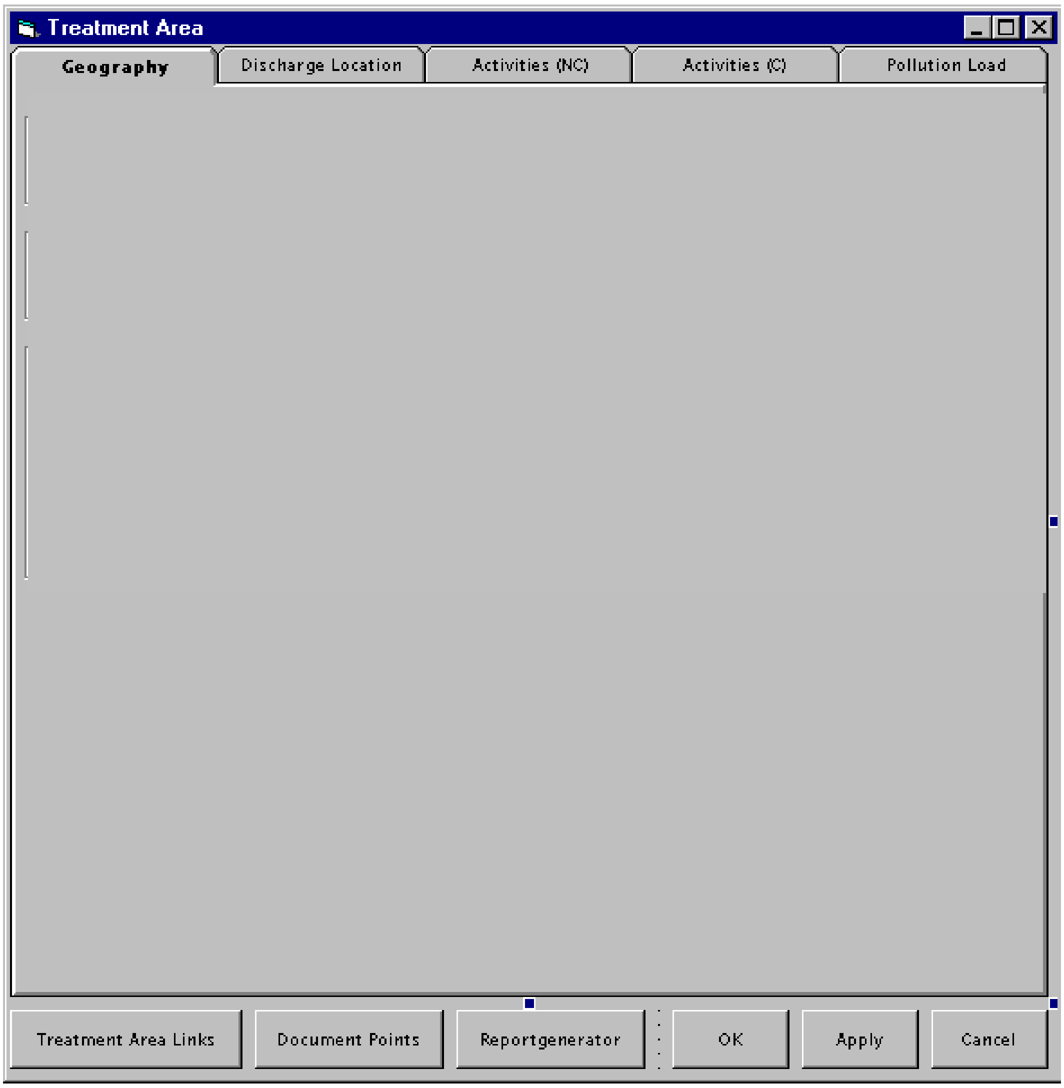
Other search criteria based on the activities within the treatment area.

Treatment Facility
All treatment areas with activities with the selected treatment facilities will be found

Owner
All treatment areas with activities with the selected owners will be found

Id and name of activity
The user might search for a treatment area containing a specific activity (search by ID or Name, i.e a special building point)

2.4.4 Registration of treatment area



The treatment area compared to ENSIS 2.05 must be reorganised and extended to be more consistent with the general user interface and to support the model functionality. In this chapter it is given an overview of the different tabs where information can be given for each of the treatment areas. The content of the tabs is described in more detail in the chapters which follow this chapter

In order to not confuse the reader, all functionality also the functionality implemented in ENSIS have been explained References have been made to ENSIS 2.05 were relevant.

There shall be 5 tabs on the treatment area (tab 3 and 4 are almost the same, but are separated on two different tabs to improve the overview for the user):

- **Geography** (taken from the present Geographical areas | Regions | Treatment area). The treatment area already given in ENSIS 2.05 shall be moved to this location and only slightly changed.

The Geography tab gives information about the Name, ID, Area, Elevation, Region and the coordinates of the area – the geographical representation of the treatment area.

- **Discharge Location** This is a similar concept as the discharge pipes in the current ENSIS 2.05 application (where the discharge goes to local recipient or domestic network), however the form reached from the treatment area module shall be renamed to "Collection point and discharge location" and will contain both collection point and the discharge location (WWTP or Local Recipient). Also the concept of losses (leakage and overflows) and the link to a building register have been introduced.

Discharge says something about the transportation of waste water from the source to the recipient, and describes location for collection and location for discharge including the recipient and the municipal WWTP if any.

- **Domestic Activities (not connected)** is used to calculate the discharges from the domestic WW activities in the treatment area which is not connected to the domestic ww network The user shall be able to enter data manually, but also convert data from the building register based on the buildings connected to the collection point. Also the concept of losses due to separate treatment at the individual sources before discharge to local recipients has been introduced The calculated figures are saved to the database and are used as input to the pollution load model.

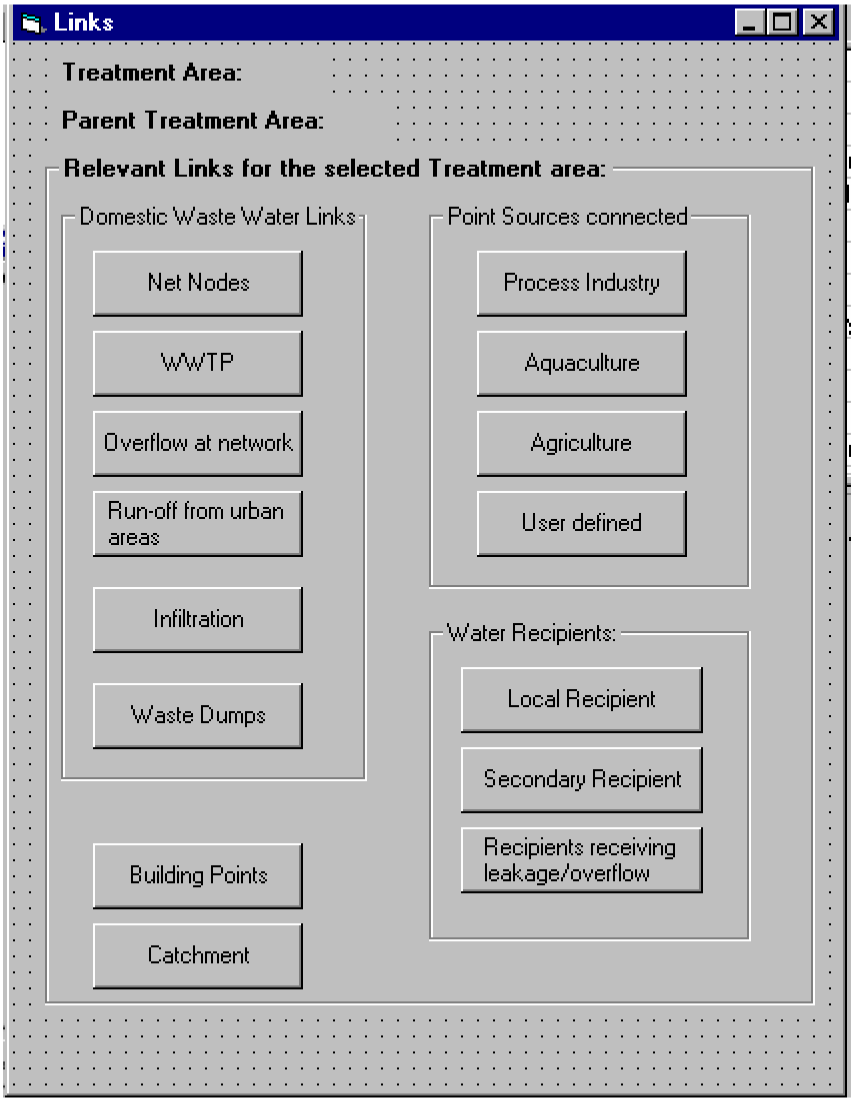
- **Domestic Activities (Connected)** is used to calculate the discharges form the domestic WW activities in the treatment area which are connected to the domestic network. The user shall be able to enter data manually, but also convert data from the building register based on the buildings connected to the collection point. Also the concept of reduction in discharge[13] due to separate treatment at the individual sources before discharge to domestic network has been introduced

- **Pollution Loads:** This TAB gives the user the possibility to calculate the loads from a treatment area for any period based on the data registered on TABs Acrivities(nc) and activities(c). The calculations are based on the same routine as in the pollution load model among others for interpolation and extrapolation The user gets results from the different "flows" of the mass balance such as the total production from the activity, treatment, leakage/overflows and final discharges.

[13] Not so common with individual treatment at domestic ww source if the source discharge to a municipal network.

Treatment Area (links)

From each defined treatment area there will be links to other relevant objects in the application. The user may select one or several links and it will bring the user to a filtered list for the selected objects (similar to the functionality on stations)[14]. Also there will be a direct link to the document points linked to the treatment area, and the user may go to the reportgenerator with the actual treatment area already selected.



[14] The user will only have full benefit of the relevant links to the treatment area after the user has registered the data on the treatment areas.

Domestic Waste Water Links

WWTP: Filtered list of WWTP which receives domestic waste water produced in the Treatment area. The WWTP found might be located inside or outside the boundary of the treatment area since the search is based on the connection of the activities and not the geography of the treatment area. Also the "WWTP" with no treatment will be found.

Overflow: Filtered list of overflows from the domestic network. These are the overflows from the network which should have gone to the WWTP described above, but which goes to local recipients because of constraints on the network. The system will first search on the activities defined for the treatment area, which WWTP these belongs to and from this list select the overflows (The overflows at network has a connection to the WWTP they should have been discharged to, see the registration form for point sources | overflow at network)
The user should be aware of that overflow at the network might not be defined as a separate source in the system, but identified as a general loss figure for the activities defined at the treatment area.
In this latter case the described search criteria will not be relevant/not function

Point sources connected:
These are filtered list of point pollution sources discharging to the domestic network within the treatment area (discharge to net nodes located within the area) These sources are defined in the industry module, aquaculture, or and the module where other point pollution sources may be defined

Building Points: A subgroup of all building points which are located within the boundary of the treatment area.

Water Recipients (receiving domestic WW from the treatment area):
The domestic WW activities within a treatment area can discharge to:

1) Directly to local Water Recipients,
2) To chain of net node_WWTP_ secondary recipients.
3) To recipients on the way to the local recipient recipient (losses might be assigned to these recipients if the elements are defined as recipients in ENSIS ref. Form collection point and discharge location)

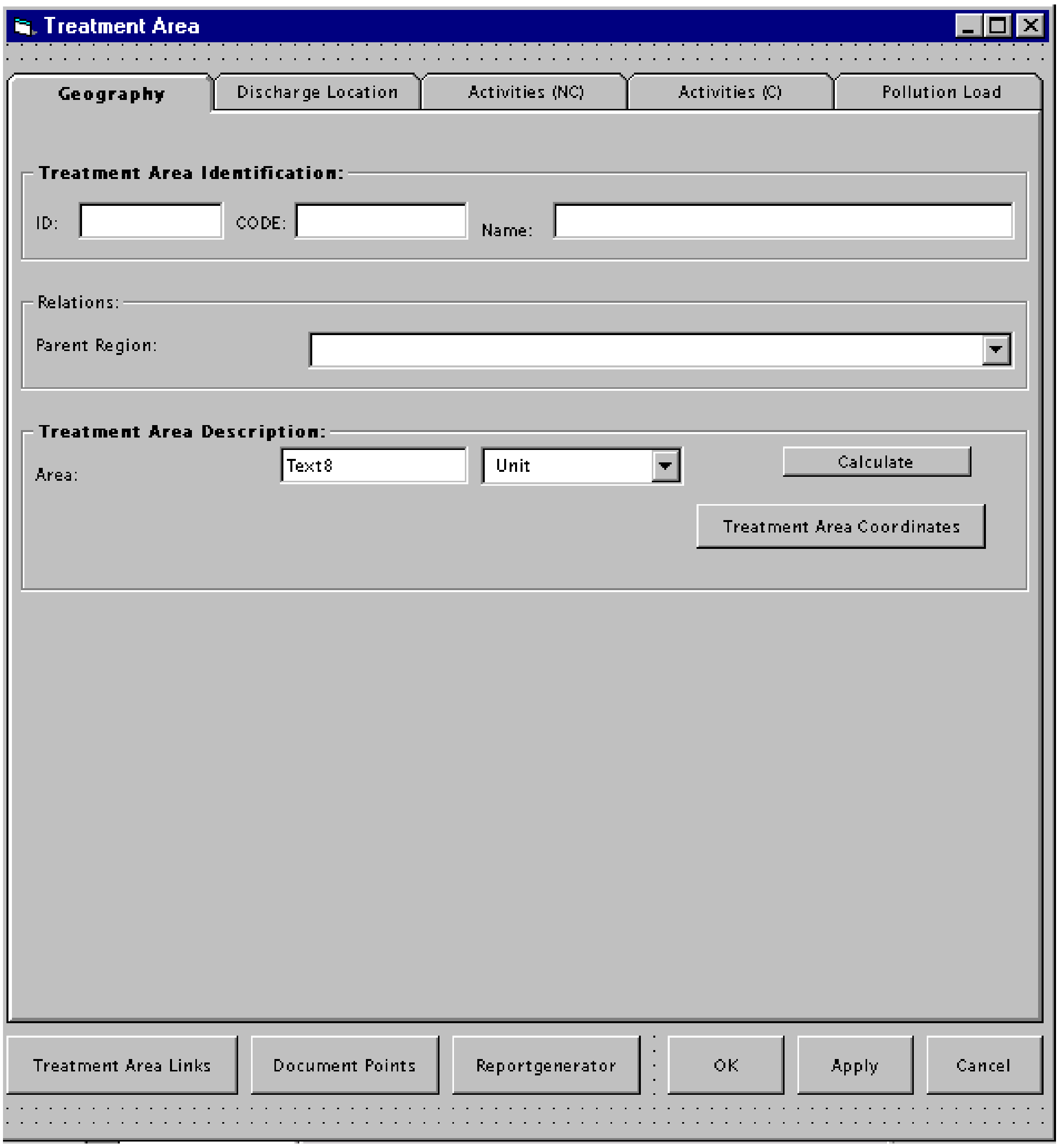
The recipient links give the user access to:

1) local recipients receiving domestic WW within the treatment area
2) secondary recipients/downstream recipients receiving from the WWTP or from direct discharges through the municipal network, and
3) recipients defined as receiving losses (leakage and overflow).

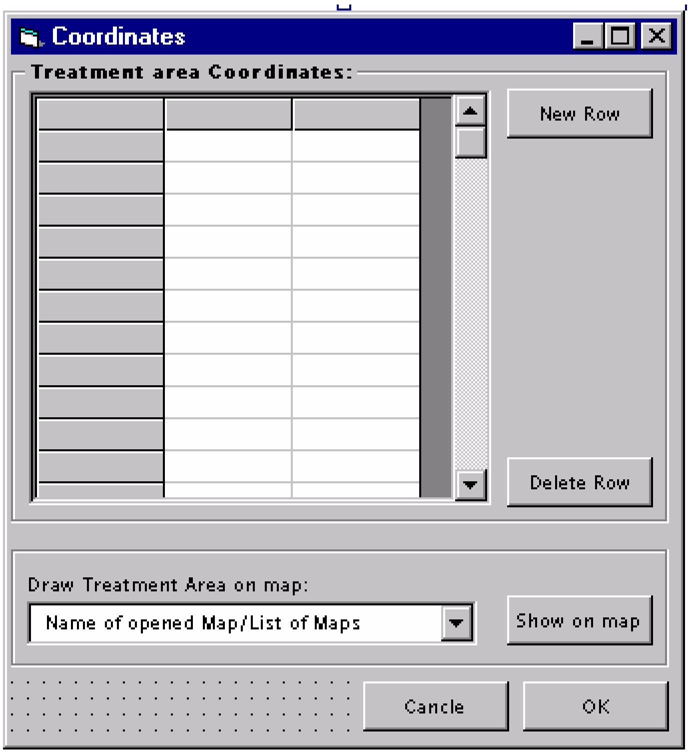
The recipients for the three scenarios above, may be river nodes, lakes or coastal area. Separate lists of all three types /coast, lake and recipient will be opened, but instead of opening the filtered lists of river nodes, the downstream river links connected to the river nodes shall be opened (or the river nodes shall be opened with a link to the riverlinks, see geography menu).

From the filtered list of recipients other relevant information can be found such as the link to monitoring stations linked to the recipients etc.

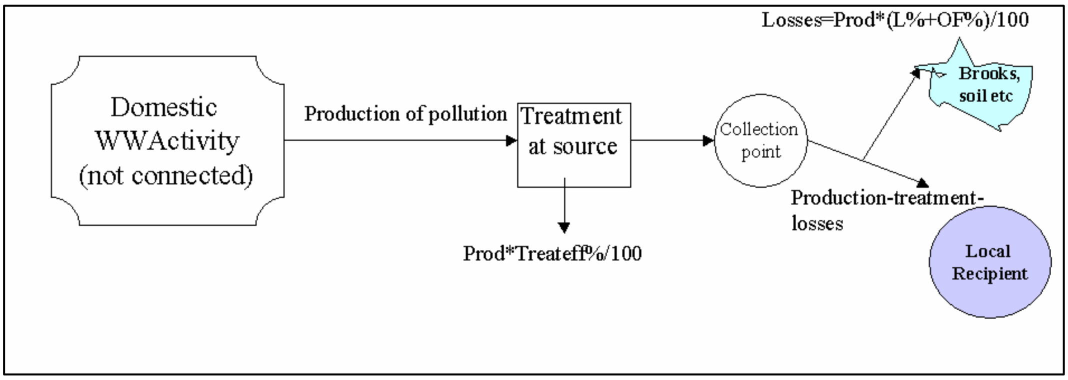
2.4.5 Treatment area (tab geography)

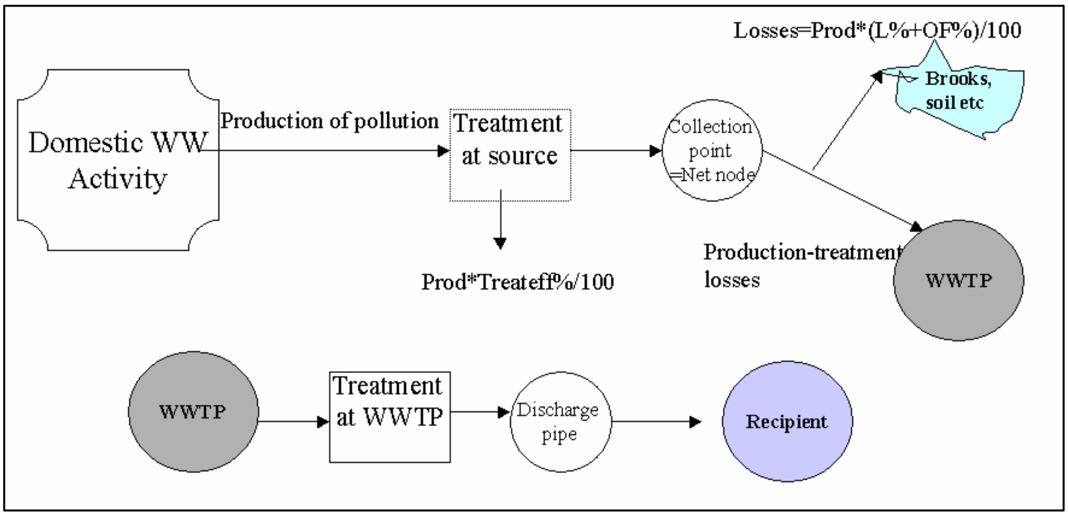


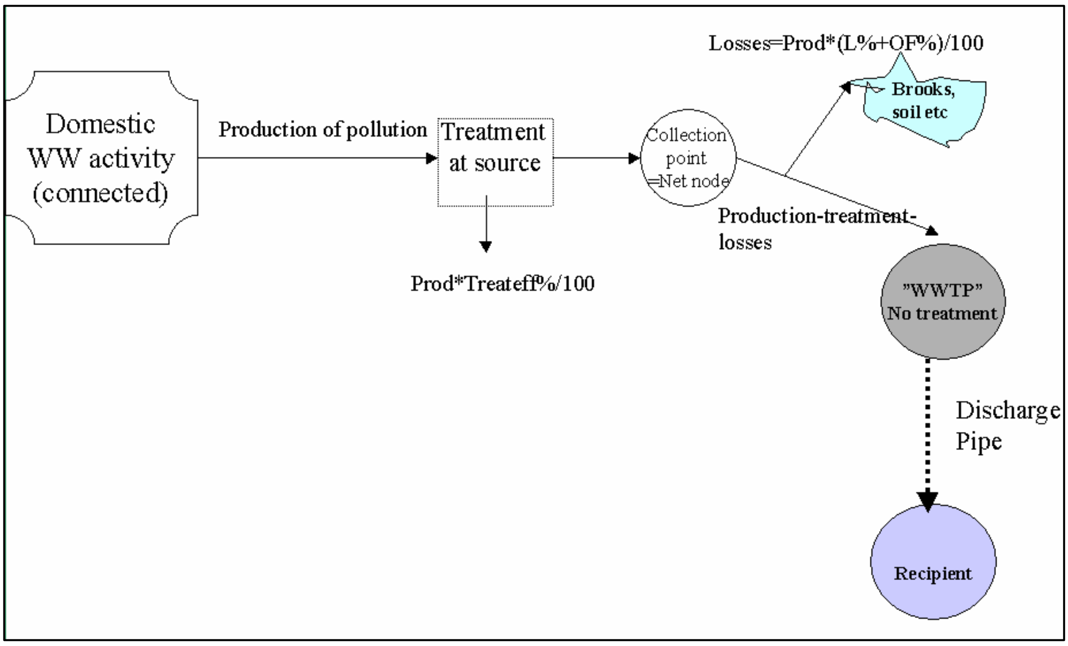
The user identifies the Treadment area with an ID, a code, a name, a activity name and a reference to the parent region. The user may also enter the area of the Treatment area, or calculate it based on the coordinates for the area. The coordinates are hidden behind the coordinate button, and from this form the user may draw the area on the map directly (however it is more likely that the area is imported from a shape)


Coordinates
Treatment area Coordinates:
New Row
Delete Row
Draw Treatment Area on map:
Name of opened Map/List of Maps
Show on map
Cancle
OK

2.4.6 Treatment area TAB Discharge Location







The **collection point** is as explained earlier defined as the point representative for one or several domestic WW activities. The collection point is either the net node (in the case when the domestic WW activity is connected to a network), or it can be a point which shall represent the collection point for activities which discharge to "local water recipients" (through the soil or brooks).

The term soil and brooks might be confusing on the figure. The user may define these water objects in the system, but most likely these elements are to small or not of relevance. In this case the user will not assign the losses to recipient, but only account for the loss before local recipient. In the case of losses from network, it is more likely that these are significant and the user might want to assign the losses to one or several of the defined recipients in the system.

The **discharge location** is either a local recipient or a recipient receiving waste water from a WWTP[15].

2.4.6.1 Contents of the TAB

All collection points defined for the treatment area will be listed (both connected and not connected). The collection points are inherited from sub treatment areas of the selected treatment area, and shall be listed with the following properties: ID, Name, Alternative, Discharge Alternative (either connected or not connected), and name of treatment area the collection point is defined for[16] In addition the validity from and to shall be displayed. Alternative is explained further in chapter 5.

Information displayed (disabled)

The disabled part of the discharge tab for discharge location has two ways of appearance, Not connected and connected, depending on if the collection point selected in the list (pointed on in the list) is connected or not connected.

These data are relevant for the user to get an overview of, and is a subset of the data registered for the collection point, the domestic activity registered and data registered elsewhere in the application. The subset displayed for the user is

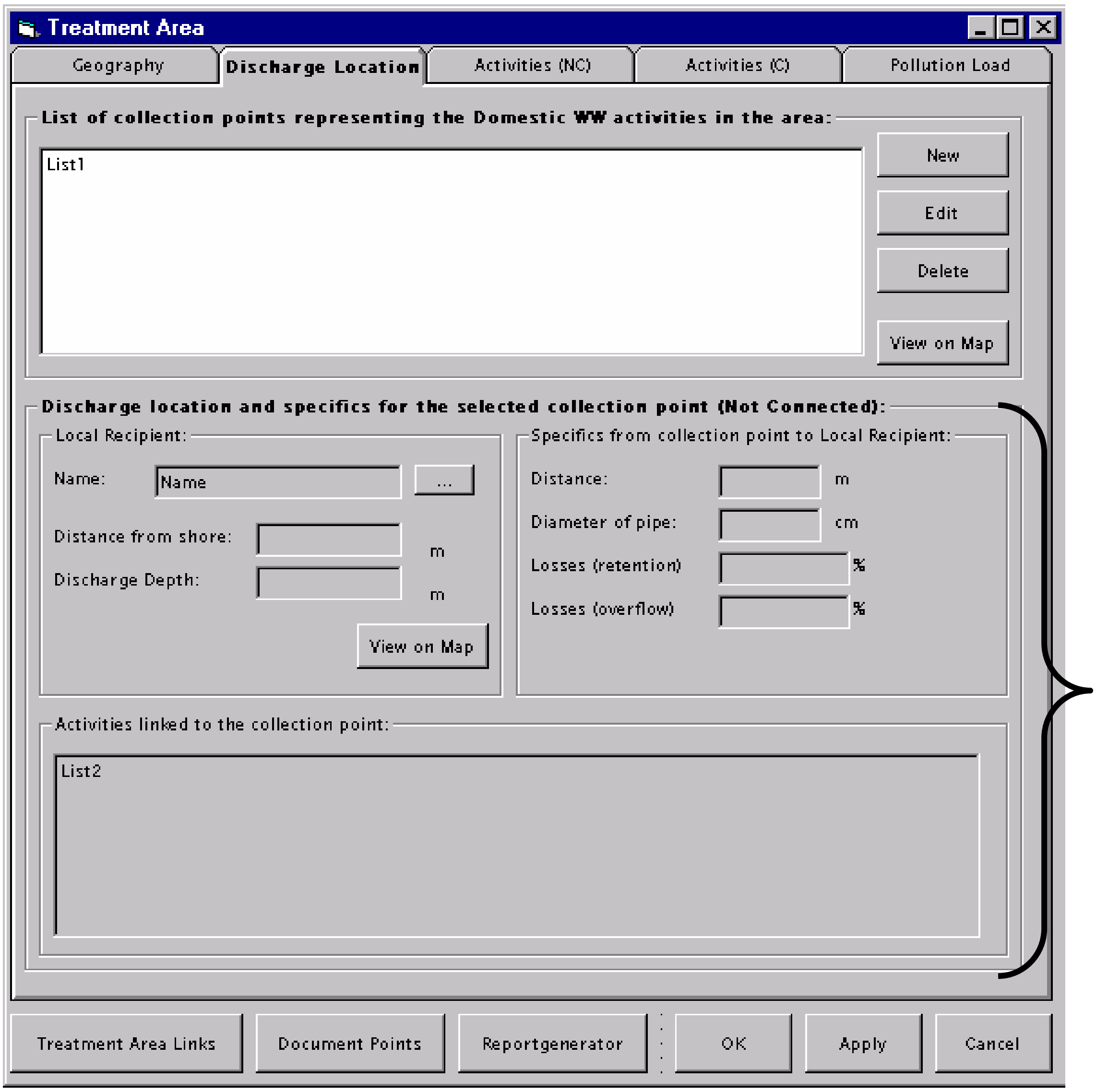
1) the final discharge locations for the selected collection point
2) the losses of discharges on the way to the local recipien, to the domestic WWTP and the secondary recipient and
3) the activities linked to the collection points.

Also there shall be a scrollable list of the activities defined for the collection point (result of registration on the two next tabs or on other treatment areas for inherited collection points)

The forms with the two appearance are explained in detail below.

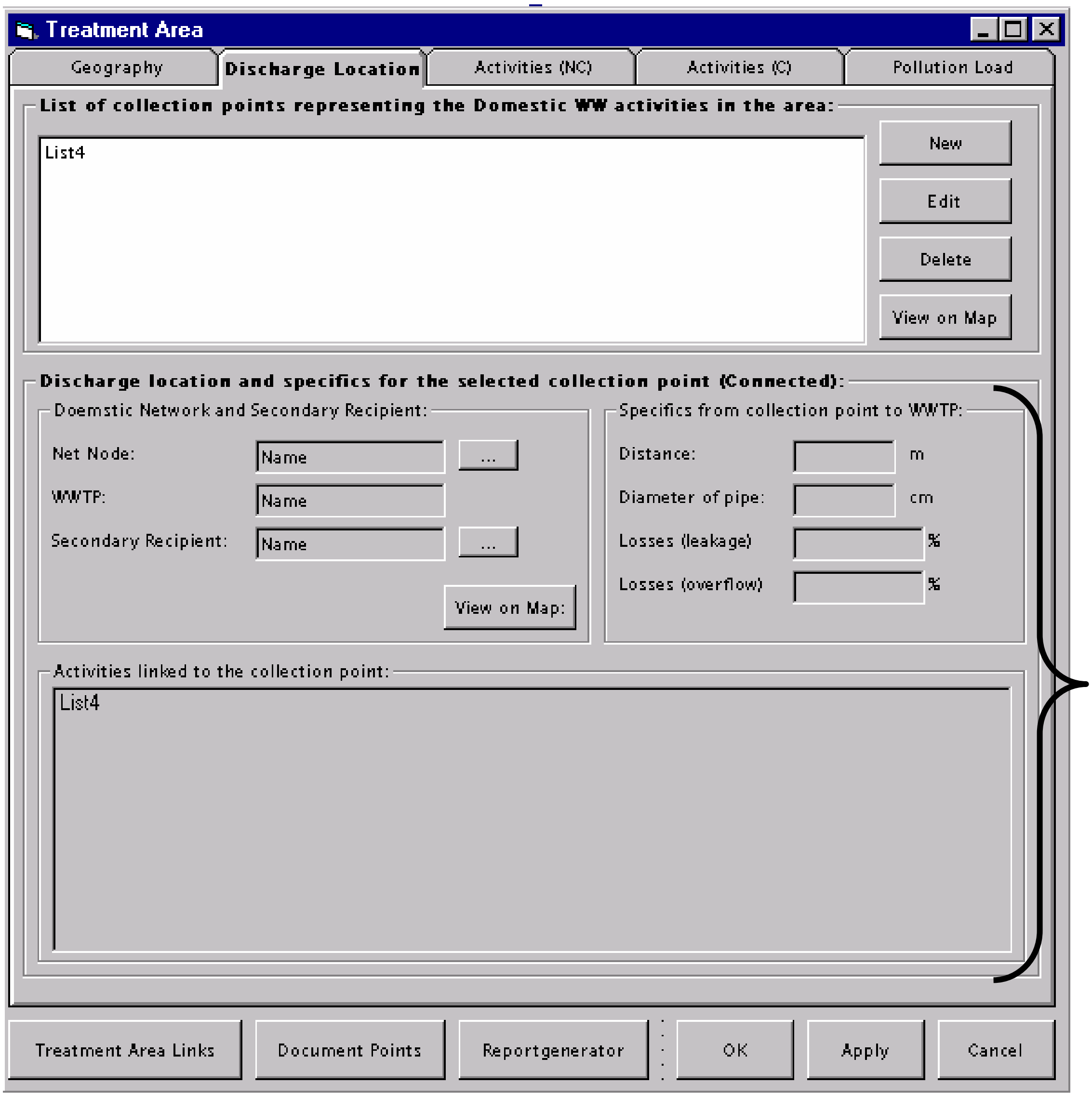
[15] The WWTP might be a “real” WWTP or a “WWTP” without treatment
[16] The collection point discharge either to local recipients (not connected) or to domestic ww network (connected). It can be judged if these should be separated on two tabs similar to the activities.

Selected collection point is **not connected** to domestic network



The content of the disabled area is self explaining after the next chapters have been read.

<u>Selected collection point is **connected** to domestic network</u>



The content of the disabled area is self explaining after the next chapters have been read.

Edit collection point and discharge location information
In order to change the information of the collection point including the loss figures etc (edit modus) the user must double click on the item or chose edit as elsewhere in the application. Then the registration form will appear, given in chapter 2.4.6.2. It is possible to edit collection points defined for the selected treatment area. If the collection point is defined for a sub area the user needs to close the form select the sub area and do the changes on this sub treatment area.

COPY
There should also be implemented a COPY button. All information should be copied except for alternative. The user should select an alternative. The user can be able to edit the information given for the collection point.

View on map (for the list)
Show all collection points (the right mouse button will show all connections described below)

View on Map(for the selected items only)
View on map is a function for the selected item only and not the whole list of collection points. This will lead the user to an open map and the following will be marked with a special colour:

Not connected (Local Recipien)t alternative:
The collection Point, The treatment area the collection point represents (the treament zone where the collection point was defined), the selected treatment area[17], the line for the collection point to the local recipient and the local recipient.

Connected (Domestic Network) alternative:
The collection Point (= net node), The treatment area the collection point represents (the treatment zone where the collection point was defined), the selected treatment area, the line from the collection point (net node) to the WWTP, the WWTP[18], the line from WWTP to the secondary recipient and the secondary recipient.

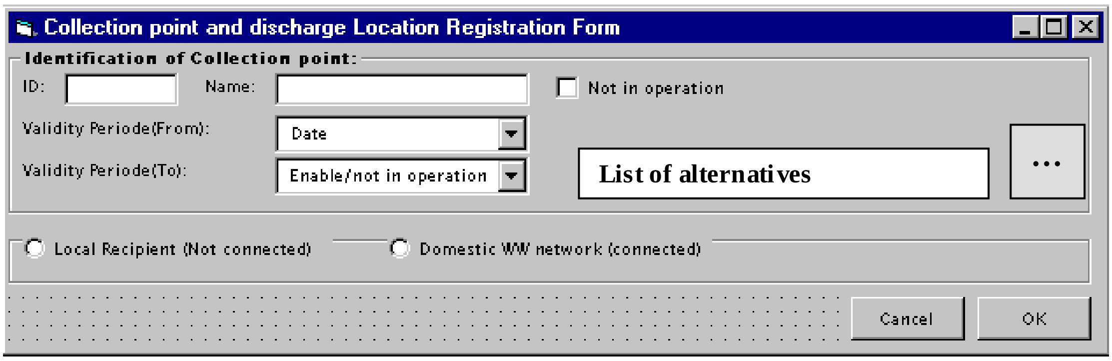
---

[17]The collection point will automatically be assigned to the treatment area/zone where it is defined (meaning the treatment area which where selected when the user created the collection point for the first time). The user will usually do the registration of collection points and activities on the lowest level in the hierarchy. However since the collection points and activities are inherited to the parent, all collection points will be available from the parent location. In this case the treatment area representing the collection point might be different from the selected area.

[18] Including those “WWTP” without treatment

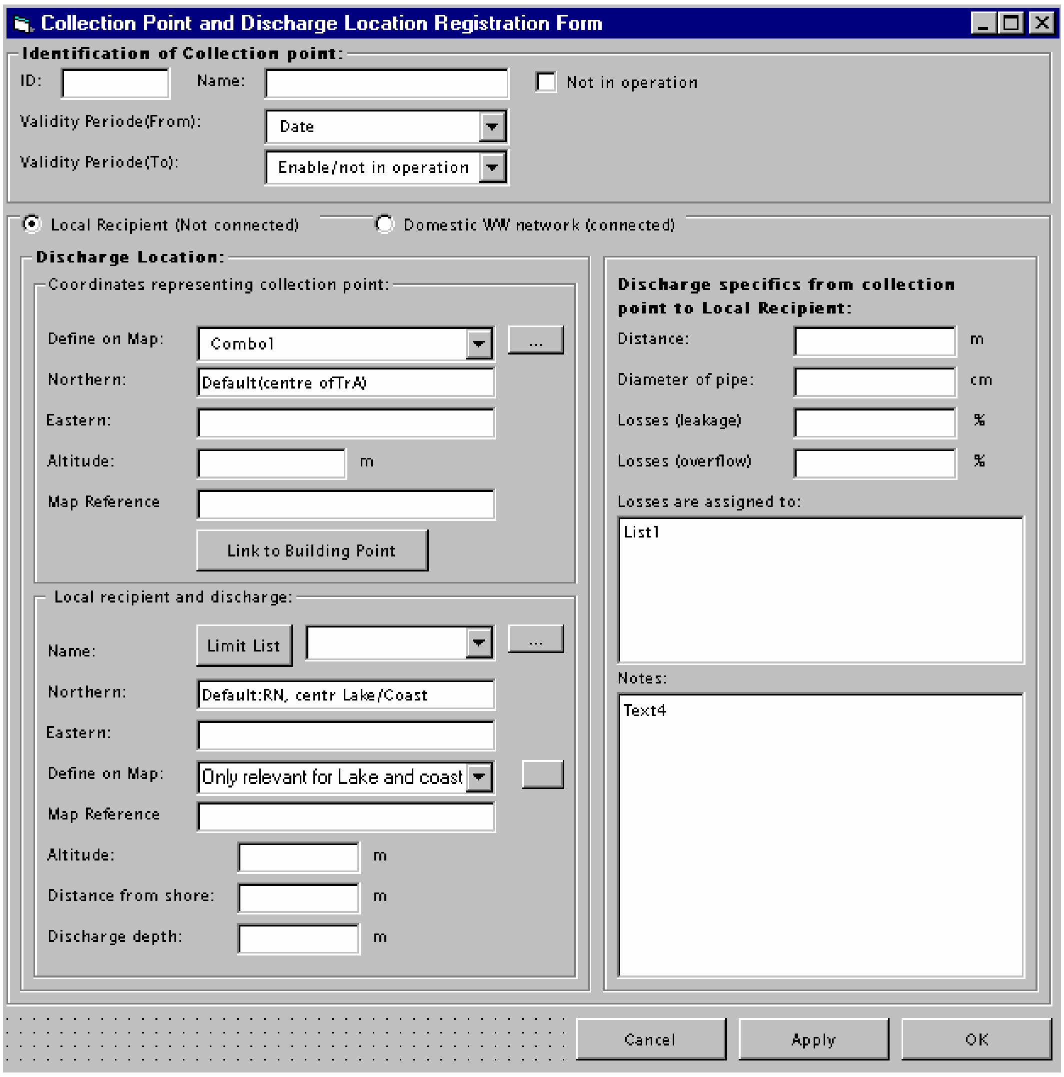
2.4.6.2 Collection point and Discharge Location Registration form (New or Edit)

<u>New:</u>When creating a new collection point and discharge location, the form below will appear:



If the user presses “Local Recipient (Not connected) or wants to edit a “not connected” point in the previous form (chapter 3.2.5.2), the form will appear like the following:

Include a combo box with a list of alternative and a button where you can select to create a new alternative.



The registration form for collection point and discharge location is based on the discharge pipe form in the ENSIS 2.05 version with the following modifications:

As explained earlier in this chapter, include a combobox for alternative.

Note that alternative in the registration form is different from the alternative “not connected”. The alternatives that should be selected when defining a source will be as described in chapter 5. The default alternative is Base alternative and means that the alternative is holding true data, if the collection point has been manipulated or is a collection point that do not exists (planning purpose) the point should be marked with another alternative than the base alternative.

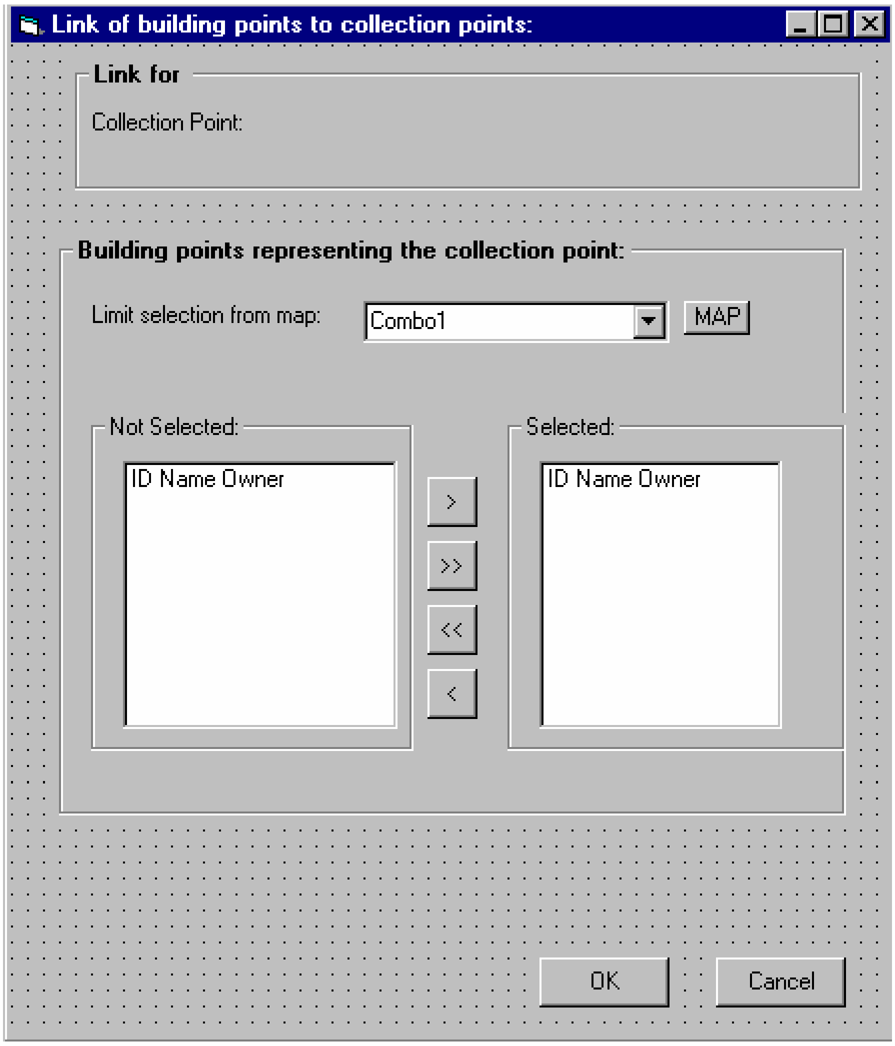
1) Validity period is related to the ”operation” period of the discharge point. If the discharge point is still consider as valid, the check box will remain unchecked (default) and the ”To” validity period will be disabled.

2) The discharge pipes physical parameters are moved, and the distance is only valid for the alternative ”not connected”

3) The co-ordinates for the collection point is given as the centre point of the treatment area, which the user stands on when defining the discharge point for the first time.
 The user can change the co-ordinates from the centre point to any location within the treatment area I.e if the discharge point shall represent a few households, it will be logical to choose a co-ordinate equal to one of the building points linked to the discharge point or a point close to the building points. If it shall represent a building only it is logical to choose the coordinates of the building. If the user open the link to building point (explained below) and select only one building point, the user will be asked if the coordinates of the building point shall be used as coordinates for the collection point.
 If the user use the defined on map the linked building points (if any will be marked with a special colour)

4) The user shall have the possibility to link building points which shall represent the discharge point (these buildings may be a mix of all types of buildings within the area)

   The user must select those which are relevant. The link to building points and thereby to owner and more detailed information is optional.



All building points within the treatment area will be listed as not selected, however the user can limit the amount of building points to select from by marking an area on the map. The user moves the selected ones over to the right hand side.

5) The user selects as in ENSIS 2.05 the local recipient the discharge goes to as well as the two optional properties: distance from shore and discharge depth. In the case of coastal area or lake the user can change the co-ordinates for the discharge as long as it is within the selected lake or coastal area. The co-ordinates are given as default = river node or as the geographical centre of the lake or coast object.

   The list of recipients in the combobox might be very long, and the user may limit the list to select from by using the “Limit list” functionality. This will bring the user to the map, where the user by “marking” an area will limit the list to those recipient partly or fully within the area. The recipients will be listed by their name.

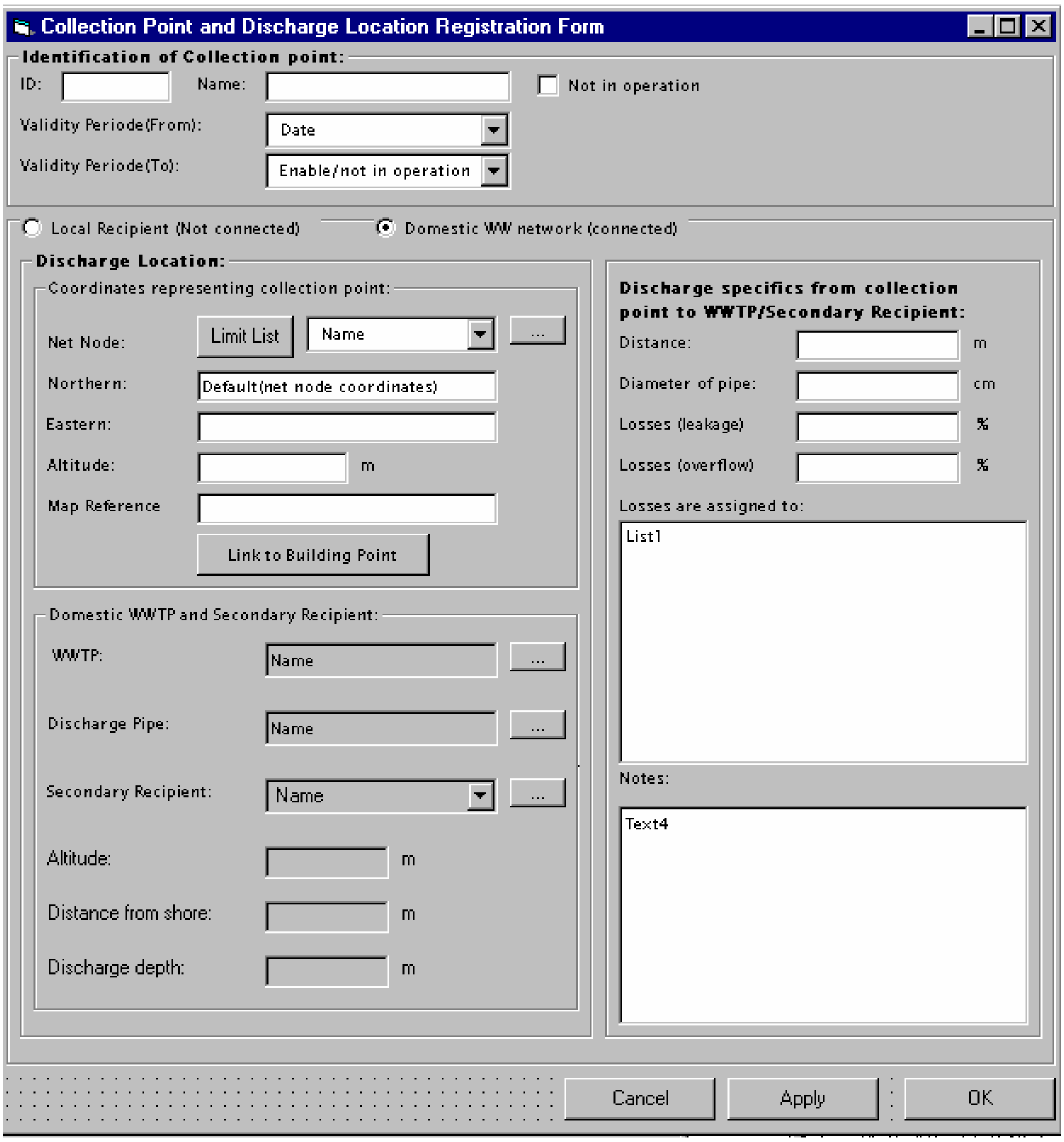
6) The discharge specifics from the collection point/discharge point to the local recipient gives the user the possibility to enter information about losses which occur before the discharge reach the specified local recipient. The user can give loss numbers for leakage and for overflow. The user can also assign these losses to one or several recipients. The list of recipients will be limited to those within the treatment area and the already selected recipient will be disabled. The user check those recipient that are of relevance, and when calculations are performed the losses will be distributed evenly between the selected recipient (i.e. if 2 recipient are selected ½ of the loss will be assigned to each of the recipient). This functionality will probably be of most interest when the collection point is a net node. The user shall also be aware of that measurements may exist for the overflows at network, and in this case it is most likely that overflows are registered as a separate source.

   When running the pollution budget model the user will be asked to use the measured overflow data or the general figures for losses connected to the domestic ww activities.

5) Notes : the notes gives the user the opportunity to write some key words for the assumptions used or other relevant information

2.4.6.3 Discharge Location Registration form (alternative domestic network-connected)

The registration form in the case where the discharge point is equal to a net node is almost the same as for the alternative local recipient (not connected):. Only the differences will be explained.



As explained earlier in this chapter, include a combobox for alternative.

1) The co-ordinates for the collection point/discharge point is given as the co-ordinates of the net node. The user has to select net node. As soon as the user select the net node he/she will be asked if the name and id of the collection point should be changed to the name and id of the net node. There might be many net nodes and the user shall have the possibility to limit the list. If the user applies this functionality he/she will be brought to the map, where it is possible to mark an area. Only the net nodes within this area will be listed in the combobox.

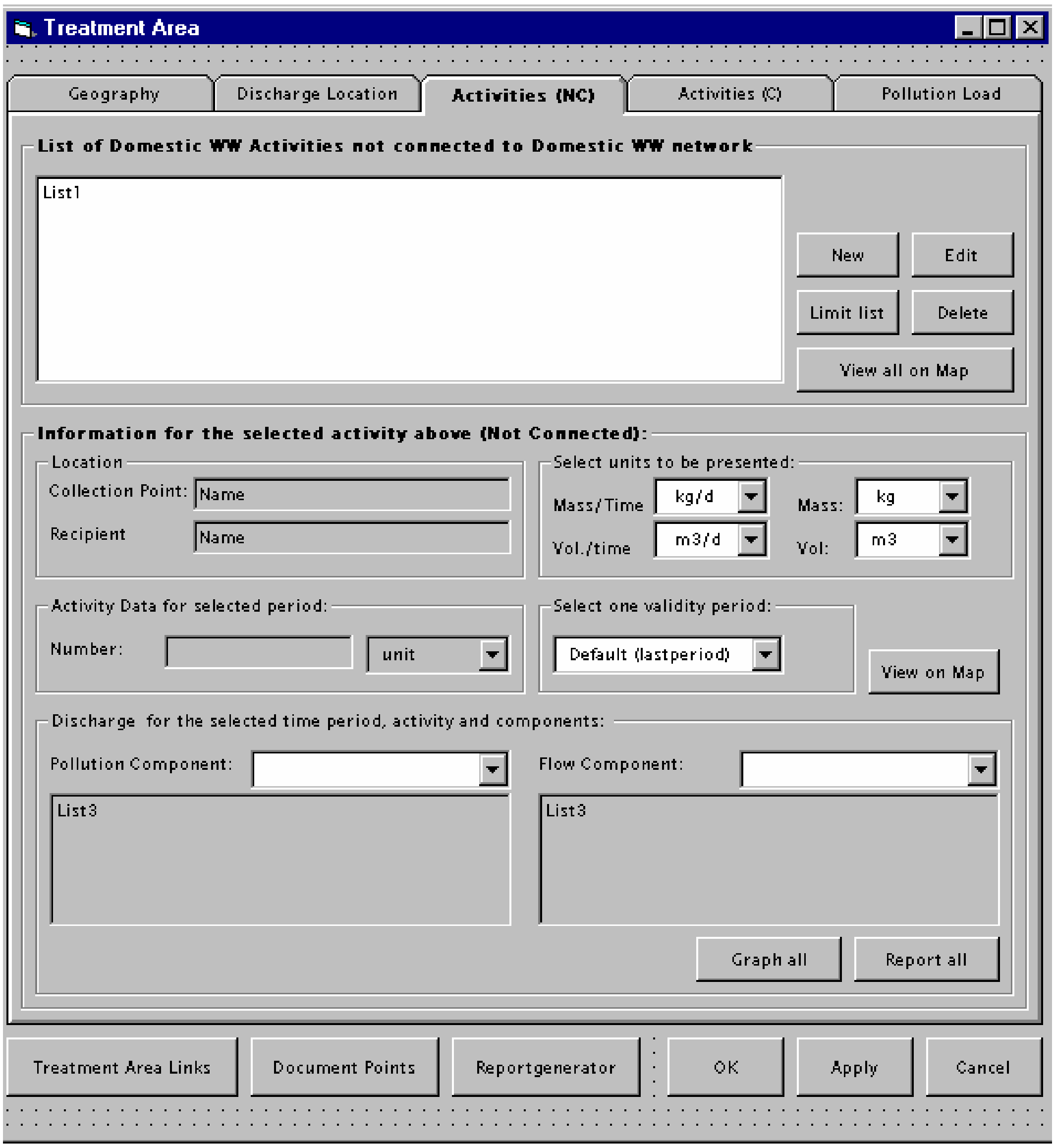
2) The domestic WWTP and (secondary) recipient information will be a direct consequence of the net node selection and the WWTP registration (the net node may be linked to WWTP which is again is linked to the discharge pipe for the WWTP, which again gives the name of the secondary recipient the WWTP discharges to). If the net node has been assigned to a “WWTP” with no treatment, the WWTP name will automatically be filled with “no treatment and only the Discharge Pipe name will be given.

3) The losses are given for the network from the collection point to the WWTP. If there are is a “ WWTP” with no treatment the distance represents the distance from the collection point to the secondary recipient.

Special Improvements from the current ENSIS 2.05 (GIS):

Open form for definition of new/edit discharge pipe is extremely slow, probably because of use of the exact polygon when searching for local recipients (lakes, coastal areas) is used. In the modularization version it shall be possible to search on the exact co-ordinates without slowing down the application.

2.4.7 Treatment area Tab “Domestic WW Activities- Not connected”



List of activities not connected to Domestic WW network

The user gets a list of all domestic WW activities defined as not connected for the treatment area. The not connected activities could be renamed to "group of individual sources". The activities will be listed with the properties: Id, name, alternative, domestic WW activity type, validity From and validity to and the alternative.   The user can edit the information about a selected activity (by double clicking or selecting edit) or create a new one.

If the user click edit or new the user will get to the forms "Domestic WW Activity" where the activity , the connection to collection point and data for the activity is defined. From this form the user goes further to the Domestic WW activity Discharge Data form, where the user assigns discharge coefficients and treatment efficiency to the activity in order to calculate the water flow and discharges of pollution components.

A button called COPY should be listed as well. As explained earlier this should give the user possibility to copy all information to a new alternative or to only copy the ID and name.

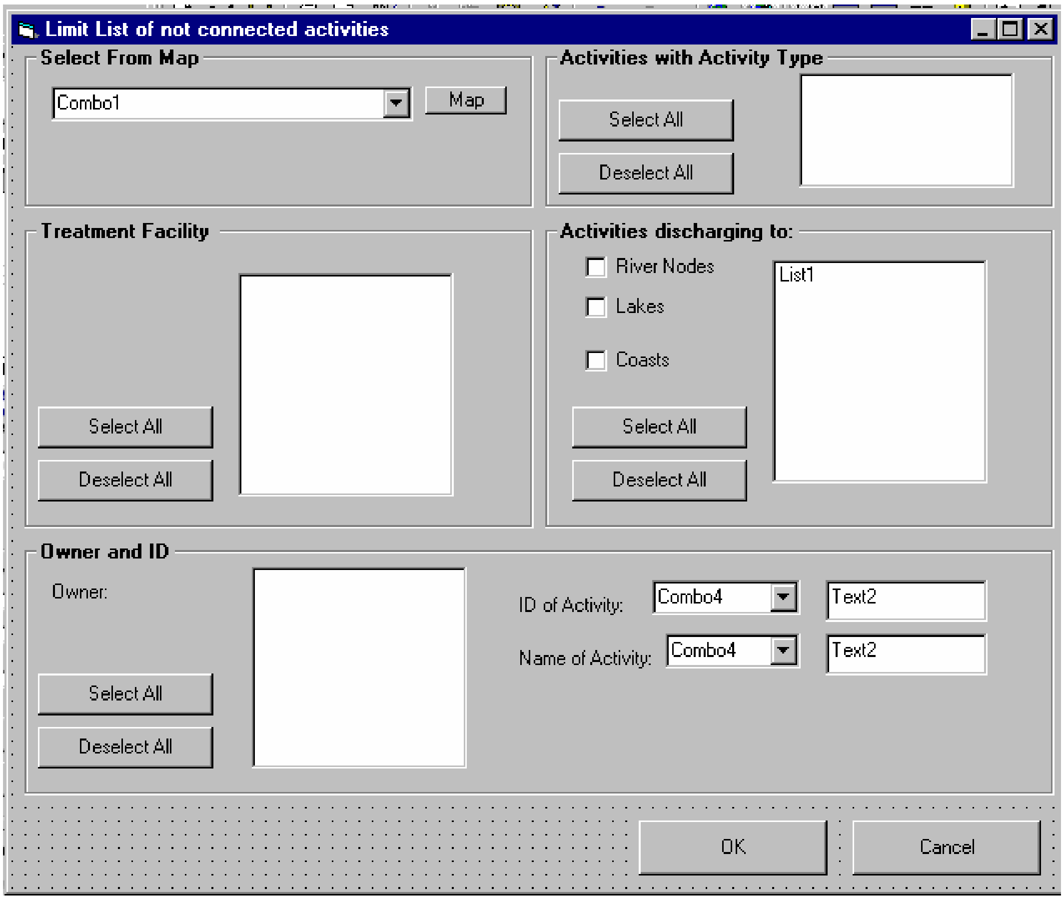
All information registered and calculated on these forms behind the tab will for each activity in the list be available for the user as soon as they are registered. This information is described below under "information for the selected activity above".

The list of activities might be long depending of which treatment area the user has selected. The user therefore have access to some some search criteria defined under advanced search for the treatment area in order to limit the list of activities to select from. The options in the search form will already be limited to those relevant for the complete list of activities (NB the binocular functionality shall be available for all lists).
The user shall also be able to limit the list according to alternative.

<Limit List>

The user can use the map search. The collection point theme will be turned on the map, and by marking an area around the collection points, the list of activities connected to the marked collection points will be limited

However, if the user does not use the map search list , he can set one or more of the criteria below (which will limit each other starting from the upper left corner to the right corner at the bottom.



<View all on map>
The view on map functionality will bring the user to the map with the discharge points/collection point marked for the activities in the list (the full list or the limited list)

Information for the selected activity above

<u>Location</u>
Based on the information about the collection point for the activity the local recipient is given. If several collection points have been connected to the activity (but is not longer in operation), the last connection will be shown.

<u>Select units to be presented</u>
The user may select the unit to present the results in (in addition to PE which is given automatically from the discharge factors given for the activity).

For the pollution component the user may select Mass/time and mass. Mass will be calculated based on Mass/time and the selected validity period.

The flow component will be given in Volume/time or volume. The volume will be calculated based on volume/time and the selected validity period.

The default units which shall be filled into the form are:

Mass/time: kg/d
Mass: kg
Vol/time:m3/d
Vol:m3

For your information, d=day

<u>Validity period:</u>
All validity periods defined for the data for the activity will be listed in the combo box, the last period will be selected as default. **NB the user shall be aware of that this is not a calculation period but the period which the data are entered with and is valid for.** The user can therefore not select whichever period. In order to do this type of calculations the user needs to go to the pollution load tab.

<u>Activity data for the selected validity period:</u>
Activity data is is the number which reflects the size of the activity (see explanation below) i.e. number of pupils.

<View on map>
The view on map will show the selected activity (only) on the map (the collection/discharge point) with the connection to local recipient and the recipient.

<u>Discharges for the selected time period, activity and components</u>

The user may display some key figures for each of the relevant components (these are already calculated but only displayed in this form). The user may display two components at the time (one pollution component and the flow component). By switching the component the figures will be updated.

The user will get information about the:

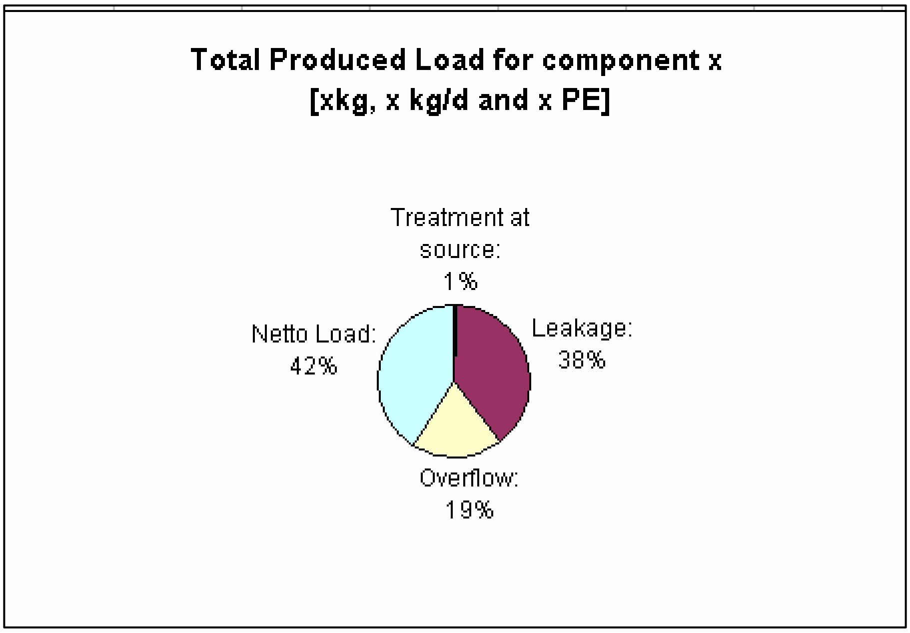
Gross discharge (= the discharge which originates from the activity=the production)
Treatment at source (=amount which is removed through treatment at source)
Losses (=leakage+overflow which for sources not connected usually are one number called retention)
Discharge to local recipient (=gross discharge minus loss figures and treatment).

The units selected for presentation will be read into the column headings.

The Timevariation (Tv) given for the activity will also be given in the table.

<Graph All>
The graphics button will lead the user to one graph of the type below for each component. The figures will be given with the unit selected i.e. kg, kg/d and PE.

The user may copy the graph to clipboard or save the result to file with or without a link to document point.



If the time variation is different from constant the user shall also be able to get a time plot over the validity period for the component.

<Report all>
The report will be design in the same way as described under the Tab pollution load, but since this report represent one activity the components will be listed in the column where activity are listed and there will be one table for each validity period.(all entries in the select validity combobox). The report will be similar for activity connected, but instead of the name of the local recipient, the WWTP and secondary recipient will be given (alternatively only the secondary recipient if the connected activity is not connected to a municipal WWTP).

The column reduction due to overflow will usually not have any information in the case of activities not connected.

The units to be presented in the column heading will depend on which units to be presented. PE will always be presented.

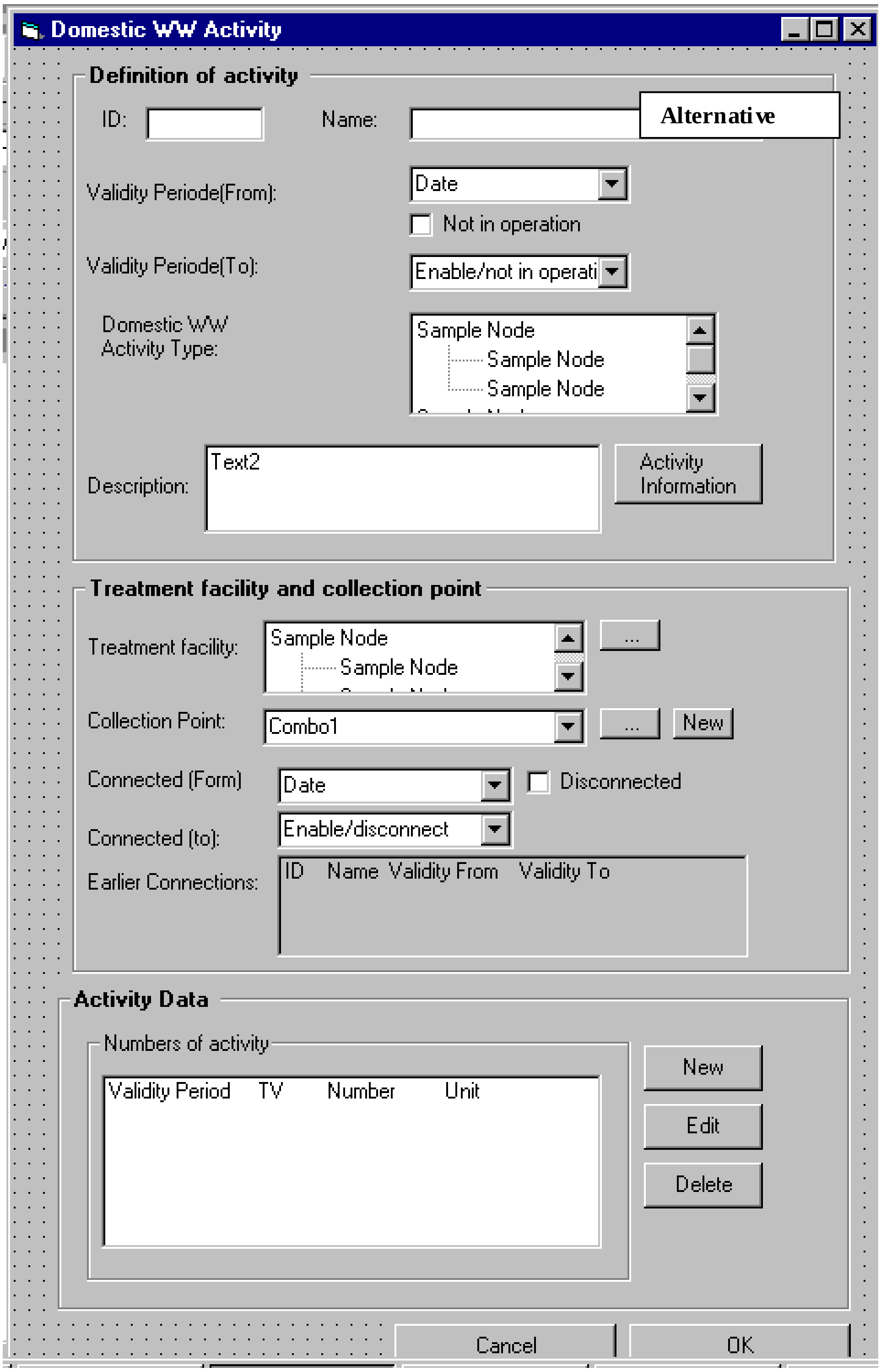
There must be a separate table for each validity period for the flow component since this component has different units from the “pollution” components.

Treatment Area:
Validity Period 1:
Activity
Activity Type
Local Recipien:

Component	Production of pollution						Netto Load to Local			Reduction - Treatment at				Reduction - Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
	Number of Activty	Unit	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
Comp 1						1.7(g/pd)																
comp 2																						
Comp 3																						
Comp 4																						

Treatment Area:
Validity Period 2:
Activity
Activity Type
Local Recipien:

Components	Production of pollution						Netto Load to WWTP			Reduction - Treatment at				Reduction -Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
	Number of Activty	Unit	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
Comp 1						1.7(g/pd)																
comp 2																						
Comp 3																						
Comp 4																						



2.4.7.1 Domestic WW activity not connected (New and edit)

This is registration form for the activity and the data connected to the activity. This form and the next form "Domestic WW Activity discharge data" is based on the definition form for activities and the discharge data for the activity in ENSIS 2.05.

The main changes and improvement from ENSIS 2.05 are :

- The activity is identified by the ID, Name and the alternative (combo box, explained in chapter 5)

- Default Discharge factors are now defined as domestic pollution production factors and they are separated from the process industry factor form. These factors are only related to the base unit of activity type (=PE).

- Instead of using the old activity type for each of the activity a new (treview lookup) has been defined “Domestic WW Activity type.

- It is possible to reduce the produced amount of pollution at source before this is connected to the collection points. The reason for this is that some sources/activities have individual treatment facilities, which need to be counted for. It is possible to give these reduction figures as percentage reduction for each activity and component. The default treatment efficiency is connected to the type of treatment facility.

- Treatment Facility is a new look up which allow the user to register treatment facilities for the domestic activities at source before these discharges to local recipient or to domestic WW treatment plants.

- Number of units describing the activity must be given with units derived from the unit type called domestic **activity unit**. The base unit of this will be **PE**. For your information, this stands for person equivalent. To avoid future possible problems related to built-in logic, we suggest that the unit type activity unit and the base unit PE are pre-defined (comes with an empty ENSIS project).

- Several activities can be connected to the same collection point, and the connection to collection point can change over time.

- All date of inventories shall be removed

- Discharge factors are a function of activity and component, medium is not necessary.

- In addition to select from default factor the user shall have the possibility to select from the factors previously defined for the activity (only the last set of discharge factors)

- It is not possible to define and store overlapping periods for one activity.

- It is possible to calculate discharges (mass/time, volume/time), total load for a given period (mass, volume) and PE based on the discharge factors with unit definition related to PE. .

- It is possible to calculate the PE = Person equivalents for a discharge based on a new look up table Definition of person equivalent (pe).

- It is possible to calculate the size of an activity (the number of activity units) based on conversion from the building points which are linked to a collection point.

<u>Definition of activity</u>

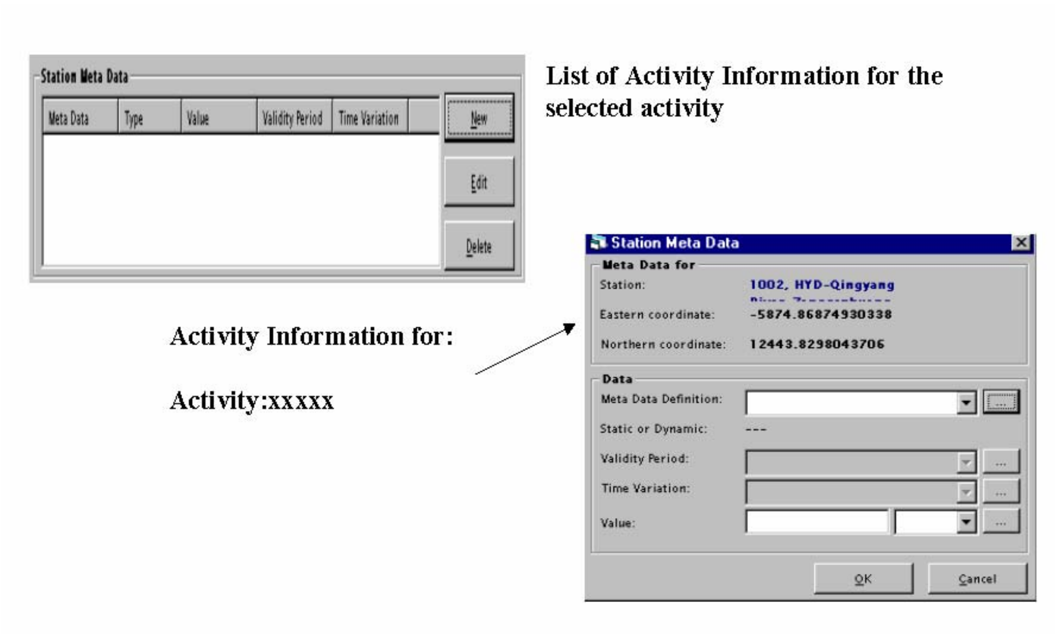
The activity is given with ID, name (the name may be representative for everything from an individual building point to a group name representing a group of activities belonging to the same domestic WW activity type) and alternative (selected from a treeview or a list – explained in chapter 5). A certain activity (combination of ID and Name) can have many alternatives.

The activity has a validity period. Usually only the from period is registered, however if the activity is not relevant any more the user will fill in the “to data”. (The activity will not be counted for in model calculations after the “to date”)

Each domestic activity (or group of activities) belongs to a domestic WW activity type. (New look up see description later in this chapter)

The user may also give some description about the activity.

In addition the user shall have the possibility as elsewhere in the application (see station meta data information) the possibility to register static and variable data. The user enters this possibility through the Activity Information button, and comes to the forms below.



This functionality requires a new look up “Type of activity information”

Treatment Facility and discharge point:

Treatment facility
This shall be a tree view. Treatment facility is a new look up table that is specified in present specification. Only the name of the treatment facilities shall be shown in the tree view.

If the treatment facility represent a group of activities with slightly different treatment facilities the user needs to create a new facility representing a combination of several facility.

It is among other important to keep this as one to one relationship and not a list box because of GIS presentation (I.e the collection point for the activity not connected may be filtered in the map interface based on the domestic WW activity type and treatment facility, i.e Household with septics, Households with mini treatment plant, etc)

Collection Point: The activity needs to be linked to a collection point as in the current application. All collection points with discharge alternative “Not connected” defined on the discharge location tab will be available in the combobox. The user can also from this location define a new collection point. If the user enter the discharge Location form from this TAB, the discharge alternative “Not connected” will be enabled and the discharge alternative connected to domestic WW network will be disabled.

The first time the user connects a collection point to the activity the “connect from “ period will automatically be filled in with the “From” validity period of the selected collection point. The user can switch to another collection point later two scenarios will then occur:

1) Data has not been registered for the activity and the user can freely select another collection point or create a new one. The From validity period of the new connection will be filled in automatically in the “connect from” field

2) Data has been registered for the activity . The user can switch collection point from the combobox or create a new one. However the user will be forced to disconnect the already connected collection point and fill in the “Connected to field”. The new connection will automatically get the “connected From” date filled in with the “connected to” date from the previous connection. The previous connection will be moved to the earlier connections list for information to the user.

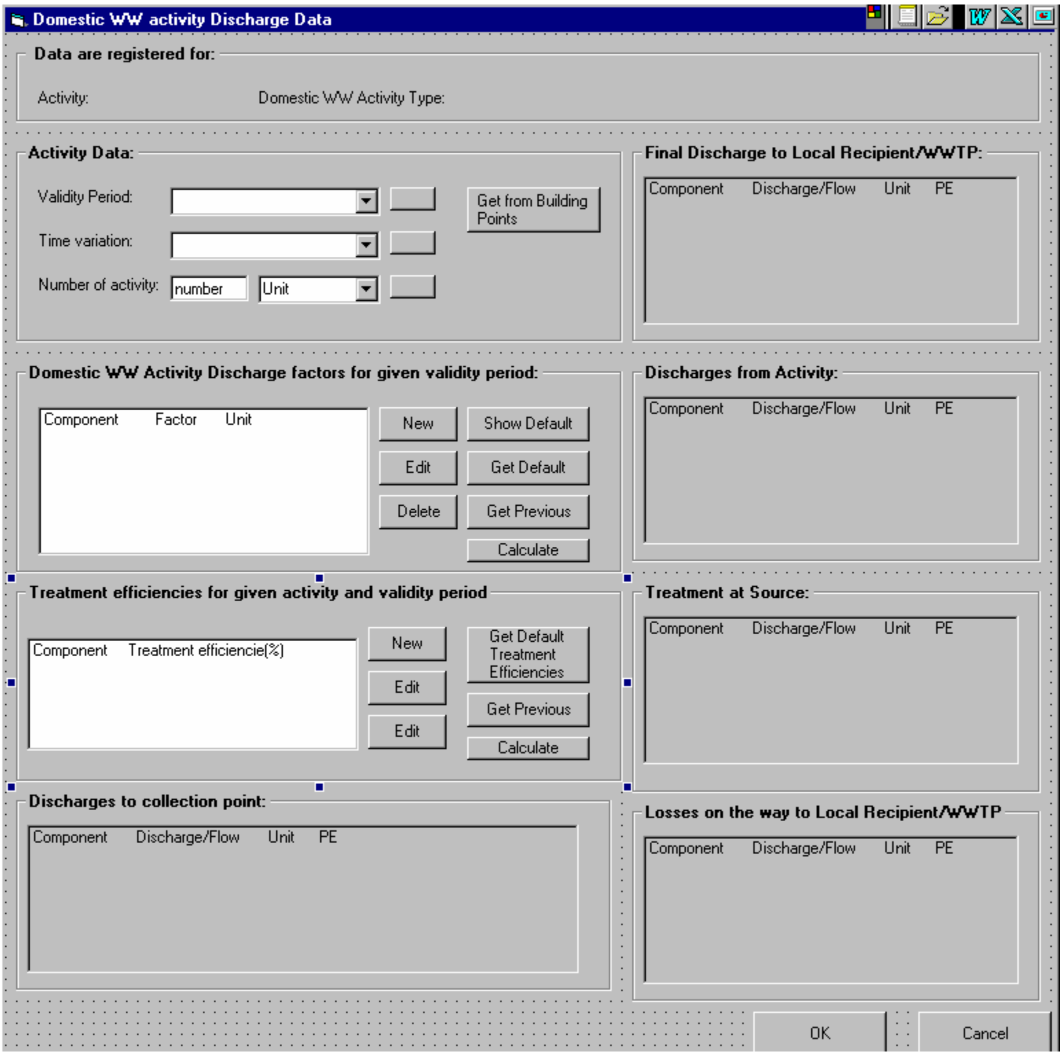
In most cases the connection to collection point will not change.

Activity data

The user defines ”production” data for each validity period. The ”production” data give a quantitative number for the actual validity period, the unit this number is given in, and the time variation if any.

The data in this form are defined on the “Domestic WW Activity Discharge Data” form where also the calculation to dischcarge data are performed.

2.4.7.2 Domestic WW Activity- Discharge Data registration (new and edit)



In this form the user register the activity data for a specific validity period, the discharge factors and the treatment efficiency for the same period. Based on this registration the user can calculate the different mass balance figures and save this to the data base. The idea is to give the user the possibility to view the discharge data for the selected activity and to minimise the calculation by the pollution budget model later on.

Data are registered for: This is only a reminder for the user of which activity (activity ID, Name and alternative) and activity type the data are connected to.

Activity Data: The user needs to determine which period the data are valid for. If the user has detailed information about the time variation for the activity over the given validity period he/She may also enter this information.

The number of activity refers as in ENSIS 2.05 to the size of the activity. Units derivied from the PE unit is used. I.e pupil which is 0.3 PE

<Get from building points>:
The user may have access to data through the building register and the subgroup which have been linked to the collection point.

If the user uses this possibility the system will search through the defined building points linked to the collection point and find all buildings registered with a vuilding type corresponding to the activity type of the selected activity. The user will get a question which type of data from the building points that shall be summed up. The alternatives are (represented by radio buttons)

1) Population,
2) employees
3) other units related to the building.

The system will find the equivalent validity period on the building point or interpolated/extrapolate based on the validity periods given for the building points compared to the validity period of the activity. The system will sum up the figures. If alternative 3) other units is selected and the units given for these numbers vary from building point to building point the system shall give a warning (the numbers are not given with the same unit), but still sum up the figures.

If the user confirm that he/she will use the numbers after the calculation has been performed the total figure will be written into the Number of activity field. The user needs to assign a unit.

For description of building point functionality see description in this document.

Domestic WW activity discharge factors for given validity period

The user defines for each relevant component a domestic pollution production factor.

To simplify the registration the user can select from default factors as in the current ENSIS 2.05 application. The form for registration of default factors has been changed (see description later in this document).

If the user chooses to get the default factors the system will pick those which corresponds to the base unit given for the number of activity .e g: g /PE*d).

(Mass/(PE*Time))

The user can also get previous set of factors. The system will then get the factors for the actual activity for the last previously defined validity period.

When read into the table the factor will be transformed to the unit given of the activity i.e. g/(pupil* d) (unit of activity is pupil)

The user may edit the factor since there might be several reasons to change the default factors.

<Calculate>
Based on the information given the user may calculate the discharge from the activity in the units Mass/time(Volume/time) or PE.

Some of the other figures will be calculated :

Discharge to collection point = Discharge from activity-Treatment

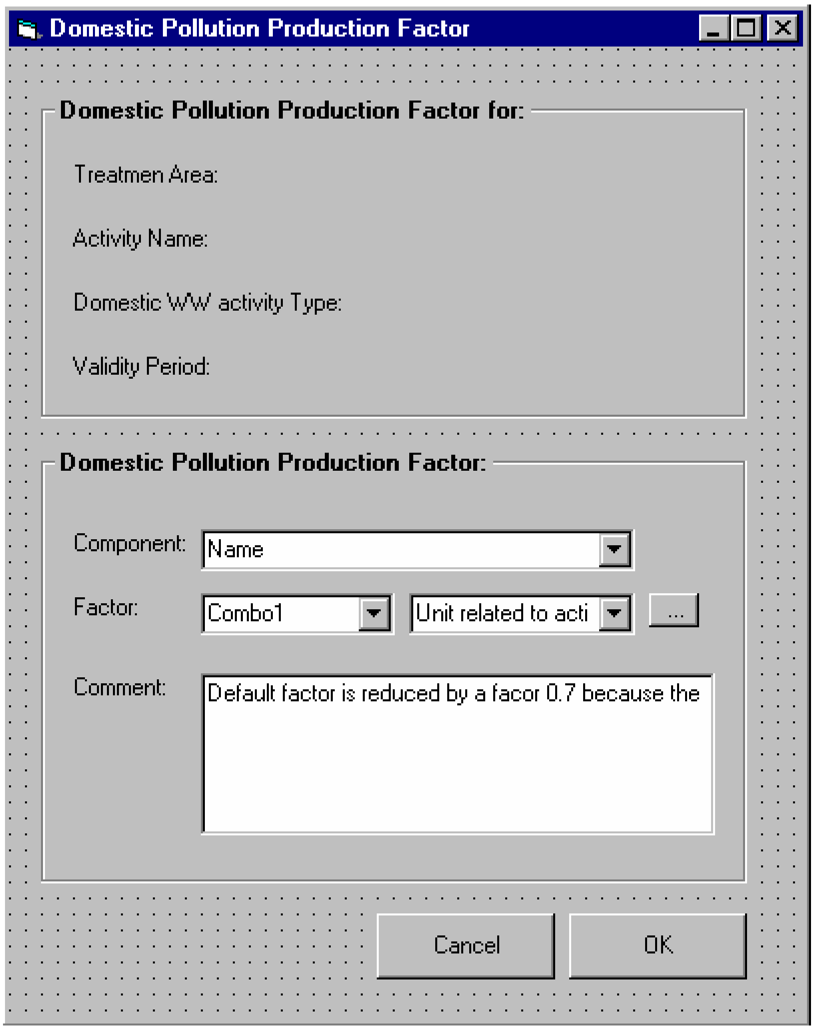
Losses on the way to local recipient/WWTP is calculated based on the information on the connected collection point.

Final Discharge = Discharge to collection point-Losses

The figures might get updated if the user also enter treatment efficiency information. Otherwise treatment efficiency is set to 0 (or any other number which is already entered for treatment efficiencies) .

<u>Domestic Pollution Production Factor (new and edit)</u>

The user can create new factors or edit the existing ones. The difference from ENSIS 2.05 is that the facto is not depended on the medium but only the component. The factor does not depend on region or domestic WW activity type.



The units available should be units derived from the following unit types: Mass/(activity unit * time), i.e. g/PE*day, or volume/(activity unit*time), i.e. l/PE*day

The user might also want to give comments to the discharge factor. I.e in the case of discharges from households the default discharge factor may be related to the fact that the persons living there are 100% present in the home. The fact is that depending on the distribution of the population (people in school age, people working etc) these numbers need to be reduced. For this particular example one can usually count that the factor should be reduced by 30-40%, meaning that the default factors should be reduced by 0.7-0.8. It is important to document these assumptions.

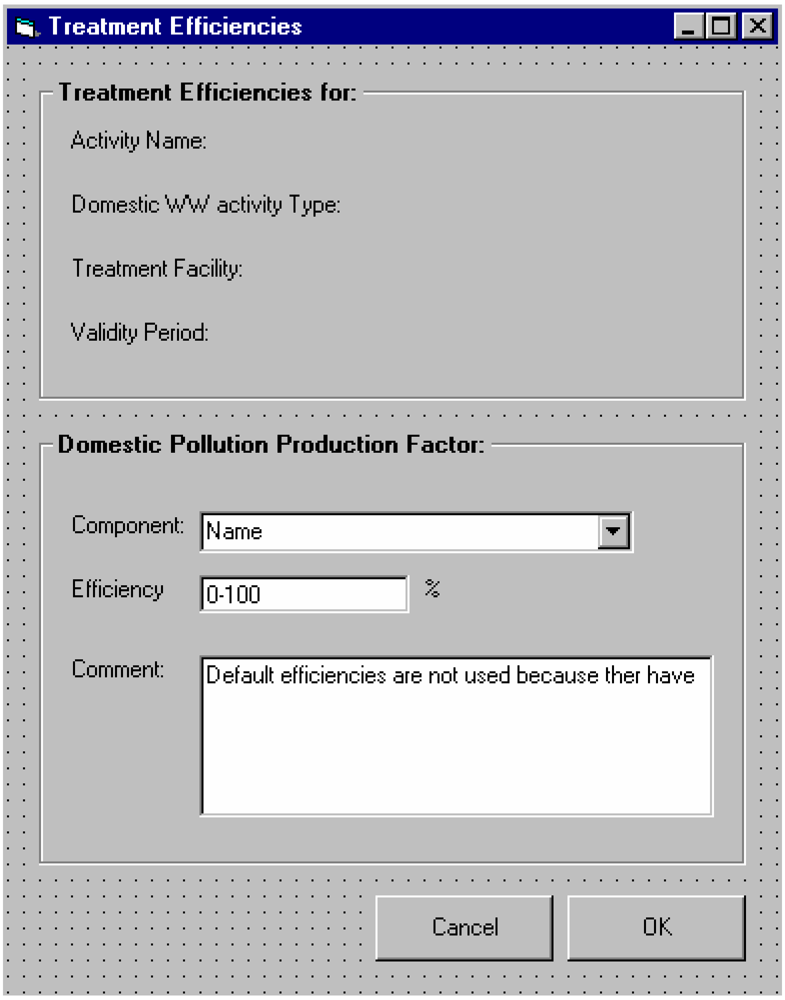
Treatment efficiencies for given activity and validity period;

The user can for each component give a treatment efficiency. The efficiencies are given as numbers between 0 and 100 and describe how well the treatment facility removes the different components from the waste water. The default values shall be 0 %, unless anything else is defined.

The get default Treatment efficiencies will copy the efficiency numbers defined in the treatment facility look up table (Each type of treatment facility is linked to a set of treatment efficiencies. See explanation later in this document).

The get previous will copy the efficiencies for the actual activity for the last previously defined validity period.
<Calculate>
If the user use the calculate the Discharge figures will get updated based on the formulas given above

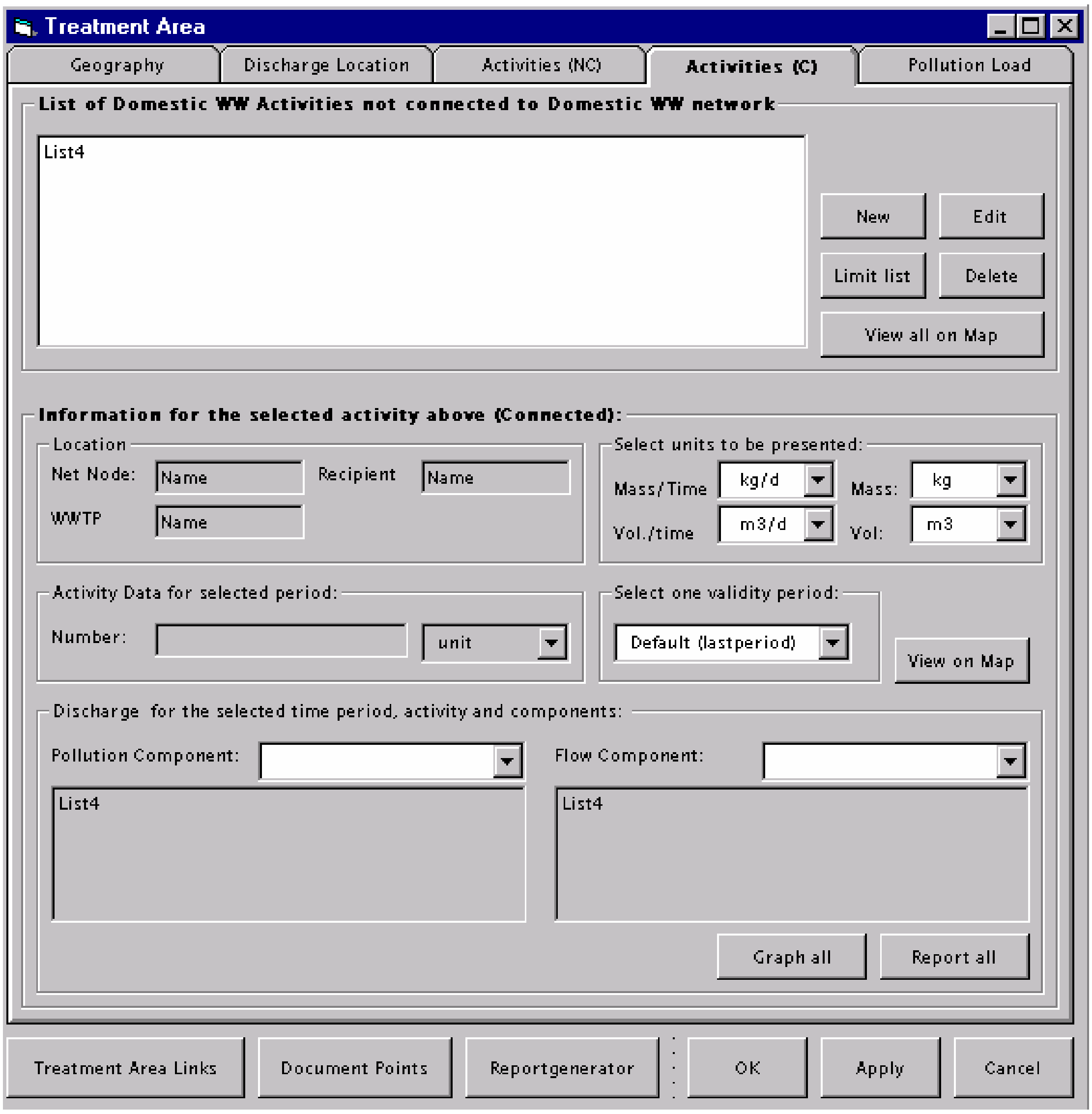
New and edit

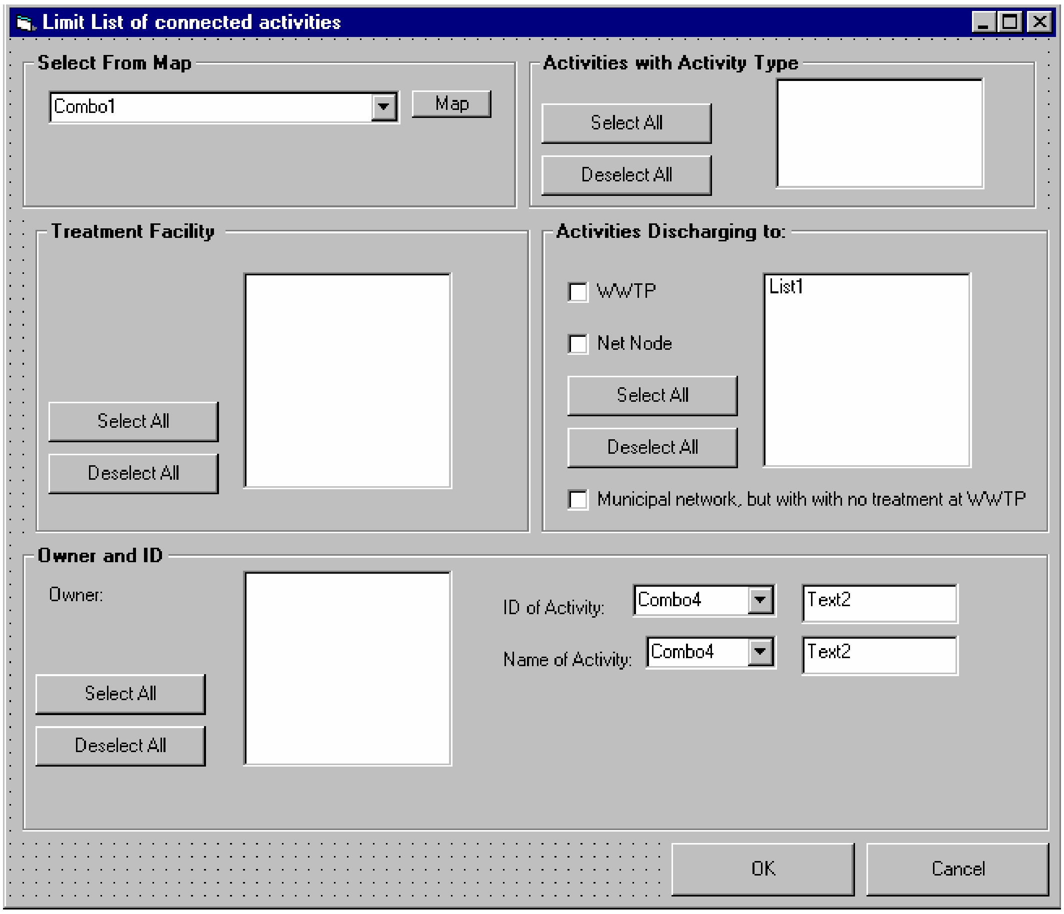


2.4.8 Treatment area Tab "Domestic WW Activities- Connected"

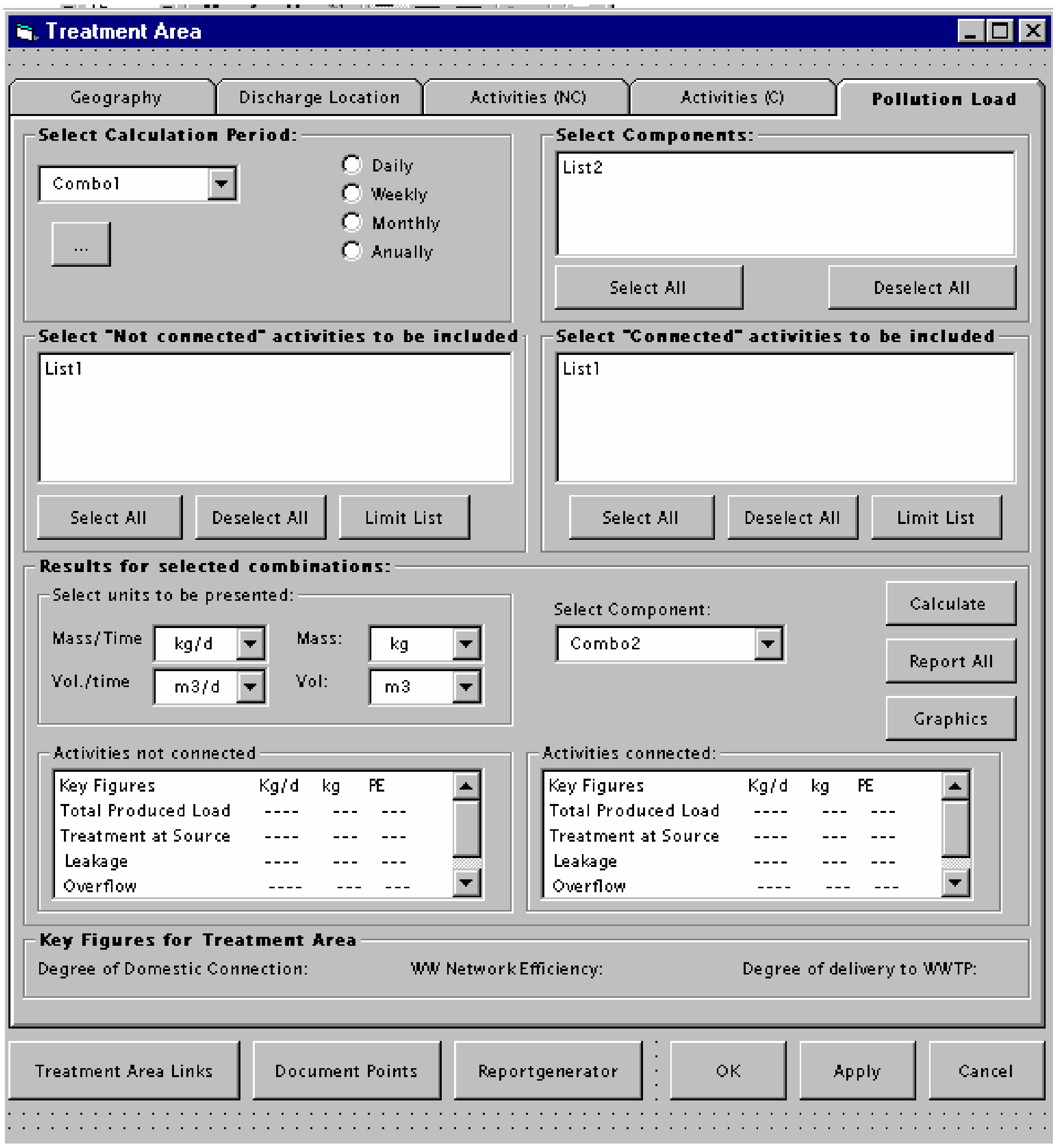
The functionality on this tab will be exactly the same as explained under the previous Tab except for:

- It is the WWTP name and secondary recipient which is displayed: In the case of a WWTP with no treatment, "no treatment " will be written in the WWTP name field and only the net node and secondary recipient name will be given.
- In the domestic ww activity form it is only collection point defined as connected which are displayed in the combobox and defining a new from this position will always launch the discharge location form with the alternative the discharge alternative "Domestic ww network" selected.
- In the domestic ww activity form, the frame shall be renamed to "Leakage, overflow...........to WWTP/Secondary Recipient" instead of "Local recipient".
- View on map for each separate activity will show the discharge point=netnode, the connection to WWTP, the WWTP (if any) and the secondary recipient
- The limit list of activities do not have the possibility to search for connection to local recipient, but to the net node or WWTP. In addition there shall be a check box in order to find the connected activities with direct discharge (which discharge to a municipal "WWTP" with no treatment)


Treatment Area
Geography
Discharge Location
Activities (NC)
Activities (C)
Pollution Load
List of Domestic WW Activities not connected to Domestic WW network
List4
New
Edit
Limit list
Delete
View all on Map
Information for the selected activity above (Connected):
Location
Net Node:
Name
Recipient
Name
WWTP
Name
Select units to be presented:
Mass/Time
kg/d
Mass:
kg
Vol./time
m3/d
Vol:
m3
Activity Data for selected period:
Number:
unit
Select one validity period:
Default (lastperiod)
View on Map
Discharge for the selected time period, activity and components:
Pollution Component:
Flow Component:
List4
List4
Graph all
Report all
Treatment Area Links
Document Points
Reportgenerator
OK
Apply
Cancel


Limit List of connected activities
Select From Map
Combo1
Map
Activities with Activity Type
Select All
Deselect All
Treatment Facility
Select All
Deselect All
Activities Discharging to:
WWTP
Net Node
List1
Select All
Deselect All
Municipal network, but with with no treatment at WWTP
Owner and ID
Owner:
Select All
Deselect All
ID of Activity:
Combo4
Text2
Name of Activity:
Combo4
Text2
OK
Cancel

2.4.9 Treatment area Tab "Pollution Load"



This Tab does not contain any registration but it is a way to calculate the discharges from a treatment area for a defined calculation period, and with a defined time step. The calculated results can be saved to file with or without connection to document point (but not to the database) and some graphics will be available for component by component.

The key figures in the form represent an average over the whole period with no specific timestep.

Select calculation period, timestep and component

The user must select the calculation period he wants to perform the calculation for, the timestep and the components.

Select activities
The user also decides if he/she wants to perform the calculation for all activities in the treatment area or only a subset.

The activities are divided in connected and not connected.
The limit list function in the same manner as described under the tabs Activities (NC) and Activities (C). Remember to include the limit list according to alternative.

Results for selected combination

<Calculate>
After the selection the user calculates the results, or actually the user sums up the calculations saved on the previous tabs for the calculation period given and divide the sum on the timestep.

If the calculation period chosen on this TAB does not correspond with the validity periods given for each activity on the previous tabs, the system shall perform interpolation/extrapolation as elsewhere in the application (as specified and applied in the pollution budget model in ENSIS 2.05).

<Report all >

The user may choose to report all component for the calculation. The report is described below and will be given in the units determined by the user.

The default units shall be as specified on the activities TABS

In addition PE shall be presented.

<Select Component>

Key figures and graphics may be shown for each of the calculated components. There will be separate tables for activities not connected and activities connected.

The key results displayed for connected and not connected domestic sources shall shall be:

Total Produced Load:
Treatment at source:
Leakage:
Overflow:
Netto Load:

Key figures for treatment area:
The key figures for the treatment area will only be filled in if the user has selected all activities within the treatment area for calculation. All numbers are dimensionless and are between 0-1.

The different figures are calculated as described:

<u>Degree of domestic connection =</u>

$$\text{Degree of domestic connection} = \frac{Sum(PL_c)}{Sum(TPL)}$$

PLc : Produced Load from connected Activities
PLnc : Produced Load from not connected Activities
TPL : Total Produced Load from connected and not connected activities, where

$$TPL = PL_c + PL_{nc}$$

<u>Domestic WW Network efficiency =</u>

$$\text{Domestic WW Network efficiency} = \frac{Sum(WWTP_c + CSR)}{Sum(PL_c) - Sum(T_c)}$$

$WWTP_L$: Load to WWTP
CSR : Load to Secondary recipient for connected activities with discharge to a " WWTP" with no treatment
Tc : Treatment at source for connected activities. Usually there are no treatment at source for connected activities and this part of the equation will in this case be zero

<u>Degree of delivery to WWTP=</u>

$$DegreeofDomesticConnection * \frac{Sum(WWTP_c)}{Sum(PL_c) - Sum(T_c)}$$

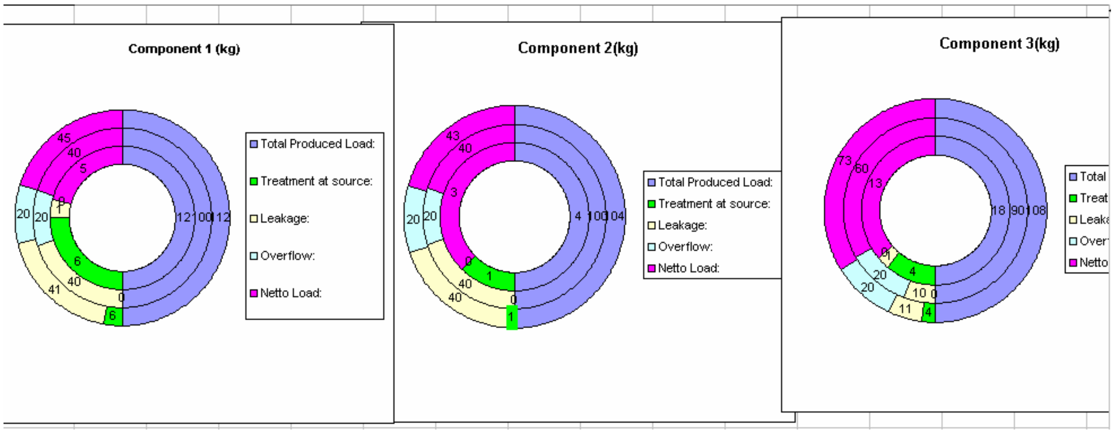
This is actual the product of Degree of domestic connection*_Domestic WW Network efficiency W Except for the fact that Domestic WW Network Efficiency in this case shall only account for the connected activities which are treated at a municipal WWTP.
The user shall be aware of that losses through overflow are calculated based on the general percentage reduction given on each activity in the treatment area and overflows given as separate sources (i.e. timeseries) are not used for this calculation. Also it has not bee accounted for that there may be some bypass at the treatment plant.

Graphics
If the user chooses to display graphics he/she shall for each component get the following figures. The figure in this example show key figures for three components. The example is in kg . The same figures shall be produced for PE and the unit mass/time.

The inner circle represent key figures for activities not connected, the middle circle represent figures for activities connected, and the outer circle represent figures for the total mass balance for the activities which are calculated. It shall be possible to copy the graphics and the key figures to clipboard or save to file.

The figures represent the whole calculation method.

Component 1	Sources not c	Sources cor	Total
Total Produced Load:	12	100	112
Treatment at source:	6	0	6
Leakage:	1	40	41
Overflow:	0	20	20
Netto Load:	5	40	45
Component 2	Sources not c	Sources cor	Total
Total Produced Load:	4	100	104
Treatment at source:	1	0	1
Leakage:	0	40	40
Overflow:	0	20	20
Netto Load:	3	40	43
Component 3	Sources not c	Sources cor	Total
Total Produced Load:	18	90	108
Treatment at source:	4	0	4
Leakage:	1	10	11
Overflow:	0	20	20
Netto Load:	13	60	73



The user shall also be able to get a time series graph which shows the total calculated figures for connected sources, not connected and total for each timestep for each component.

Detailed Report

Treatment Area:
Calculation Period:
Component: A3

Activity Description (Activities Not Connected)					Production of pollution						Netto Load to Local			Reduction - Treatment at				Reduction - Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Activity	Timeperiod	Activity Type	Collection Point	Local Recipient	Number of Activty	Unit	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
										1.7(g/pd)																
SUM		xxxxx	xxxxxx	xxxxxx	xxxxx	xx	sum	sum	sum	xxxxx	sum	sum	sum	sum	sum	sum	xx	sum	sum	sum	xxx	sum	sum	sum	xxx	xxxxxxxxxxxxxxxxxxxxxx

Activity Description (Activities connected)					Production of pollution						Netto Load to WWTP			Reduction - Treatment at				Reduction - Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Activity	Timeperiod	Activity Type	Collection Point	WWTP	Number of Activty	Unit	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
										1.7(g/pd)																
SUM		xxxxx	xxxxxx	xxxxxx	xxxxx	xx	sum	sum	sum	xxxxx	sum	sum	sum	sum	sum	sum	xx	sum	sum	sum	xxx	sum	sum	sum	xxx	xxxxxxxxxxxxxxxxxxxxxx

Treatment Area:
Calculation Period
Component: component2

Activity Description (Activities Not Connected)					Production of pollution						Netto Load to Local			Reduction - Treatment at				Reduction - Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Activity	Timeperiod	Activity Type	Collection Point	Local Recipient	Number of Activty	Unit	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
										1.7(g/pd)																
SUM		xxxxx	xxxxxx	xxxxxx	xxxxx	xx	sum	sum	sum	xxxxx	sum	sum	sum	sum	sum	sum	xx	sum	sum	sum	xxx	sum	sum	sum	xxx	xxxxxxxxxxxxxxxxxxxxxx

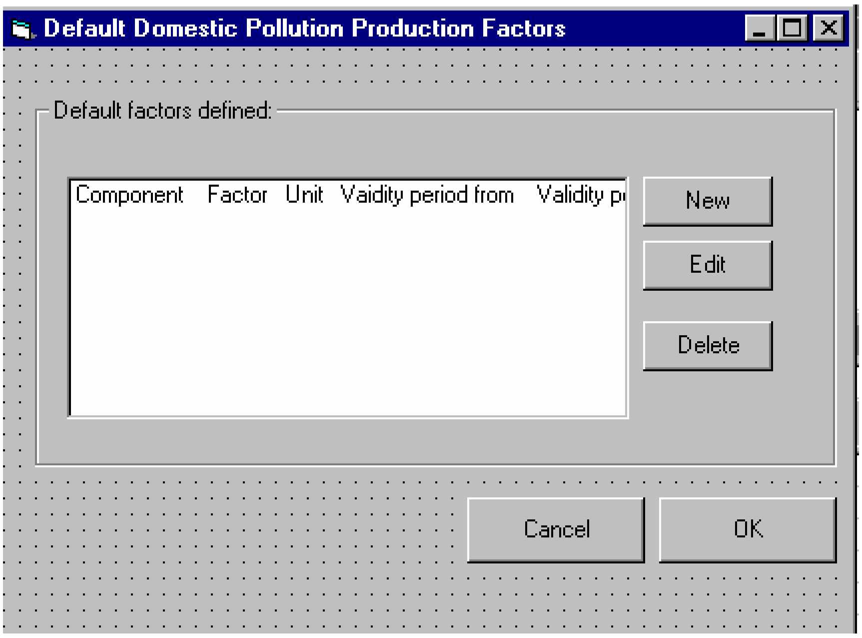
Activity Description (Activities connected)					Production of pollution						Netto Load to WWTP			Reduction - Treatment at				Reduction - Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Activity	Timeperiod	Activity Type	Collection Point	WWTP	Number of Activty	Unit	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
										1.7(g/pd)																

If the user chooses to show details for the activities separate result tables will be displayed for the activities which are not connected and for the activities which are connected to domestic network. There will therefore be two tables for each component. It will be possible to copy the results to clipboard or save them to file.

The result table shall be built up by the properties shown in the figure above, except for that the column WWTP shall be separated in two columns : WWTP and Secondary Recipient. If the connected source is not discharging to a municipal WWTP, but directly to a recipient, the WWTP column shall be filled with no treatment and only the secondary recipient column will be filled in.

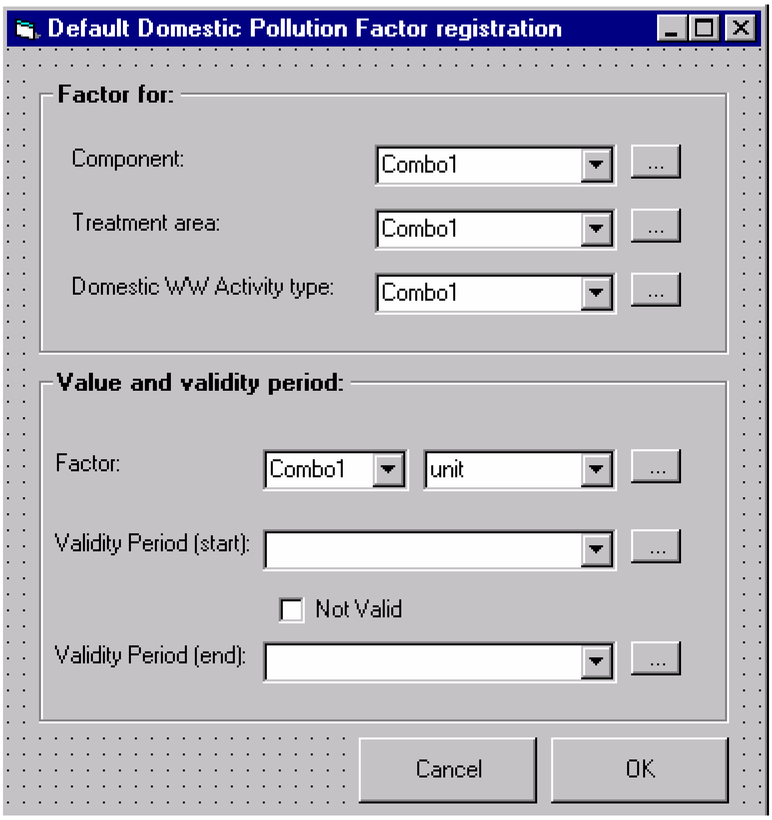
The table will first list all periods for an activity , and thereafter a new activity and all timeperiods (time periods mean the time "from" and "to" for each timestep within the calculation period). From this type of table the user can easily take out one and one activity and make timeplots.

2.4.10 Default Domestic Pollution Production factors



The default domestic pollution production factors have been separated from the Industry production and consumption factors.

The default factors are dependent on Treatment area and Domestic WW activity type.



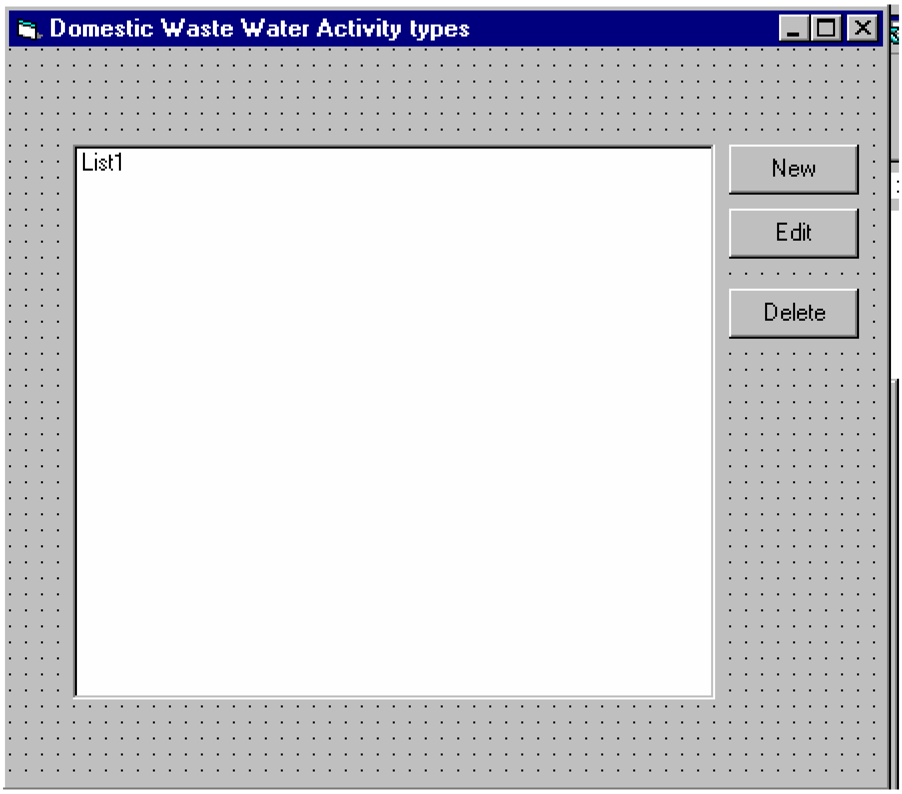
The units available should be units derived from the following unit types: Mass/(activity unit * time), i.e. g/PE*day, or volume/(activity unit*time), i.e. l/PE*day

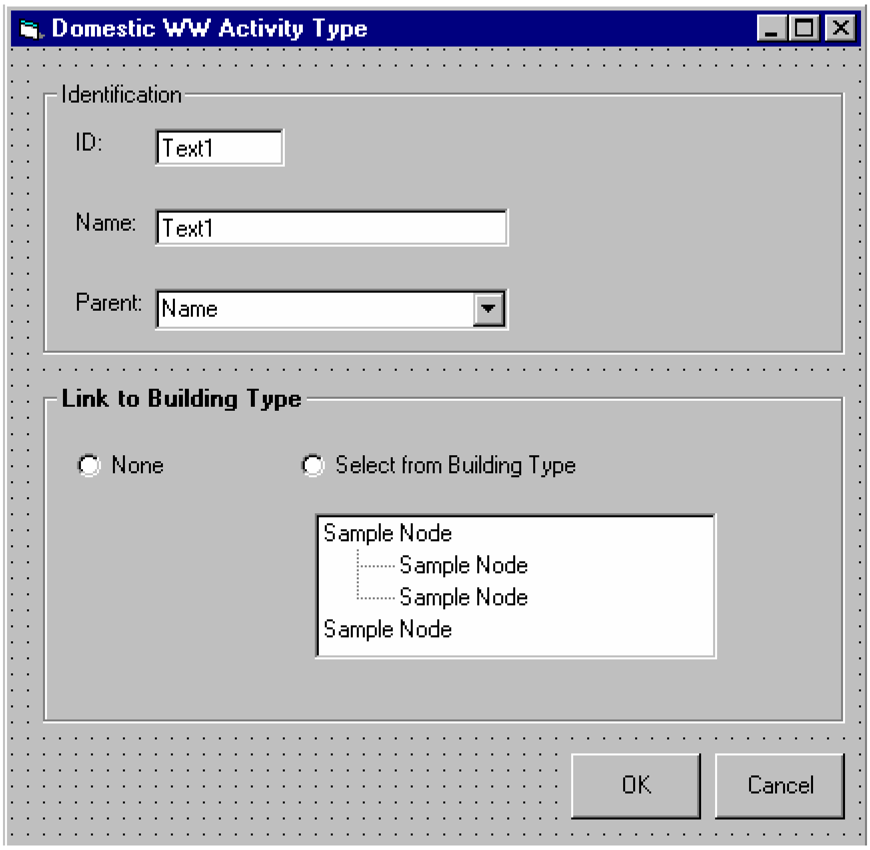
The default factors may change over time. I.e. due to better knowledge or changes in life style. The default factors are still valid as long as the “not valid” check box is not defined.

The validity period (end) only gets enabled when the check box is checked.

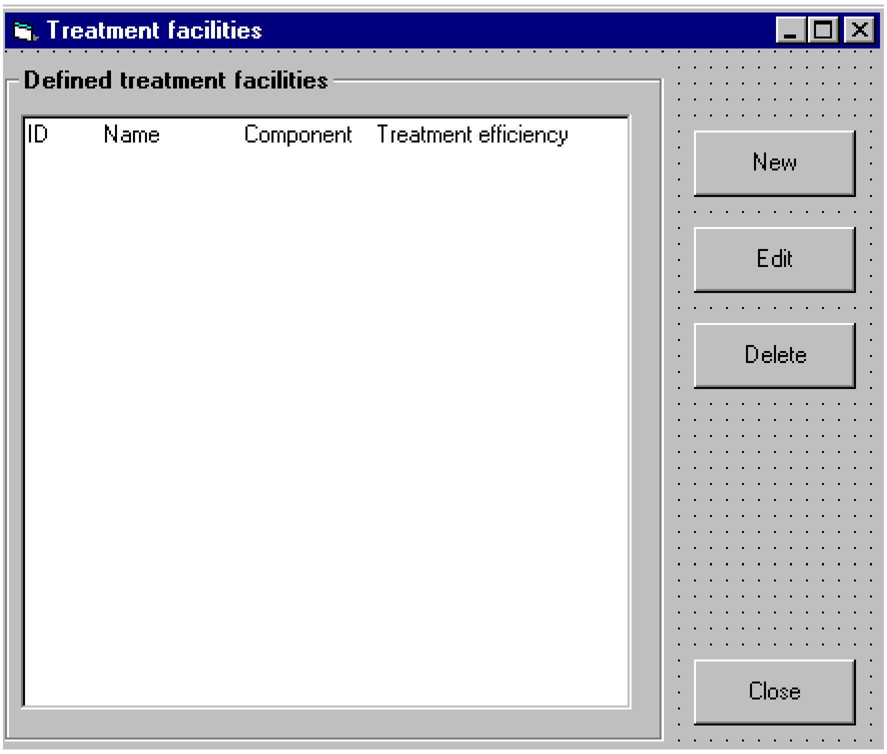
2.4.11 Domestic WW Activity Types

The domestic WW activity types have been separated from the Industry activity types (ref ENSIS 2.05). The domestic WW activity types is a look up table, where the different types are organised in a tree view. The domestic activity type is defined by an ID, name and a parent type. The user can also link the domestic activity type to the building inventory through the building type



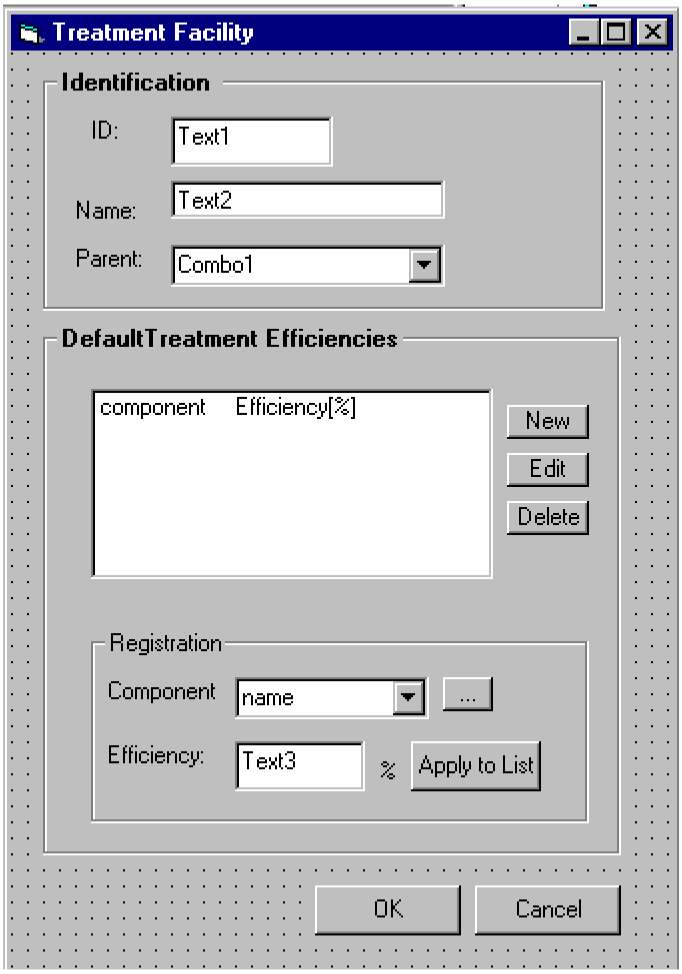


2.4.12 Treatment Facilities



This is a standard treeview, containing the defined treatment facilities, with component and corresponding treatment efficiency. The following properties shall be shown: ID, name, parent, component and treatment efficiency.

Treatment facility, <New> and <Edit>



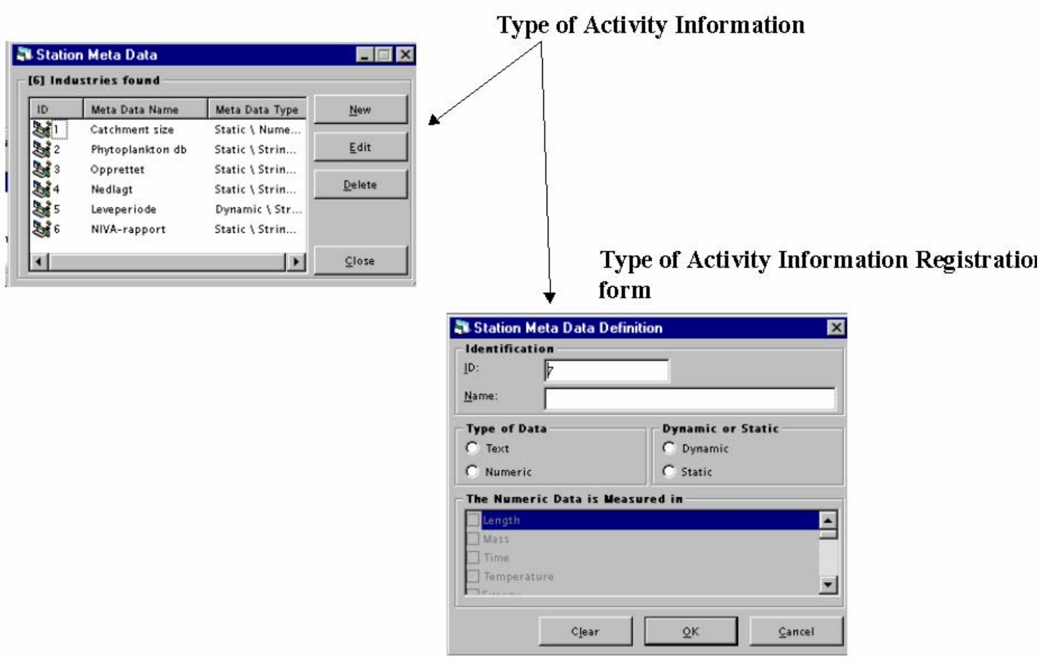
This is the form where new treatment facilities are defined. It shall contain standard ID and name.

The link to parent facility must also be given.

It shall also contain the possibility to enter default treatment efficiency for a component. The treatment efficiency is a number between 0 and 100.
The user will typically register the efficiency on the lowest level of the hirarchy.

The ID , name and parentshall be required, the rest shall be optional.

2.4.13 Type of activity Information



2.5 Waste Water Treatment plant

2.5.1 Introduction

A domestic waste water receives waste water from the following sources:

- Domestic ww activities connected to the WWTP (defined at treatment area)
- Process Industry which discharge process water (treated or untreated) to the domestic waste water network (Defined in the Industry module)
- Other point sources discharging to the domestic waste water network (i.e aquaculture, agricultural sources, waste dumps, infiltration and other user defined sources)
- Urban Run off

All these sources are linked to the WWTP module in a more consistent and closer way compared to ENSIS 2.05.

Before the sources reaches the WWTP some of the pollution discharged to the network are lost due to leakage and overflows at the network. Some is also lost at the WWTP as a direct overflow.

The bypass property in ENSIS 2.05 is in this specification replaced by “overflow at WWTP” and is defined as a separate point source. This source is linked (an only accessible) through the WWTP object.

The leakage at the network is defined and connected to each source which discharge to the WWTP, and this possibility also exist to define the overflow at network. However, the source overflow at network may also be defined as a separate point source (if there exist measurement data for these either as timeseries or aggregated data).

If the overflows are defined as separate point sources these sources have an extra property saying which WWTP which should have had received the waste water if it had not gone in overflow. In this manner the overflow at network defined as a separate source, is also linked to the WWTP. The user must decide which of the two approaches

1) overflow at network defined as general figures for each connected source
2) Measurement at network he/she will use in model calculation for the particular WWTP and in connection with the pollution budget model.

The changes from ENSIS 2.05 are explained in detail in this specification, however the major changes for the WWTP module are:

- The search for WWTP and the presentation of the found items are done as elsewhere in the application with the possibility of view on map and links to other parts of the application is possible. Also the search criteria has been changed a bit.

- The Tabs have been rearranged and some additional tabs have been added.

- WWTP is given by ID, Name and alternative. Remember to include alternative as for Treatment area.

- There has been included an info tab which holds some basic information about the treatment plant including a link to addresses.

- Discharge point has been included on the Info tab since there are only one pipe. The discharge pipe has been somewhat modified according to the changes on treatment area. The discharge point form the WWTP may be linked to a net node (Another WWTP), but these cases a rare[19].

- The treatment processes and sludge handling have been separated on two different tabs and the possibility of drawing a process diagram has been introduced. The user has also been given the opportunity to give some more details about the treatment plant and the sludge handling.

- The discharge data has been renamed to Measurements and discharges and inlet, outlet, overflow at WWTP and other measurement points have been included on the same TAB. Measurements always gives the user access to two different ways to enter this information based on the details about the measurements 1) ”real” measurements=Timeseries, 2) Aggregated measurements data (manually or automatic calculated) .

- The new tab linked sources gives the user a link to registration done elsewhere in the application in order to sum up the contribution from the sources linked to the WWTP. This sum may be used to report how many PE is currently connected to the WWTP.

- A new model input tab has been included in order to priority the data to be used in model calculation.

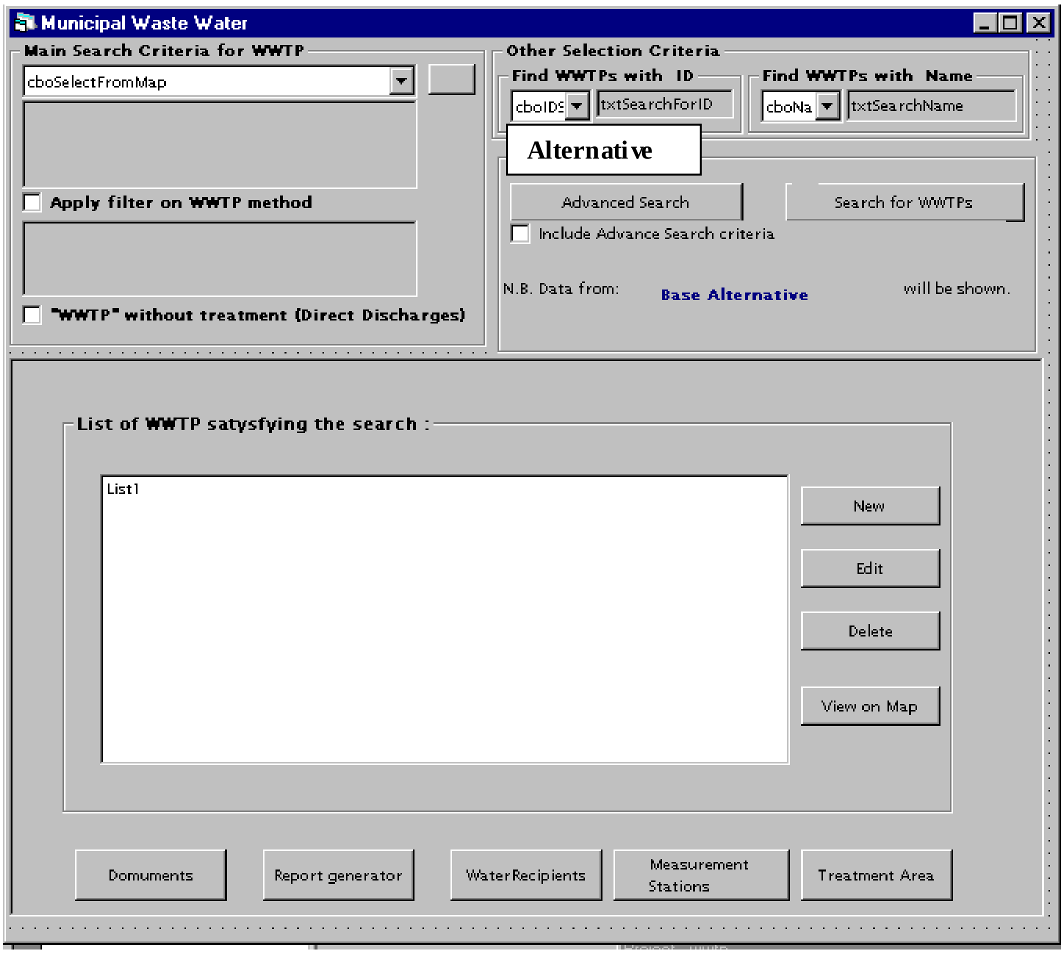
- A new load TAB with the possibility to calculate the load for the particular WWTP has been introduced.

[19] The only reason for defining a WWTP for a discharge which is transported to another WWTP is if there exist treatment or measurments at the WWTP. If not there will be no additional information which can be given on the WWTP which is not available from the treatment area.

- The content of the discharge permits tab has been changed.

    - Another main change is that a treatment plant can not be defined as a collection point. A treatment plant is pr definition a source which is a direct discharge through a disharge pipe (no treatment) or a “real” treatment plant (with treatment processes). The number of TABS and the content will change depending on if it is a “real” treatment plant or not. This is explained below. The information “inter municipal treatment plant” or “private domestic treatment plant” is only for the sake of information.

2.5.2 WWTP, Main Search Form



This is the main WWTP form with new and reorganised search criteria. The upper part of this main form will contain the following controls:

- Standard geographical search (by selecting in the tree view and marking an area on the map)
- Search for waste water treatment plants as a function of defined waste water treatment method (identical to present search criteria) + a check box to search for those"WWTP" which do not have treatment (direct discharge through a discharge pipe)
- Search for WWTPs as a function of ID, name and alternative (standard ENSIS functionality)

There shall also be a button that opens up a new form where additional (advanced) search criteria can be defined (similar to other places in the application). There shall also be a check to notify that the advanced search criteria are applied and a button that start the search. The found WWTPs will be listed in a list.

The found WWTPs shall be listed with ID, Name, Alternative, Dishcarge pipe and Recipient. IN the case of "WWTP" with no treatment "no treatment shall be given instead of ID and name.

From the found list of WWTP there shall be link to other relevant information which is relevant for the found items.

Documents: When the user presses this button, the document handling system shall be opened with only those document points that are linked (are made valid for) to the found WWTPS.

Report generator: This will bring the user to the report generator with the selected objects already selected

Water recipients: This is a link to the water recipients the selected WWTPS[20] discharge to. A filtered list of Lakes, coastal area and river links (Based on the upstream node) will be opened (if relevant).

Measurement stations: This will open a link to Measurement stations located within or linked to the recipients described above.

It is also of interest to get an overview of the treatment areas draining to the selected WWTPs (which have activities connected to the WWTPS).

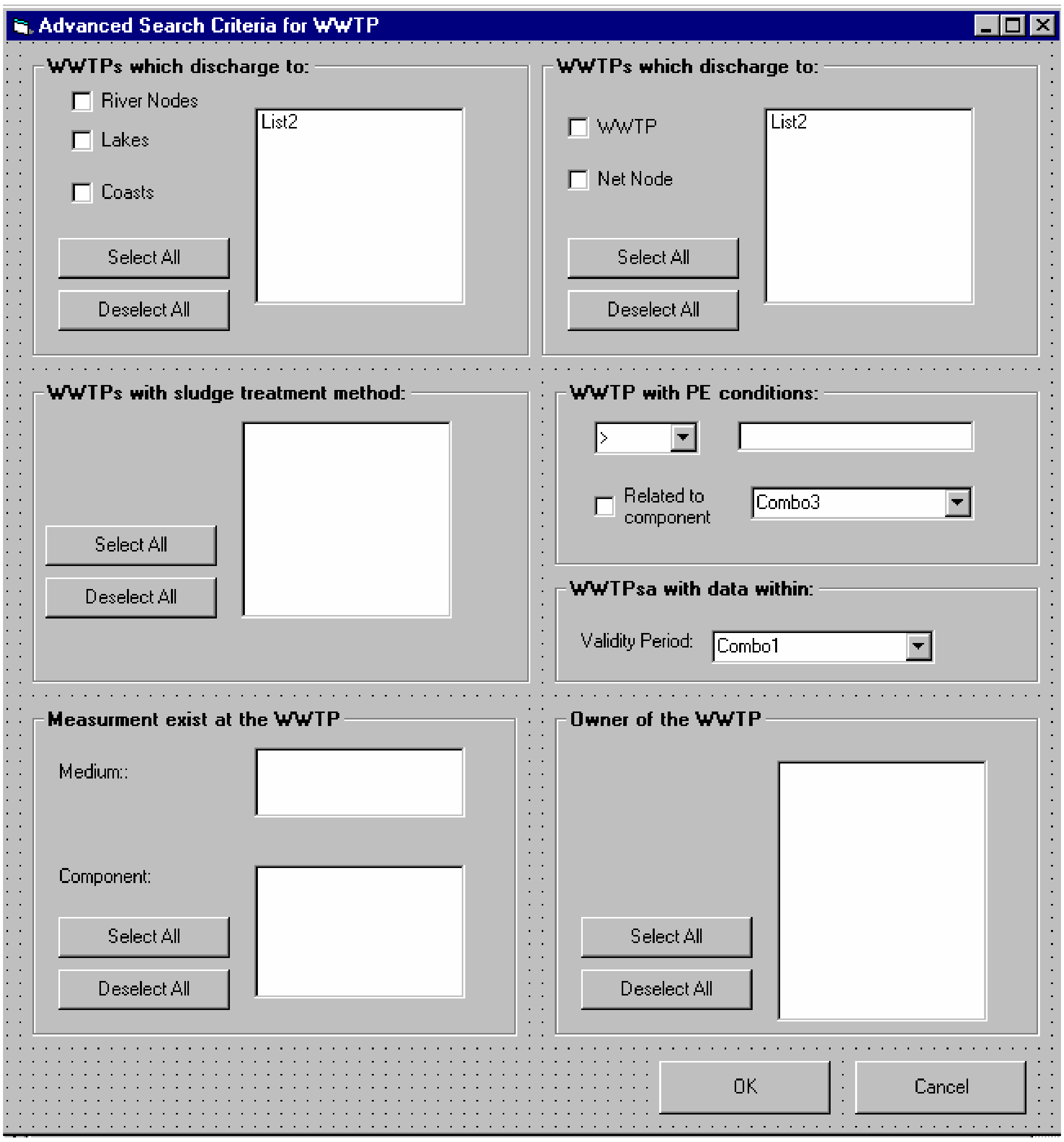
Other links (i.e to sources draining to the WWTP in general) are available when the user enters the specific for each treatment plant through the tab linked sources

If the user wants to create a new treatment plant he enabled new. If the user wants to edit or view details about one of the found treatment plants he/she double click on the item or push edit.

View on map shows the found treatment plant on the map. The right mouse button gives also the discharge pipes and the recipients.

[20] Also those WWTP without treatment

Advanced Search criteria



WWTPS discharging to

The list of recipient will be limited to those within the previously geographical selection. The system will search for those WWTPs connected to the selected recipients through the discharge pipe.

WWTPS discharging to

The list of WWTP and net nodes will be limited to those within the previously geographical selection. The system will search for those WWTPs which are connected to a net node/WTTP (a very rare case).

WWTPS with sludge treatment method

The user can filter thoseWTTPS using a particular sludge treatment method.

WWTPs with PE conditions:
It shall be a search for the information entered about PE for each treatment plant. The system will read this information from TAB 2 , Last registered PE connection.

A combo box listing the boolean operators >, <, =, >=, <= and between shall be implemented in the combo box. It shall be possible to do a general PE search independent of component or link the search to a component.

WWTPS with data within
The user search for WWTP which has measurement data (timeseries or aggregated) within a specific period.

Measurements at the WWTP
The user can search for WWTP which has measurments based on components. The user can search independetly of medium or as a consequence of medium. Medium at at WWTP is typically. Waste Water, sludge and Sludge/Wastewater.

Owner
All WWTPS with selected owners will be found

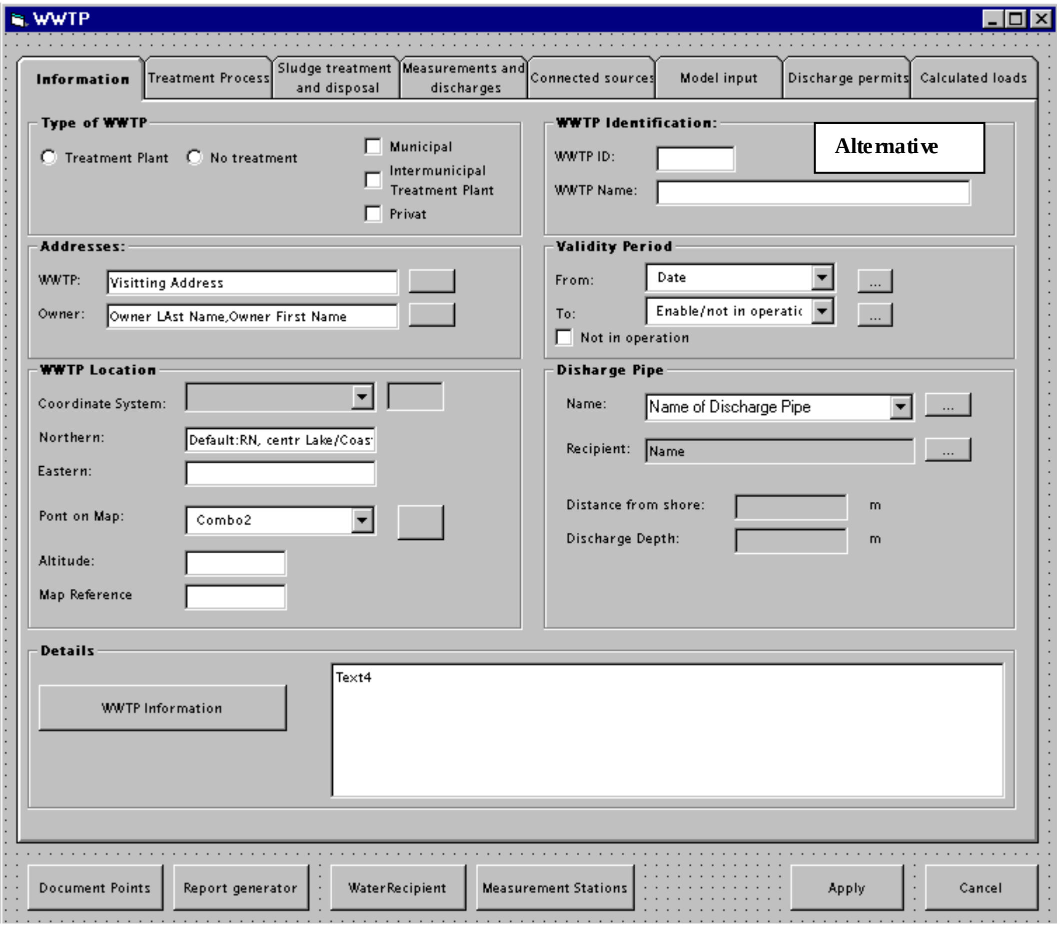
2.5.3 Overview of TABs

A WWTP with treatment processes shall have the following TABS

- INFORMATION
- TREATMENT PROCESSES
- SLUDGE TREATMENT AND DISPOSAL
- MEASURMENTS AND DISCHARGES
- CONNECTED SOURCES
- MODEL INPUT
- DISCHARGE PERMITS
- CALCULATED LOADS

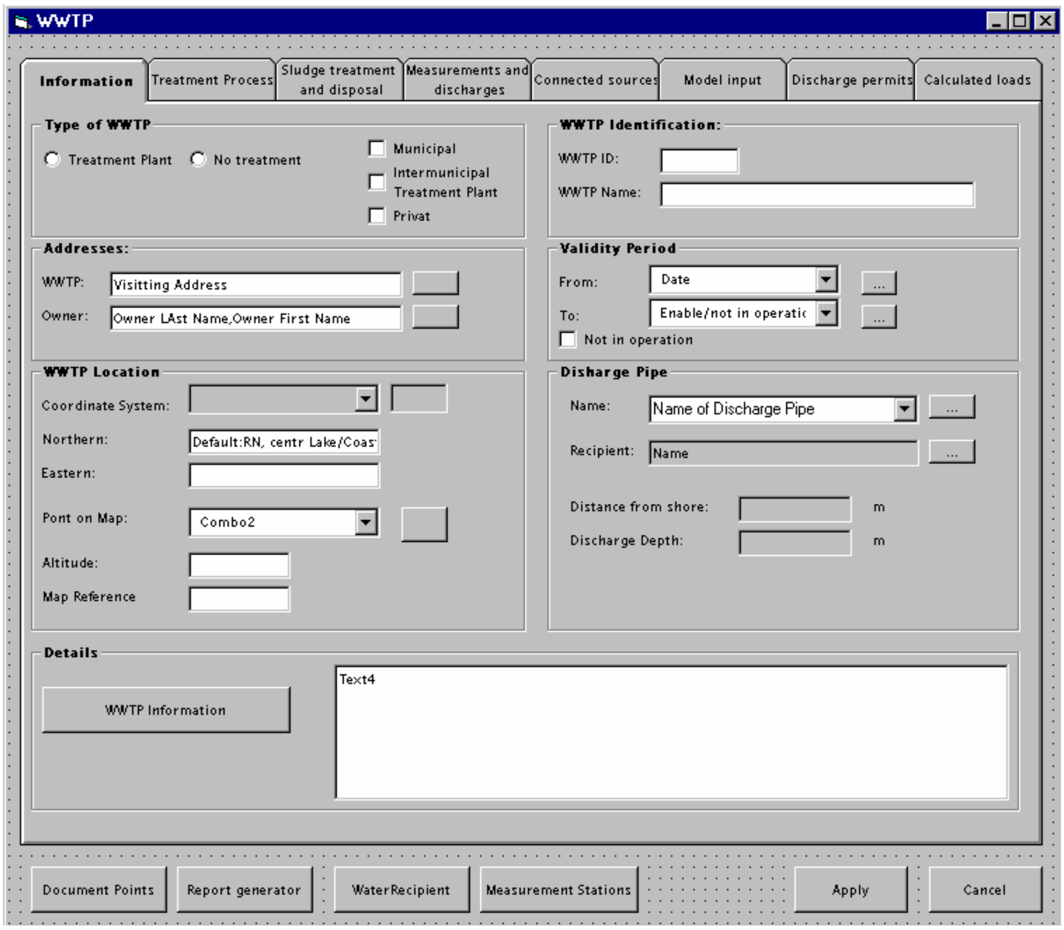
A WWTP which do not have treatment processes shall have the following TABS.

- INFORMATION (Modified compared to “real” WWTP)
- MEASURMENTS AND DISCHARGES (only measurements representative for outlet)
- CONNECTED SOURCES
- MODEL INPUT (only measurements representative for outlet and linked sources)
- DISCHARGE PERMIT
- CALCULATED LOADS


WWTP
Information
Treatment Process
Sludge treatment and disposal
Measurements and discharges
Connected sources
Model input
Discharge permits
Calculated loads
Type of WWTP
Treatment Plant
No treatment
Municipal
Intermunicipal Treatment Plant
Privat
WWTP Identification:
Alternative
WWTP ID:
WWTP Name:
Addresses:
WWTP:
Visitting Address
Owner:
Owner LAst Name,Owner First Name
Validity Period
From:
Date
To:
Enable/not in operatic
Not in operation
WWTP Location
Coordinate System:
Northern:
Default:RN, centr Lake/Coas
Eastern:
Pont on Map:
Combo2
Altitude:
Map Reference
Disharge Pipe
Name:
Name of Discharge Pipe
Recipient:
Name
Distance from shore:
m
Discharge Depth:
m
Details
WWTP Information
Text4
Document Points
Report generator
WaterRecipient
Measurement Stations
Apply
Cancel

2.5.4 WWTP-TAB: WWTP INFO

The WWTP info is very similar to the Industry info tab, but the programmer shall be aware of that the info tab for Industry also has changed compared to ENSIS 2.05.



Type of WWTP

The user decides if this is a treatment plant or if this is actual a "WWTP" without treatment (direct discharge). The default is treatment plant. If it is a direct discharge the registration form will change as described BELOW.

If it is a municipal, inter municipal or private treatment plant is for information only. The default is municipal.

WWTP Identification

The WWTP is identified by ID, Name and Alternative. If this is actual a direct discharge the ID will be blank and the name will be filled in with "no treatment".

Validity Period
Only the validity from is filled in by the user as long as the WWTP/direct discharge still is in operation. The validity period to is disabled. As soon as the not in operation is checked the "to" validity period is enabled.

Addresses
Addresses for the WWTP and the owner might be linked to the WWTP. The owner is a result of the link to WWTP address . For definition of address see chapter later later in this document.

If it is a direct discharge without treatment this frame will be disabled.

WWTP Location
This is the location of the WWTP with functionality as described elsewhere in the application. The functionality has been moved from the address form.

If it is a "WWTP" with direct discharge (and no treatment) the location represent the upstream point of the discharge pipe.

Discharge Pipe
The user enters information about the discharge pipe. After the pipe is defined, the pipe is listed by name.

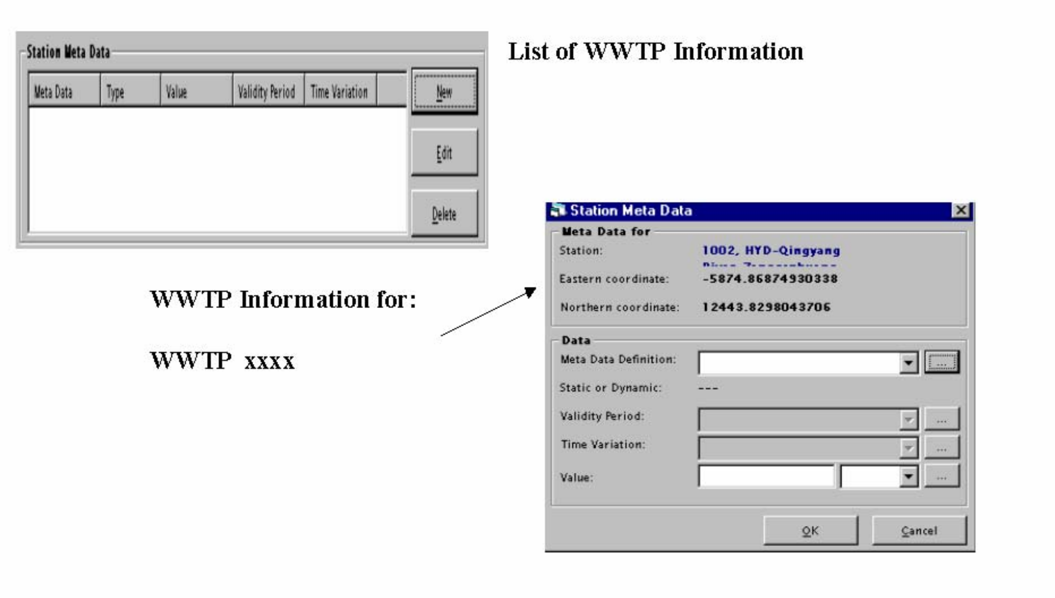
If the WWTP discharge to local recipient the name of the recipient will come as a consequence of the link to discharge pipe. If the WWTP discharge to an inter municipal treatment plant (which is rare), the name of the inter municipal WWTP name shall be displayed instead of the recipient.

Only one discharge pipe can be linked to the WWTP at a time, and this discharge pipe can only be linked to one WWTP. The validity period of the discharge pipe is therefore the validity period of the connection to the WWTP.

If the user chose to connect the WWTP to a new discharge pipe he/she will be forced to write the Validity "to" date of the old discharge pipe. This old discharge pipe connection will then go to the list of earlier connections, and be one entry in the combobox (for information later on). Most likely there will only be one connection over the time. However if the discharge pipe is replaced by a new one, the validity "from" date of the new pipe will be equal to the validity "to" date of the "old" connections.

Details

This gives the user access to register any type of static or variable information, and to write some comments. The functionality is the same as under station meta data information. The functionality results in a new look up called "WWTP Information Type", see the end of this chapter

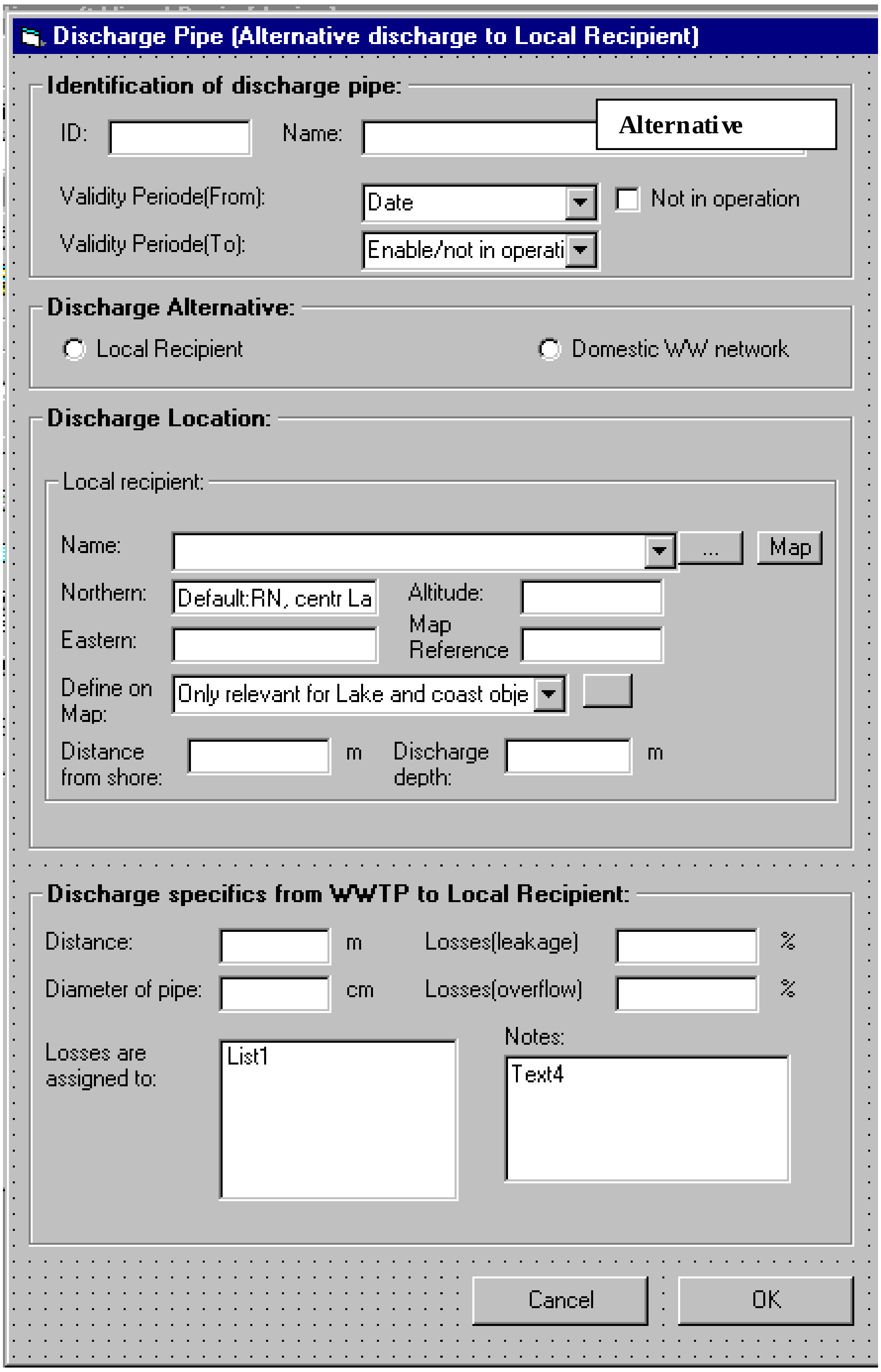


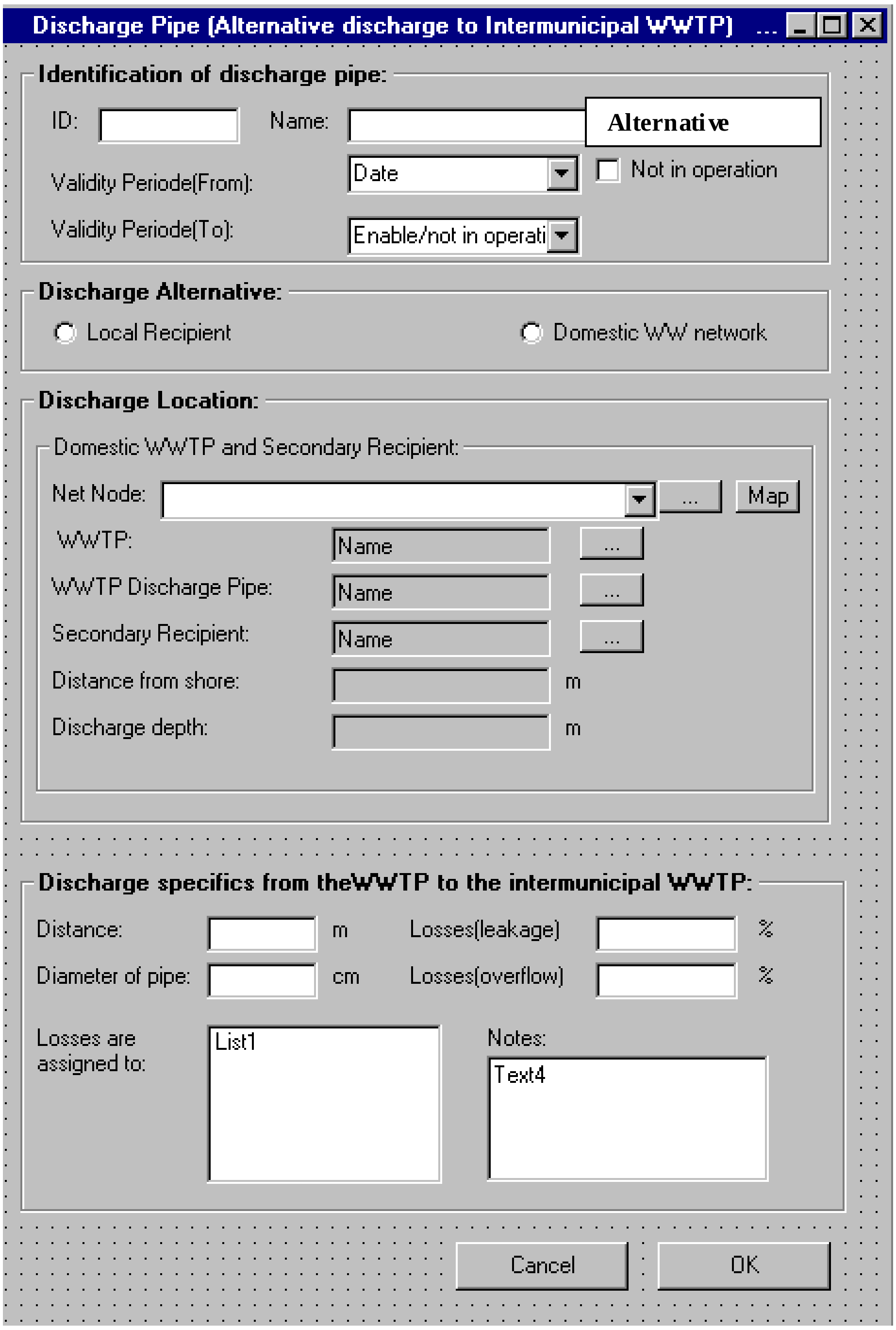
2.5.4.1 Edit/ New Discharge pipe

The discharge pipe information is changed a bit to be harmonised with the changes under treatment plant. The registration forms for the discharge alternative to local recipient and to inter municipal WWTP are shown below. The default discharge alternative is “to local recipient”. The functionality in the forms is described in detail under discharge location under treatment area. The only difference from the discharge location form under treatment area, is that the collection point location is removed from the discharge pipe form. The equivalent to collection point in the WWTP module is the co-ordinates of the WWTP.

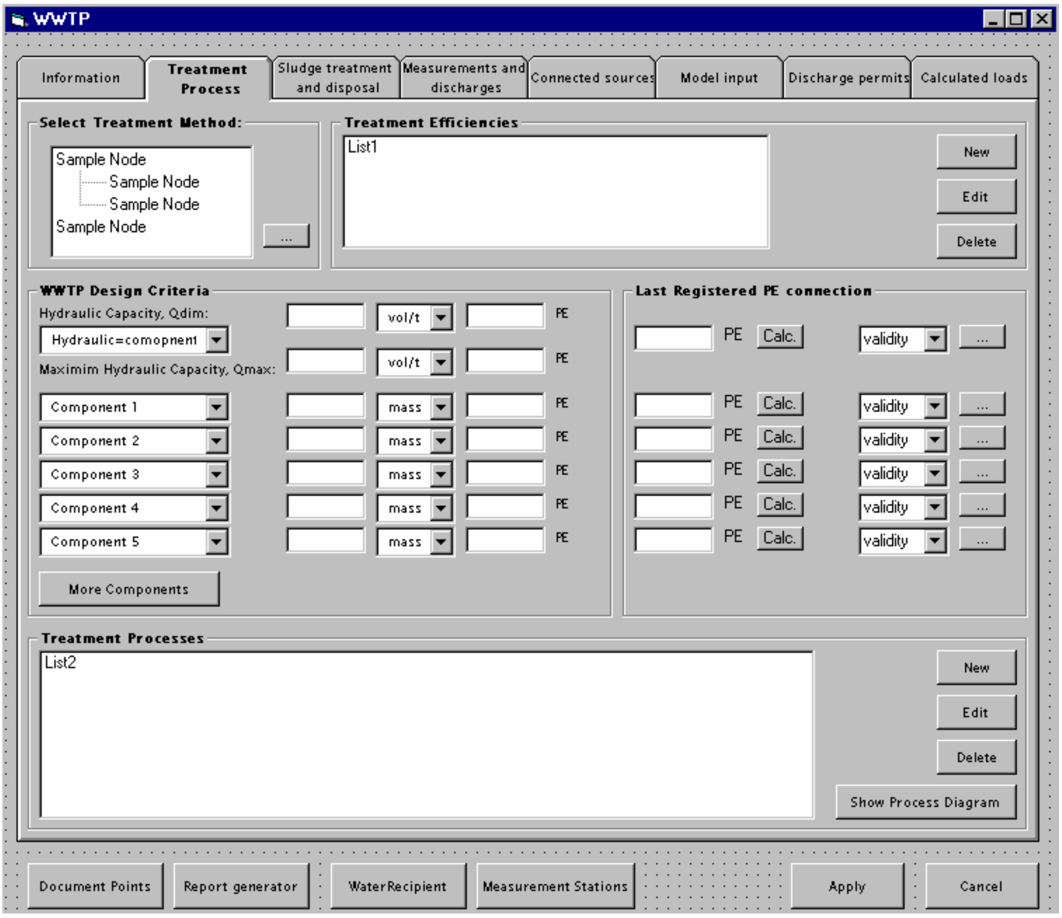
Also a map button has been implemented next to the recipient button. This will allow the user to limit the list of available water elements to select from in the combobox (since WWTP do not have a geaographical area the list will consist of several elements). The limitation will also aplly to the list of local recipients receiving losses.

The same map limitation is done for net node and the local recipient for the net node discharge alternative.


Discharge Pipe (Alternative discharge to Local Recipient)
Identification of discharge pipe:
Alternative
ID:
Name:
Validity Periode(From):
Date
Not in operation
Validity Periode(To):
Enable/not in operati
Discharge Alternative:
Local Recipient
Domestic WW network
Discharge Location:
Local recipient:
Name:
...
Map
Northern:
Default:RN, centr La
Altitude:
Eastern:
Map Reference
Define on Map:
Only relevant for Lake and coast obje
Distance from shore:
m
Discharge depth:
m
Discharge specifics from WWTP to Local Recipient:
Distance:
m
Losses(leakage)
%
Diameter of pipe:
cm
Losses(overflow)
%
Losses are assigned to:
List1
Notes:
Text4
Cancel
OK


Discharge Pipe (Alternative discharge to Intermunicipal WWTP) ...
Identification of discharge pipe:
ID:
Name:
Alternative
Validity Periode(From):
Date
Not in operation
Validity Periode(To):
Enable/not in operati
Discharge Alternative:
Local Recipient
Domestic WW network
Discharge Location:
Domestic WWTP and Secondary Recipient:
Net Node:
...
Map
WWTP:
Name
WWTP Discharge Pipe:
Secondary Recipient:
Distance from shore:
m
Discharge depth:
Discharge specifics from theWWTP to the intermunicipal WWTP:
Distance:
Losses(leakage)
%
Diameter of pipe:
cm
Losses(overflow)
Losses are assigned to:
List1
Notes:
Text4
Cancel
OK

2.5.5 WWTP-TAB: TREATMENT PROCESSES



Treatment method

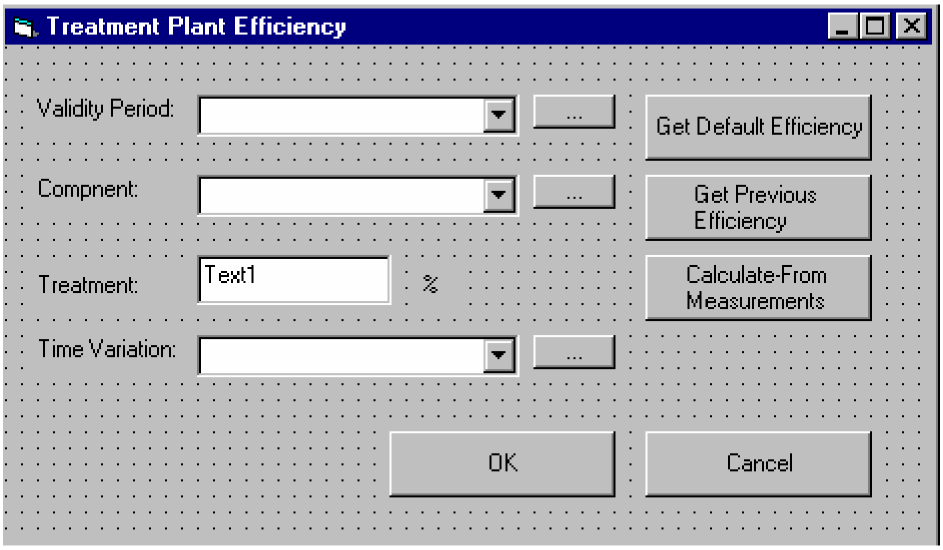
The selection of treatment method is moved from the address form, and the hard coded alternatives such as ”to inter municipal WWTP” and “Direct Discharge” shall be removed.

The user will typical select at the lowest level in the tree view. The parent level usually represent the treatment principle and the the child level the method.
I.e Tertiary nitrogen removal (principle) and pre-denitrification (method)

The treatment plant method is changed from ENSIS 2.o5, and in the new version it shall be possible to define default treatment efficiencies for the methods (as for treatment facilities). The user will define the default treatment efficiencies at the lowest level in the tree view.

The changes to treatment method form is described later in this document.

2.5.5.1 *Treatment plant Efficiency (New and edit)*



The following changes are done compared to ENSIS 2.05. Link to medium is removed. The user only needs to enter information about component.

The efficiency shall always represent treatment efficiency for the waste water which are treated /the WW which actual reach the treatment), and shall not include the overflow at network in the treatment efficiency.

The user may enter the efficiency for the given validity period manually, but it is also possible get efficiency from default efficiency (determined by the treatment method, see changes to treatment method).

The user can also choose the same efficiency defined for the last previously defined validity period for the component, or calculate the efficiency from measurements.

Calculate from measurements will lead the user to all timeseries defined for the treatment plant (see tab measurements and discharges).
The “Measurement at inlet” and the “Measurement at outlet” measurement points shall be checked and the system shall find all series with the actual component.

The user may select the concentration data for inlet and outlet (move down as selected in the dataseries window). The user needs to push OK before returning to the efficiency form. The user will then be asked if the series should be aggregated over the selected time period using:

- Arithmetic average
- TimeWeighted Average
- Interpolated average

The system select a method as default depending on the type of sampling method of the timeseries (i.e fixed timestep or grabsamples). See rules given for the measurment module-aggregation.

After selecting a method the system will aggregate the two series over the selected validity period and calculate the treatment efficiency by (Aggregated concentration in-Aggregated Concentration out)/ (Aggregated concentration in) *100

If the user has good measurement for water flow, he/she will typically have created discharge series for inlet and outlet (Mass/time). In this case the user may select the two discharge series. The user will be asked to give the aggregation method and calculate treatment efficiency by: Aggregated discharge in-aggregated discharge out)/ (Aggregated discharge in) *100

The last scenario is that the user has measured at several places in the plant and feel that other measurement points than the hardcoded inlet and outlet are representative to calculate the treatment efficiency. I.e this could be the case if overflow is located after the measurement at inlet. In this case the user needs to select the relevant measurement points and select the two series which are representative. The rest of the operation will be as described above.

The time variation will by default be constant, but the user may change it manually (the system will not calculate a time variation)

WWTP Design Criteria

The user may give information about the WWTP design criteria for the hydraulic capacity, Qdim and Maximum Hydraulic Cacacity, Qmax. The user also need to define which component in ENSIS is defined as the flow component i.e Waterflow (Q) (Volume/time) measuring hydraulic capacity.

As soon as the user gives the capacity numbers with unit volume/time, the PE equivalent will be calculated automatically based on the Default domestic discharge factors. Or vice a versa if the user gives the numbers in PE the numbers in volume pr. time will be calculated. The default unit shall be m3/d.

This will also be possible for 5 other components i.e Tot P, BOD etc which the user can select .The units for the other components are mass/time. By default the unit shall be kg/d.

Last registered PE connection

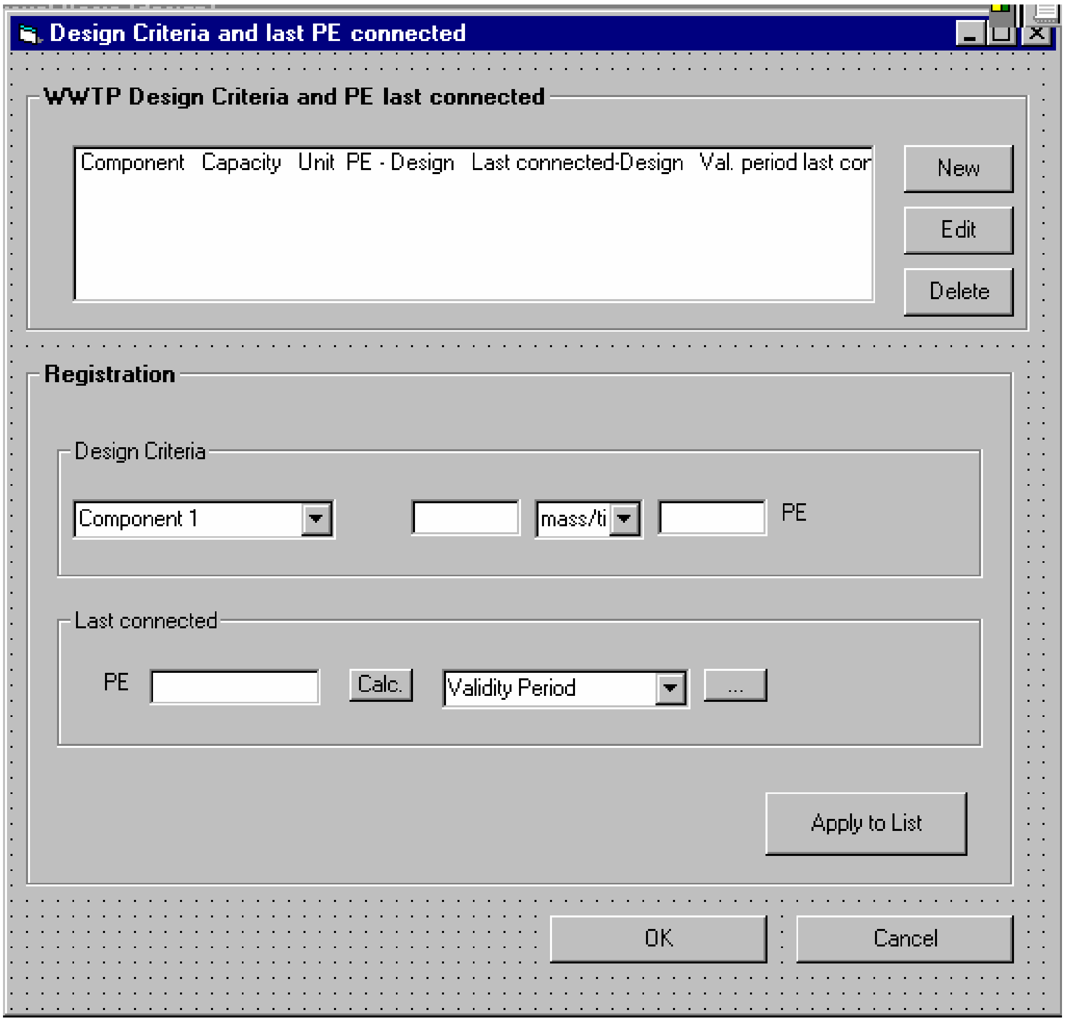
The user may be interested to compare the last registration of PE connection to the plant (PE reaching the plant, The load to WWTP) with the design criteria. which is registered. The numbers and the validity period can be typed in manually.

NB! The user will typically type this manually if the user of ENSIS only use the WWTP module and not the different modules for the sources connected to the treatment plant. Or in cases where the register of connected sources is only partly developed. Manually entered PE values may also be input to the model (see tab model input). This is an example which demonstrate how ENSIS might be used in detail or not, depending on focus/task of the user, the data available and the amount of time the user wants to put on the registration of data.

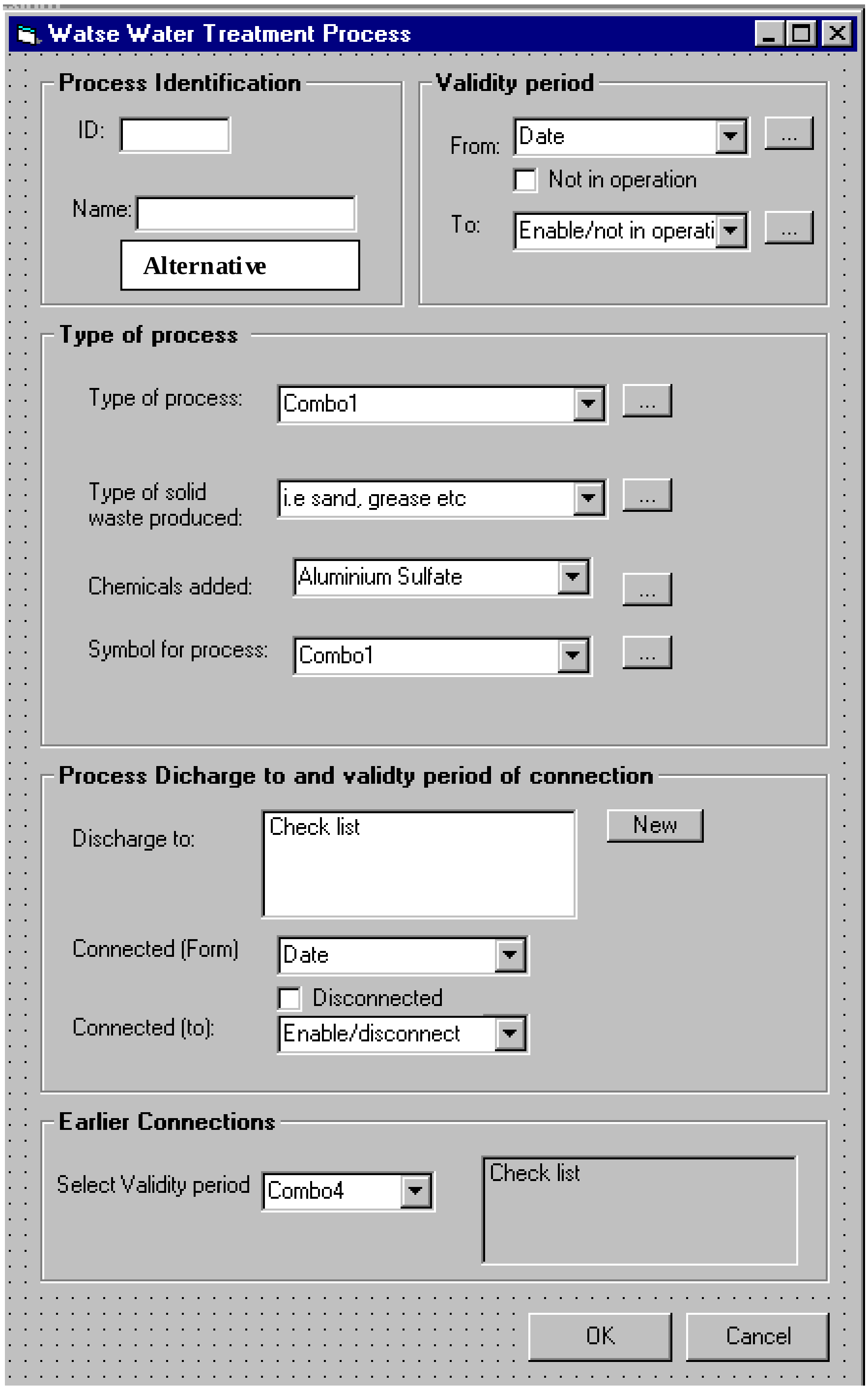
However the user may lso get these PE numbers from the connected sources TAB which shows all sources connected to the WWTP and which is a result of registration in the other modules. IF the user select this option he/she will be brought to the connected sources TAB. The validity period and component will already be filled in.

The user will decide how to calculate (which sources to include or not). The figures calculated might then be copied by the user. (see description under the connected sources TAB)

<More Components>
If the user wants to enter more design criteria or last PE connections for more components he/she may do so by entering the more component button . He/she will come to the complete list of registration with the possibility to enter more components.


Design Criteria and last PE connected
WWTP Design Criteria and PE last connected
Component Capacity Unit PE - Design Last connected-Design Val. period last cor
New
Edit
Delete
Registration
Design Criteria
Component 1
mass/ti
PE
Last connected
PE
Calc.
Validity Period
...
Apply to List
OK
Cancel

2.5.5.2 *Treatment Processes*



The waste water treatment processes are determined as in ENSIS 2.05 except for the following changes.

- The validity period has a from and to date
- Treatment process is identified by ID, Name and alternative.
- Take away "Date of inventory.
- There shall be implemented two extra comboboxes ”type of solid waste” and ”Chemical added “

- It shall be possible to select a process symbol from a combobox. There shall be a limited list of symbols to select from

- The check list "Process discharges to" shall contain the discharge pipe defined for the WWTP, other waste water treatment processes defined for the WWTP, and sludge treatment processes defined for the WWTP .

- Process discharges to shall not be required, but the user shall get a warning if he does not specify anything in this control.

- The process discharge to combination has a validity period, because the connection can change over time. If the user tries to establish a new combination of connection (New). The user must fill in the data for the connected "to" date. The old combination will be saved and be available from the list of earlier connections which the user may view based on the validity period. The validity period of the new connection starts with the "to date" from the old connection.

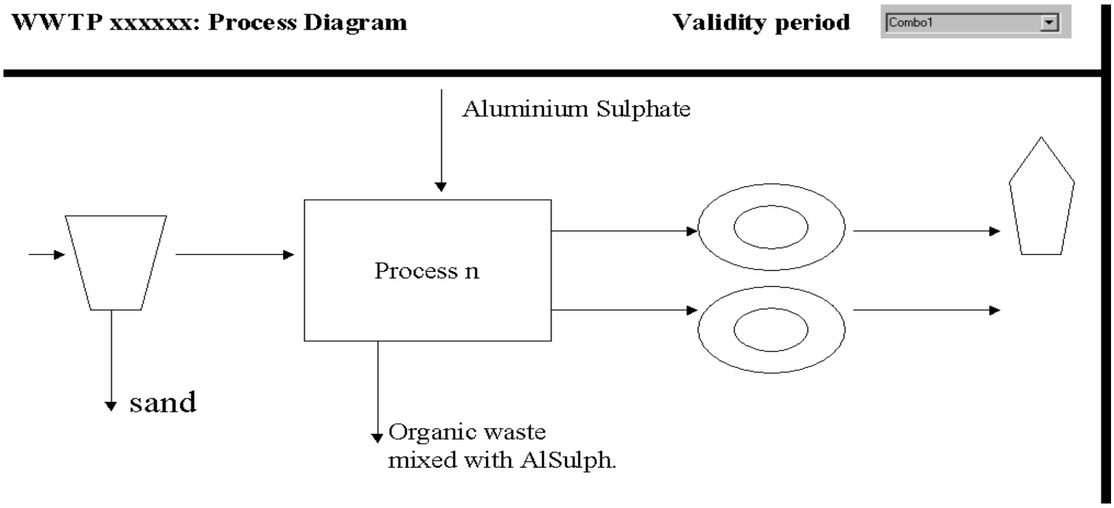
2.5.5.3 Show process diagram

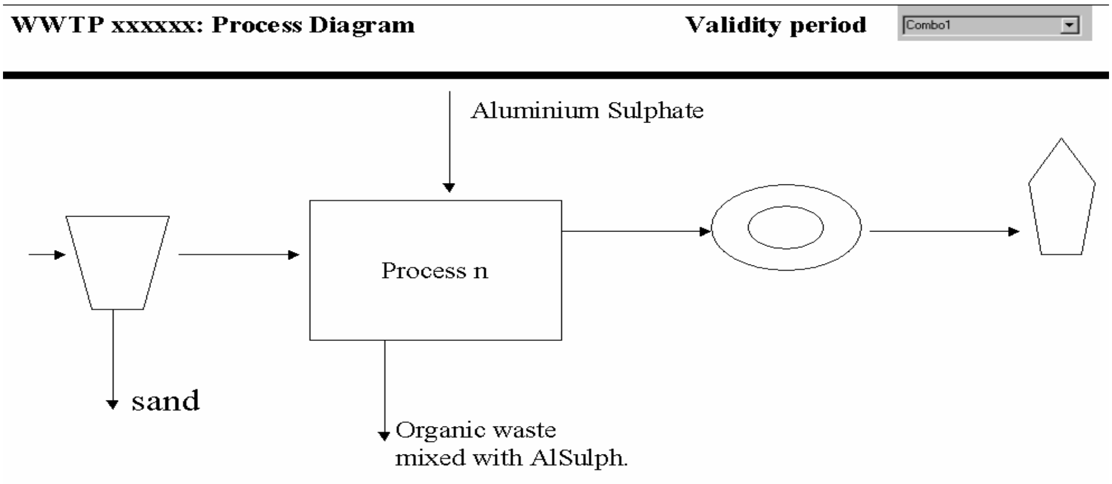
The show process diagram shall lead the user to a diagram where the processes in the Waste water treatment plant are drawn based on the symbol selected for each process. The name of the process will be written within the symbol.

Between the processes there will be arrows. The chemicals added for a process shall be symbolised with an arrow at the top of the process going in to the process and the type of solid waste produced shall be an arrow at the bottom of the process going out from the process.
The type of chemical and solid waste shall be written on the arrow.
Also an arrow going out from the bottom of the process shall be shown if the process discharge to a sludge process. The name of the sludge process shall be shown at the arrow.

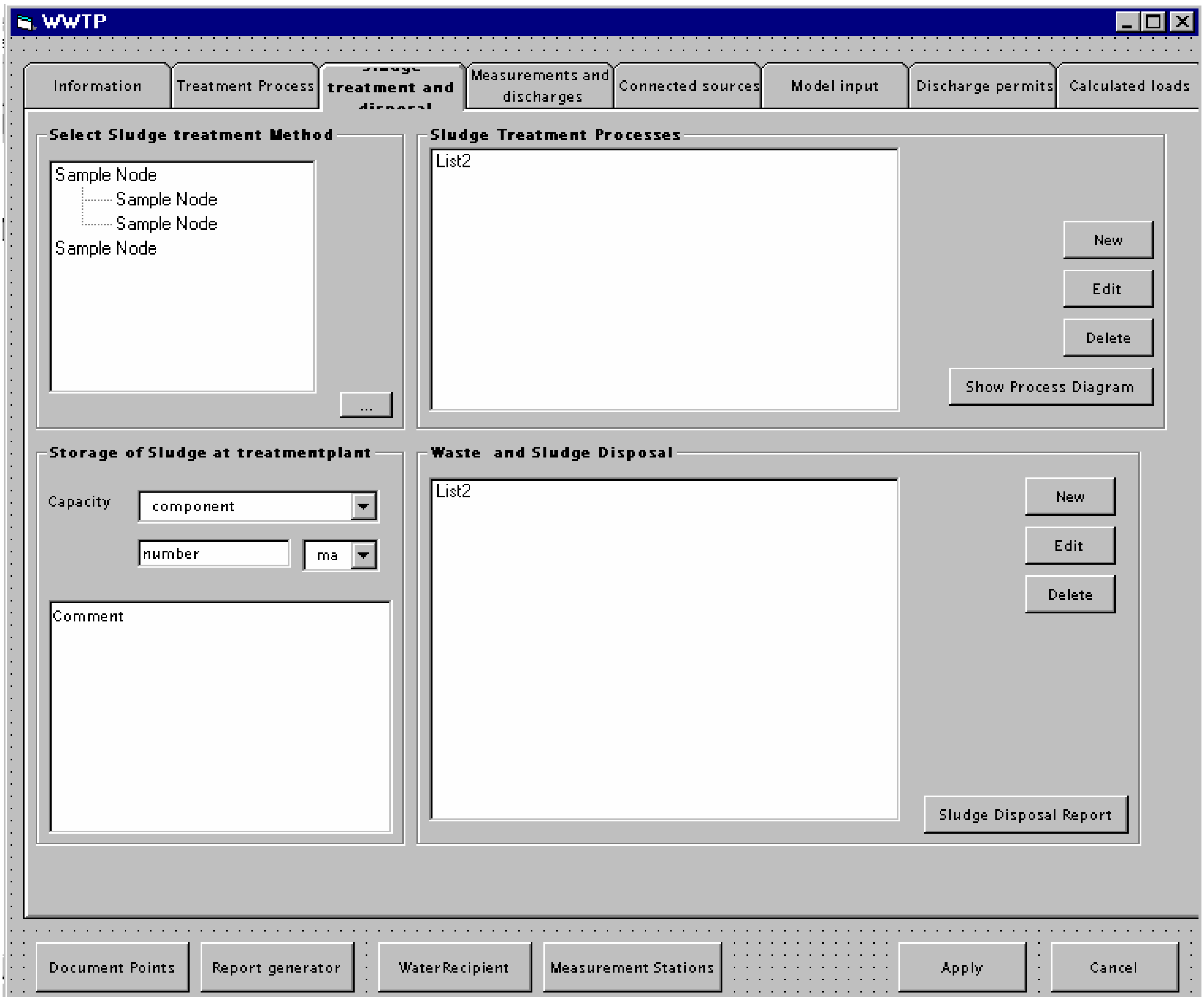
If one of the discharge links for any of the process are changed or if the process is not in operation this will "freeze" the process diagram and the validity period will be from the last change of any process or connection to the date when the change occurs again.

Either the user shall have the possibility to save the process diagram and select the validity period later for presentation purposes (as shown below). Or it shall be only possible to have one process diagram available, and the user can only have access to the old one if he/she has saved these to the document points.

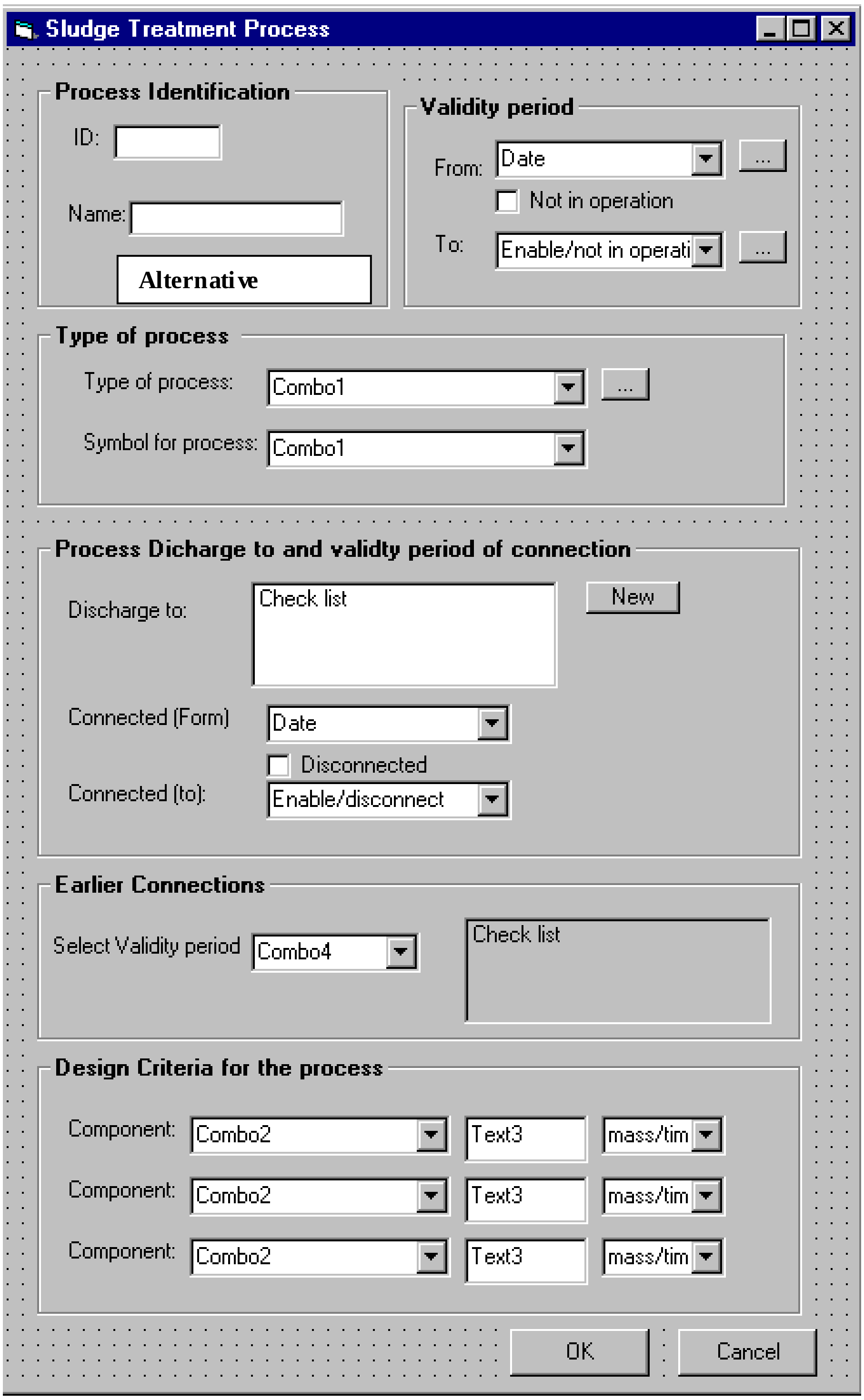

WWTP xxxxxx: Process Diagram
Validity period
Combo1
Aluminium Sulphate
Process n
sand
Organic waste
mixed with AlSulph.


WWTP xxxxxx: Process Diagram
Validity period
Combo1
Aluminium Sulphate
Process n
sand
Organic waste
mixed with AlSulph.

2.5.6 WWTP-TAB: SLUDGE TREATMENT AND DISPOSAL



2.5.6.2 Sludge treatment process



The sludge treatment processes are determined as in ENSIS 2.05 except for the following changes.

- The validity period has a from and to date
- Sludge Treatment Process is identified by ID, Name and Alternative.

- Take away "Date of inventory.

- It shall be possible to select a process symbol from a combobox. There shall be a limited list of symbols to select from

- The process discharge to shall be changed from a combo box to a check list box. (a process may discharge both to another sludge process and water back to a WWTP process)

- The check list "Process discharges to" shall contain the discharge pipe defined for the WWTP, other sludge treatment processes for the WWTP,the defined waste water treatment processes for the WWTP and even other treatment plant (small treatment plants do not have sludge treatment and send the sludge to other treatment plants)

- Process discharges to shall not be required, but the user shall get a warning if he does not specify anything in this control.

- The process discharge to combination has a validity period, because the connection can change over time. If the user tries to establish a new combination of connection (New). The user must fill in the data for the connected “to” date. The old combination will be saved and be available from the list of earlier connections which the user may view based on the validity period. The validity period of the new connection combination starts with the “to date” from the old connection.

- The user may enter design criteria (capacity of the process for some components)

2.5.6.3 Show process diagram

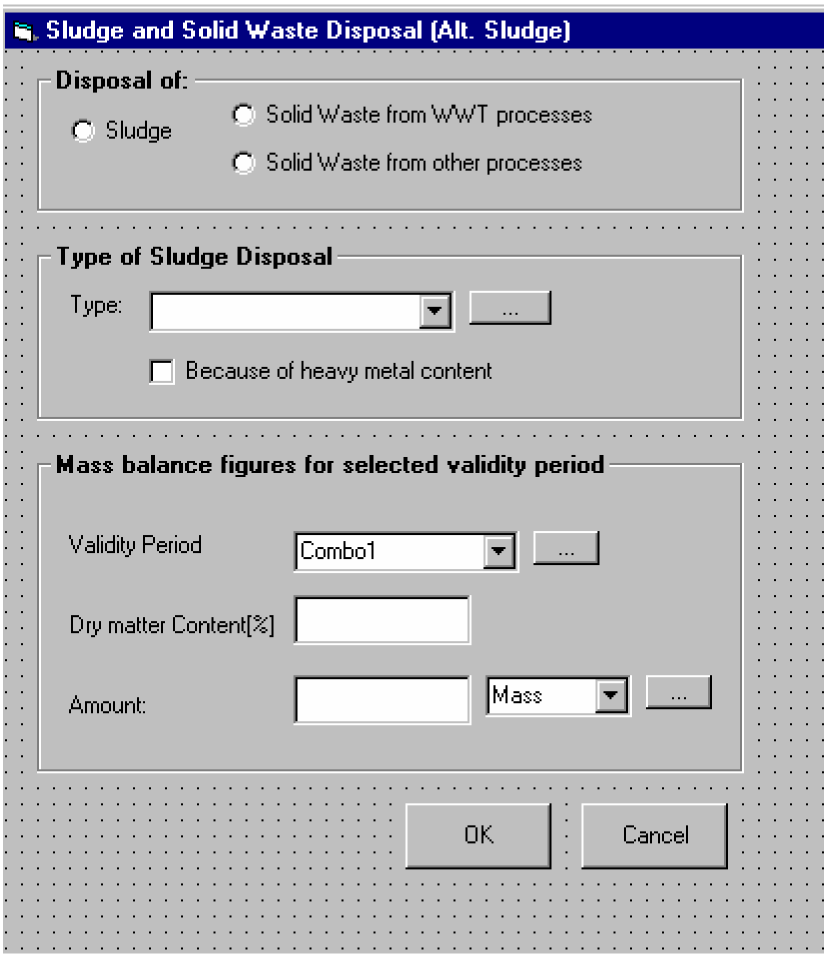
This will function in the same manner as described for waste water treatment processes.

Storage of sludge at the treatment plant

The user may enter information about the storage capacity of sludge at the treatment plant and some comments connected to this.

2.5.6.4 Sludge and Solid Waste disposal

The amount of sludge and solid waste at the treatment plant may be disposed for different purposes, or stored at the treatment plant. The sludge and Solid waste disposal functionality gives the user the possibility to keep track of the mass balance of sludge and solid waste produced.



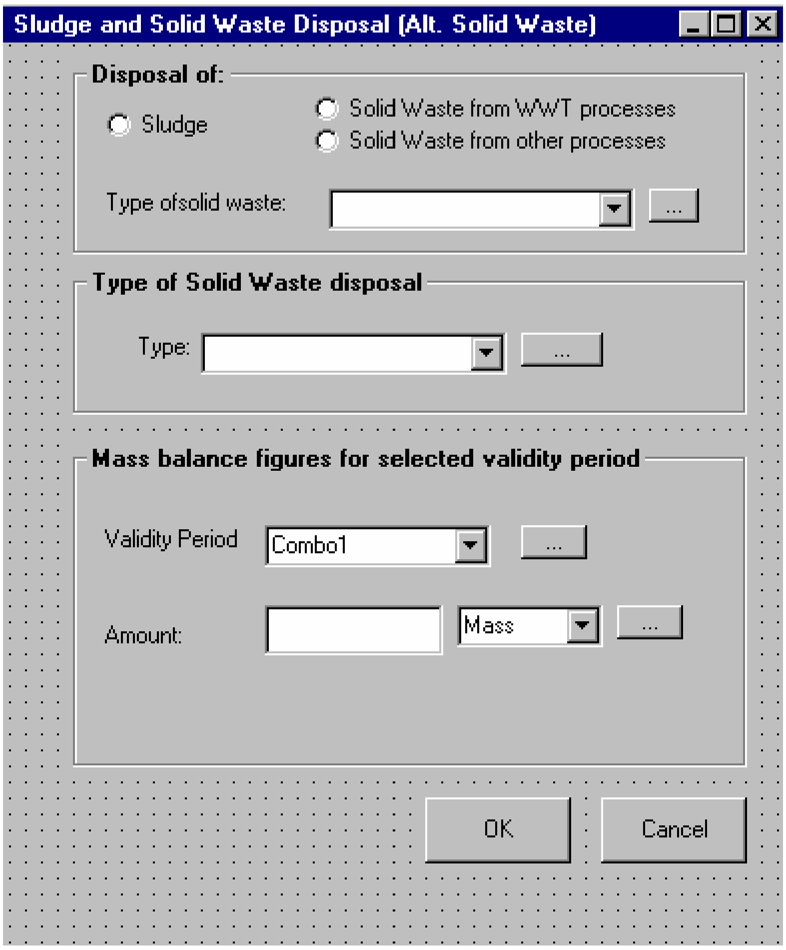
The registration form will change depending on if it is sludge or other solid waste which are disposed. The default "disposal of" is sludge. In the case of sludge the user needs to determine the sludge and waste disposal type.

If the disposal type chosen is a result of the heavy metal content in the sludge the user will check this check box. The check box is by default unchecked.

After entering the validity period the user may enter the dry matter content and the amount of sludge.

If the user shall enter information about other solid waste disposed the user chose the alternative solid waste form WWT processes or solid waste from other processes. The same form will show up for both alternatives.

In the case of solid waste the user also needs to enter type of solid waste disposed. Dry matter content is not relevant in this case.



2.5.6.5 Sludge and waste disposal report

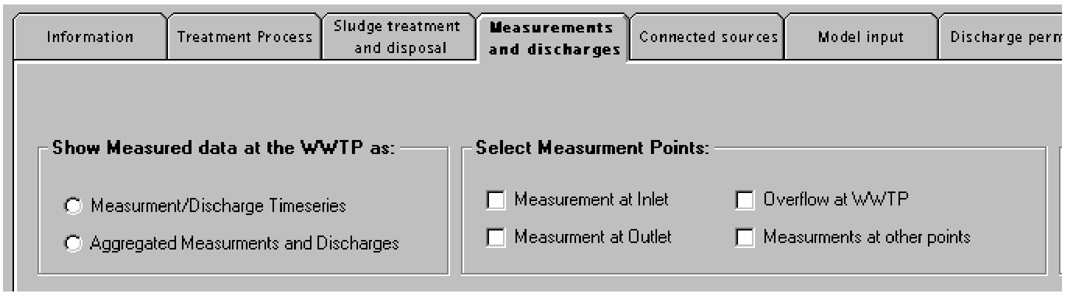
The sludge and waste disposal report may be produced based on the registration.

This type of report and graphs will typically be created in the report generator based on the users need, and can be accessed directly from the actual WWTP plant.

This type of report should typically show the total amount of sludge and waste produced including the amount disposed for different purposes:

2.5.7 WWTP-TAB: MEASUREMENTS AND DISCHARGES

2.5.7.1 General



This TAB is used to give measurement and discharge data for the WWTP. The idea behind the functionality is that the user shall be able to give the data with the level of details he/she wants to or have access to. For this reason measurements might be given as timeseries or as aggregated measurements both of pollution component and of flow. Based on these measurements the user may create discharge time series (concentration*flow) by the use of the time series calculator and aggregation of timeseries (if the flow and concentration has different timestep).

Also the user might aggregate data over a period (i.e. for a year) based on these measurement timeseriess for reporting or presentation purposes (aggregated measurement as discharges).

However, the user might not have access to measurement at the plant, and have only aggregated discharge and measurement data, i.e. from reports. In this case the user might enter this manually.

For these reasons the user needs to have access to two main forms within the tab.

1) Measurement/Discharge Timeseries
2) Aggregated Measurement and Discharge

The aggregate Measurement and Discharge form will give the user access to calculate the aggregated values based on data registered in the Measurement /Discharge timeseries main form, or enter the data manually. (NB in the form above these two options have been implemented and the TAB will only change content according to what is selected, however the user shall have access to both possibilities and for a programming point of view it might be more convenient to organise this functionality on two different TABS)

After selecting the option the user may in both cases chose if he/she wants to view data connected to all measurement point valid for the WWTP or only a selection.

There are three fixed measurement positions for a WWTP.

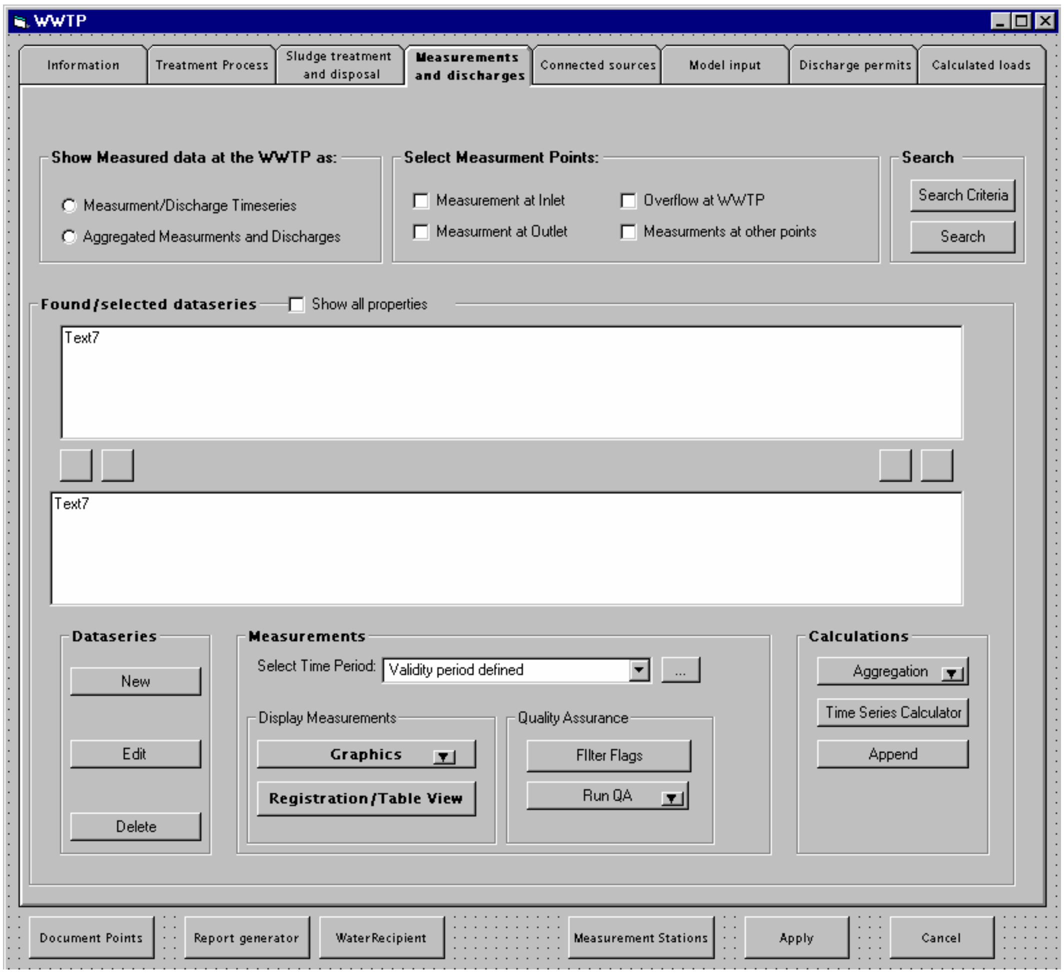
- Inlet
- Outlet
- Overflow at WWTP

In addition other points can be created.

NB The user must be aware of that only measurements and data taken on the process water (to or from) the WWTP shall be regsitered on the fixed measurement positions. Measurements taken on sludge or other relevant measurements <u>must</u> *be registered on other user defined measurement point. The model for calculation of load only selects data from the measurements/discharges on these fixed positions, and does not operate on the logic given for medium(i.e water, sludge, sludge water etc).*

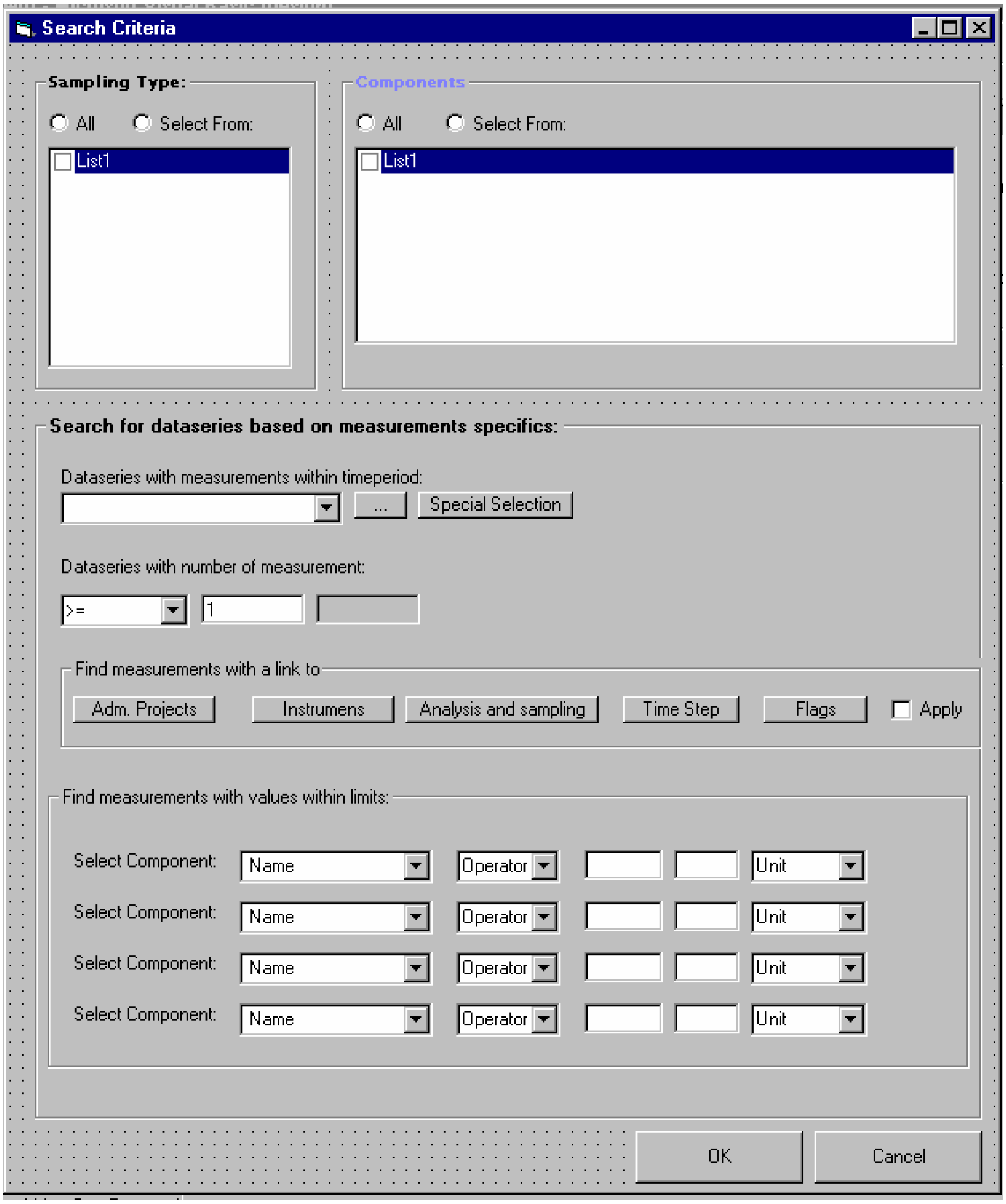
Also the user should be aware of that there are no logic between the concentration at inlet and the concentration of the overflow water from the WWTP (Usually overflow is only measured by flow and the user assumes that the concentration is the same as the inlet).In this case the user needs to copy the concentration data which is relevant for the overflow to the series registered for the overflow. We have decided to not build in this logic between inflow to the WWTP and overflow, also because there might be other measurement point at the plant which is more relevant than the inlet measurements to characterise the overflow, or in the cases where concentration measurements at the overflow actually exist.

2.5.7.2 Radiobutton "Measurement/Discharge Timeseries"



If the user chooses this alternative the Dataseries form described in the measurement module will be enabled with some modifications.

The found data series will be those valid for the selected measurement points.



If the user wants to limit the found data series for the selected measurement point he/she can do so with search criteria shown in the form below.

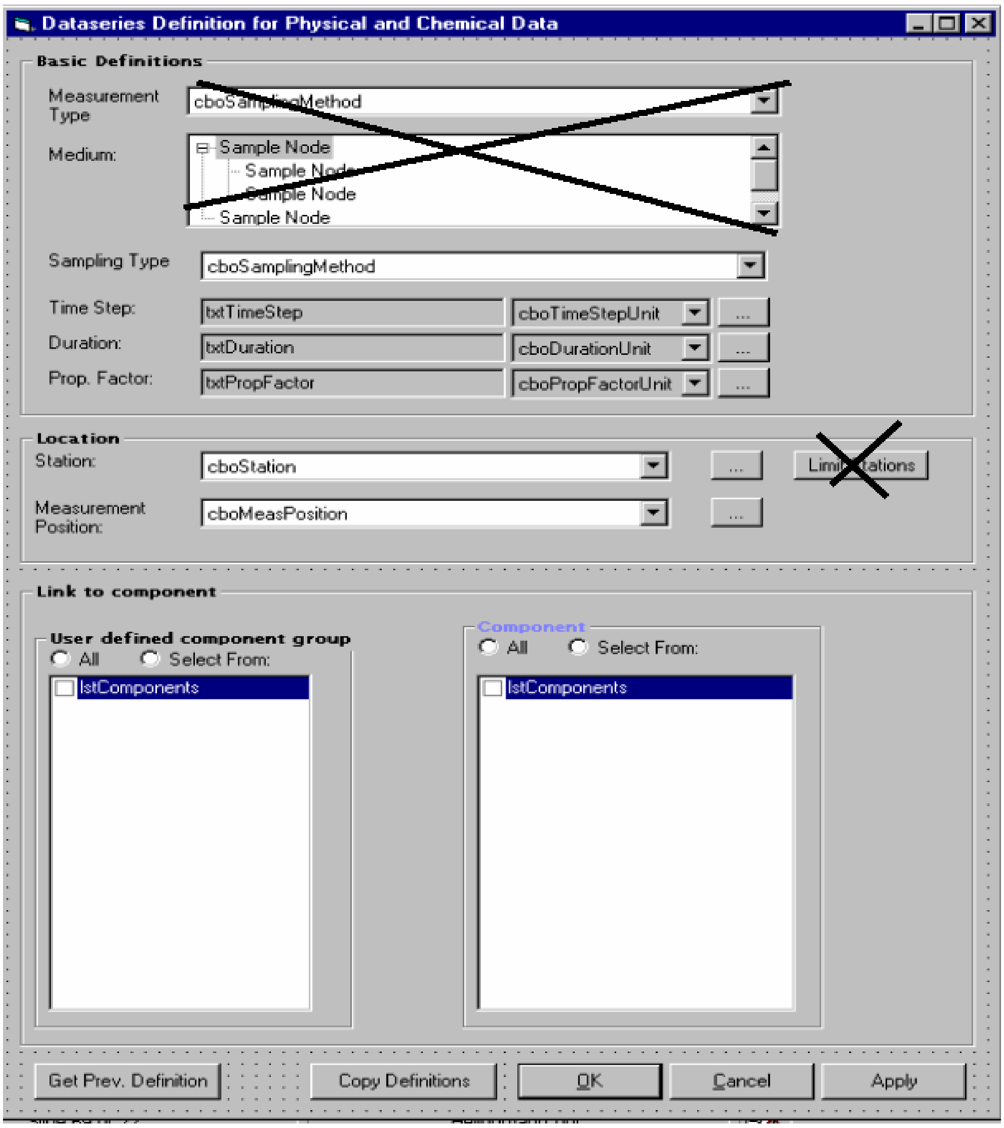
The functionality with respect to the found dataseries will be the same suggested in the Measurement part 2 specification, except for that measurement type and medium is not relevant.

In addition the user shall have access to the aggregation forms and the time series calculator functionality. In this manner the user can create the “Discharge time series” with unit mass/time. The user shall also be able to append the series as in the current ENSIS 2.05 application (The user must be aware of that the model uses discharge data only (concentration *flow=mass/time) so if the user does not have flow data, he/she must anticipate or get an average , and create these series by the use of the time series calculator).

2.5.7.3 Dataseries definition

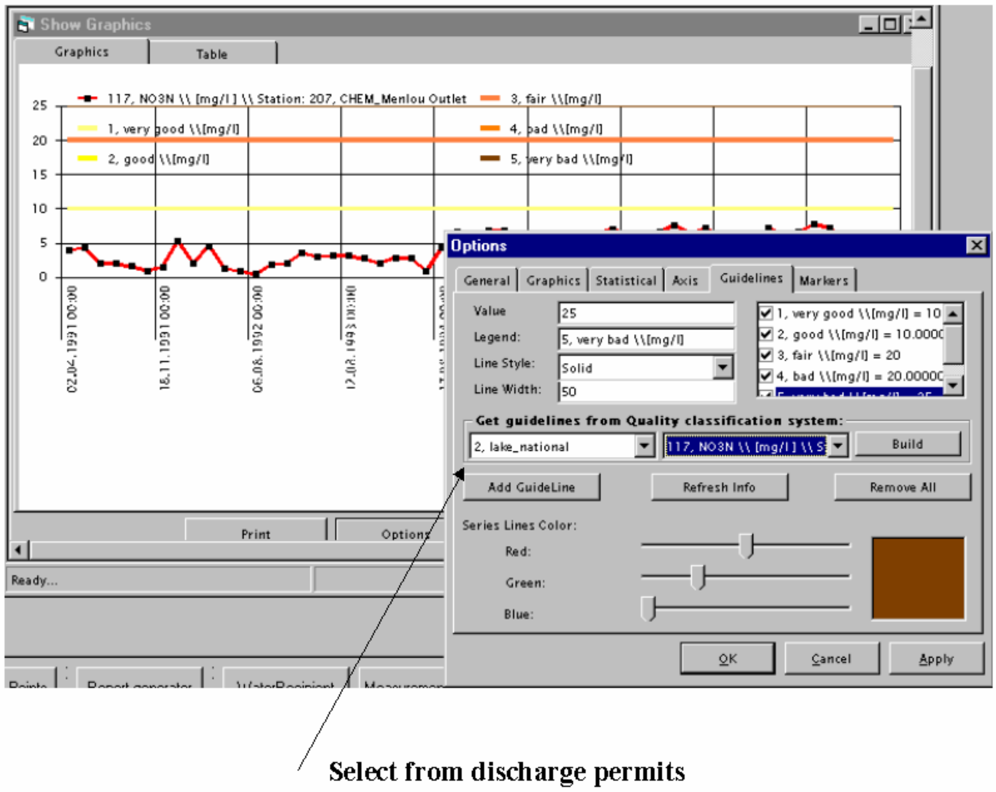
The dataseries definition shall be almost the same as described in the measurement module except the following changes need to be implemented:

- medium and measurement type shall be removed.
- The station identification is the name of the WWTP (the series are connected to the WWTP object). The data series referred to here shall only be available in the WWTP module and only for the selected WWTP. These series will not be available (visible) in the measurement module (the class might be the same?). The station combobox shall be disabled with the name of the WWTP.



Graphics

If the user chooses to show graphics, he shall be able to draw the discharge permits on the graph. (similar functionality as draw water quality limits on graph) Only component given in the discharge permit and only those component given on the graph will be available in the combobox (the figure below show the principle, but since the graph package shall be changed according to specification Measurement part 2 , the user interface might be completely different)

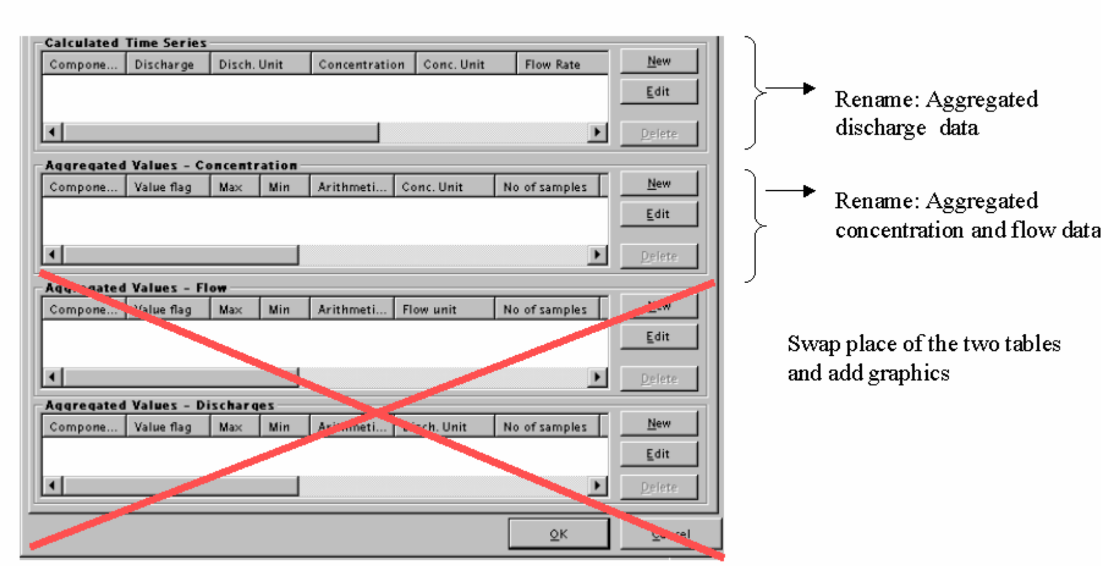


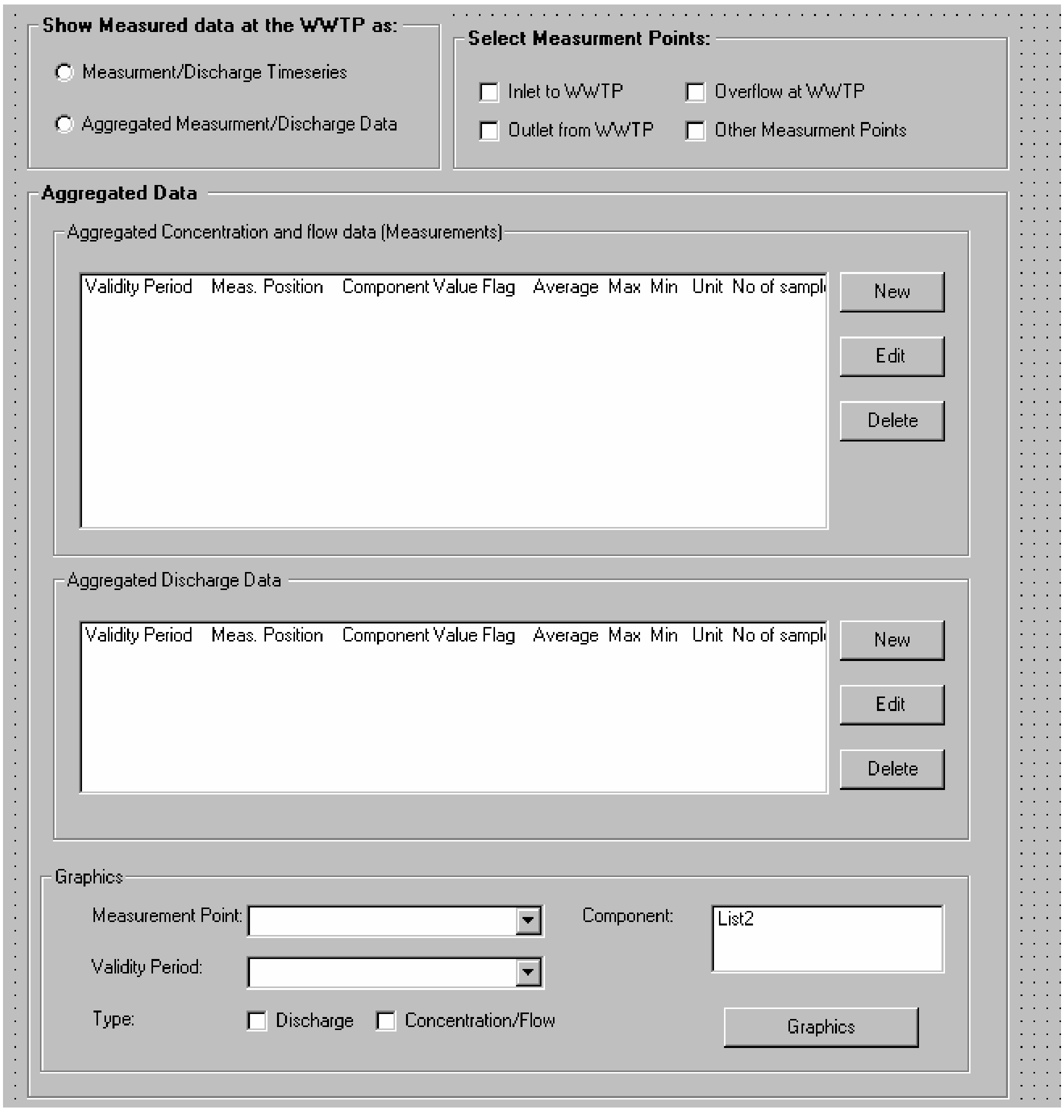
Select from discharge permits

For the concentration time series both the max concentration limit and the average concentration limit might be drawn for the selected component. The limits will be given in the same unit as the time series. If a discharge series are shown graphically (mass/time), the limit (if available) in mass/time will be drawn for the selected components. The limits will be read into the graph combobox from the discharge permit tab.

2.5.7.4 Measurements and Discharges Radiobutton "Aggregated Measurements/ Discharge Data"

The functionality on this tab is the same as the functionality in the current ENSIS 2.05 under the tabs Calculated time series (with some modifications.





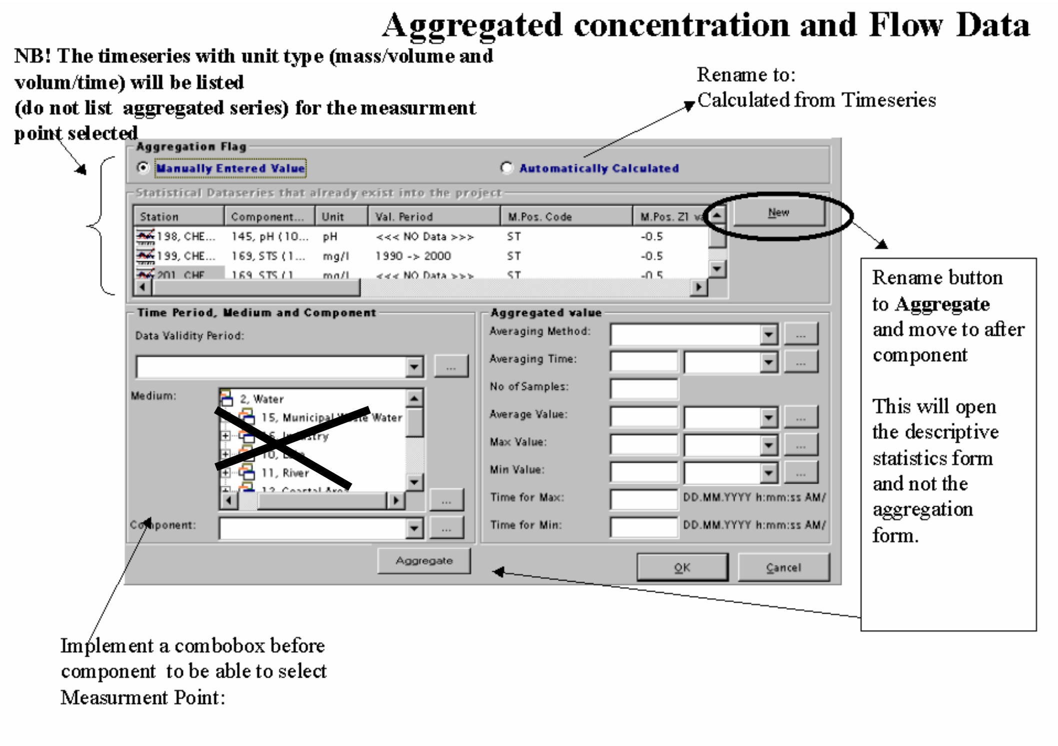
The content of the two list shall be as for the current "aggregated values concentration" (Validity Period Meas. Position Component Value Flag Average Max Min Unit No of samples etc) except for:

- validity period shall be listed first and thereafter Measurement position
- measurement position is a new item in the list, but it is the reference to the Measurement point at the WWTP (measurement position needs to be defined for each aggregated value)
- The value flag for the aggregated discharge data can hold tree flags (manual, aggregated data, Time series aggregation)

For the discharge data only the aggregated discharge data for each component and period shall be shown (units with unit type mass/time)

2.5.7.5 New aggregated concentration and flow data (measurments)

This will lead the user to the current ENSIS 2.05 application with the following changes.



The user select a timeserie and the Time period, medium component will be filled in except for the calculation period (time period).

The rest of the form is disabled.

After selecting the time period and pushing aggregate the user will be brought to the descriptive statistics form. If the user has not filled in the calculation period he need to do so by selecting the calculation period.
(the descriptive statistics form shall be changed according to the Measurement 2 specification)

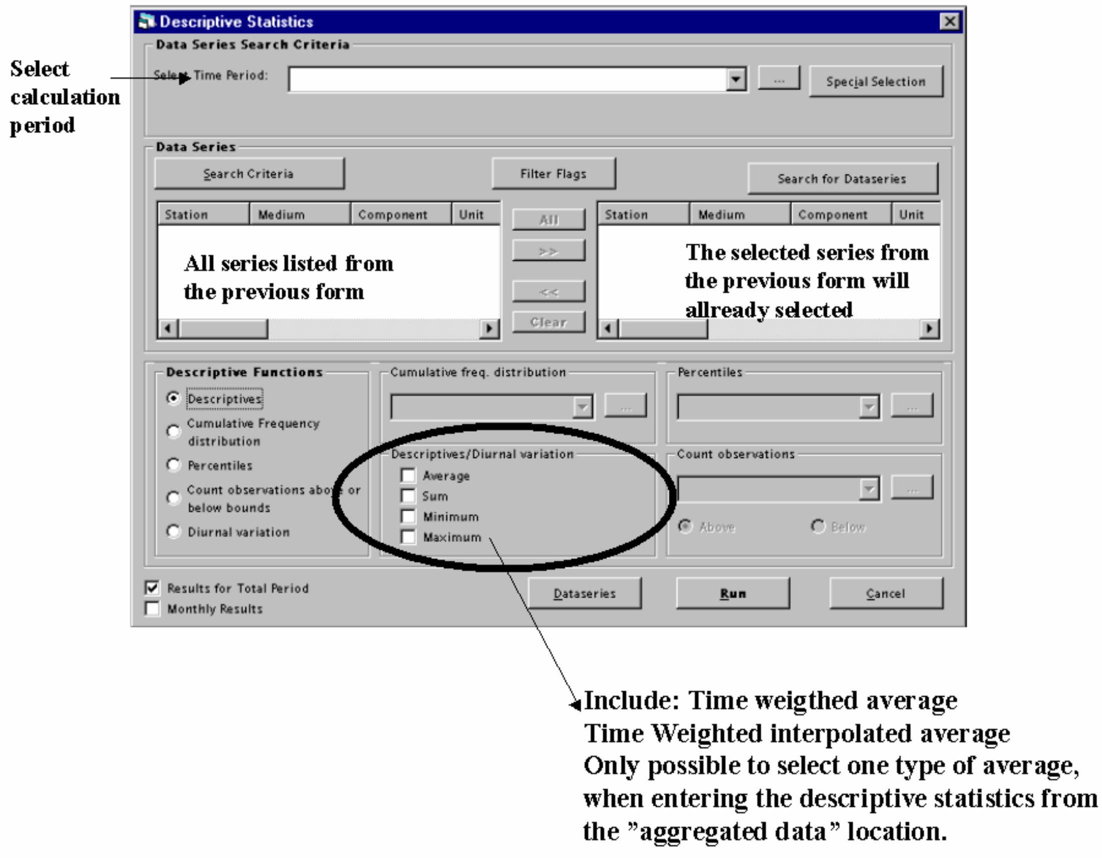
The user decide which aggregation function(s) he/she will like to use.
Max, min and time weighted average is chosen as default.

Only one type of average can be selected (Arithmetic, time weighted, timeweighted interpolated or mean). Which one that is defualt depends on the type of time series (see rules described in the measurement module).
The descriptive statistics form (in ENSIS 2.05) needs to be extended

with time weighted average, and time weighted interpolated average.

When the user push run and afterwards OK the values will be read into the form described above.

The user can choose to run the descriptive statistics for all series in one operation.Only the one selected from the previous TAB will be selected at the left hand side, but the user can select all and calcualte After the data are calculated the user may move to the main form and move from serie to serie and display the results to be saved to the list of aggregated values.



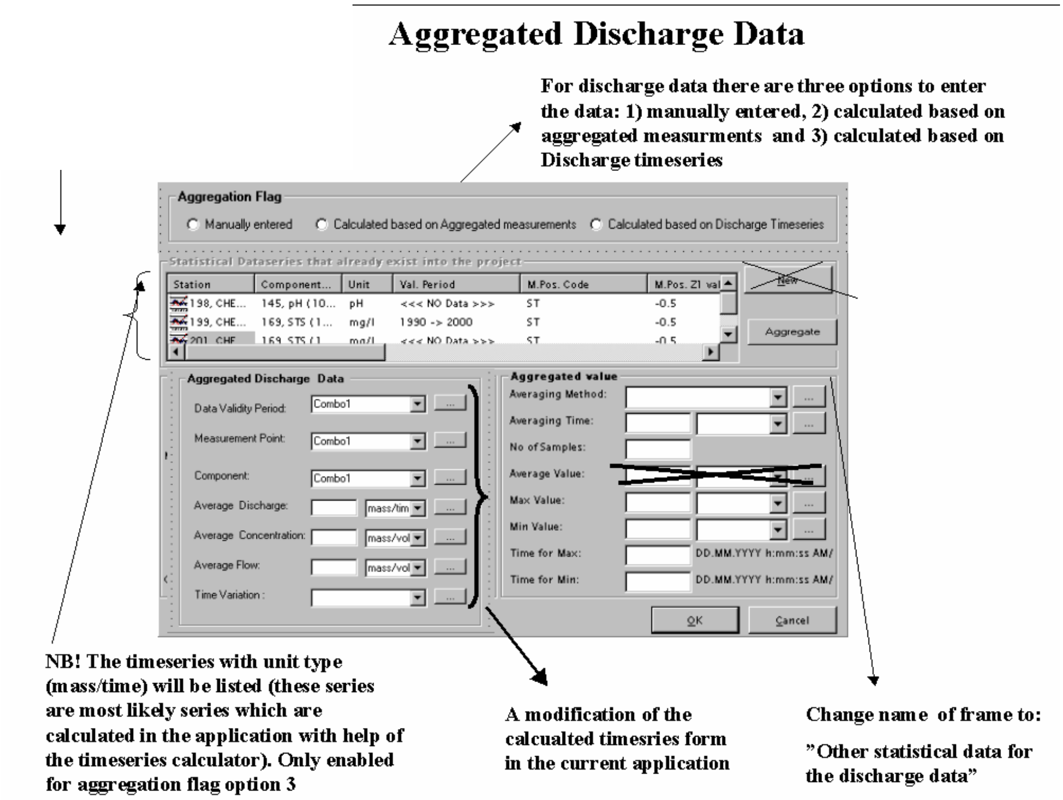
2.5.7.6 New aggregated discharge data

The new aggregated discharge data form is based on the description above and the ”calculated time series” form in the current ENSIS 2.05 application.

When the user enters aggregated discharge data he/she will not only have two options to calculate or enter the data , but 3 alternative options:

- Manually entered data
- Calculated based on the aggregated concentration and flow data
- Calculated from Discharge Time series

The list of time series will only be enabled when the third option is chosen, and the list will contain all series with unit type mass/time (including the calculated series with this unit type)



The frame “Aggregated Discharge data “ is a modification of the curren calculated time series form and contain the average discharge value. The link to measurment point is added. The aggregated value frame must change name to “Other statistical data for the discharge data” and the discharge value is moved to the aggregated discharge frame.

Manually entered

The user fill in all data manually. However there is as in the current application a control of that concentration*Average flow=Average Discharge .

Calculated based on aggregated measurement data

The user select a validity period, measurement point, and component. If the user has calculated concentration and flow data for this measurement point, component and validity period of the data will automatically be read into the concentration and flow field, and the average discharge value will be calculated automatically (concentration*flow). The user needs to enter information about time variation if he/she has any information.

Averaging time will be filled in automatically based on the data validity period.

Averaging method, number of samples, time for max and time for min will only be filled in automatically if these are the same for both concentration and flow. If time for max and time for min are the same also the max and min value will be calculated and filled in. Otherwise these additional data need to be filled in manually

Calulated based on Discharge Timeseries

This function exactly in the same manner as for concentration and flow data, except for the fact that the user select among time series for discharge (probably calculated time series).

All data are filled in automatically for the chosen calculation period (validity period) except for the time variation which need to be filled in manually.

NB the options of using calulation based on timeseries is for presentation and reporting purposes. If the user has measurement both for flow and concentration he/she will use these directly in the model calculations (see Model input TAB)

Graphics

In order to apply the graphics the user needs to:

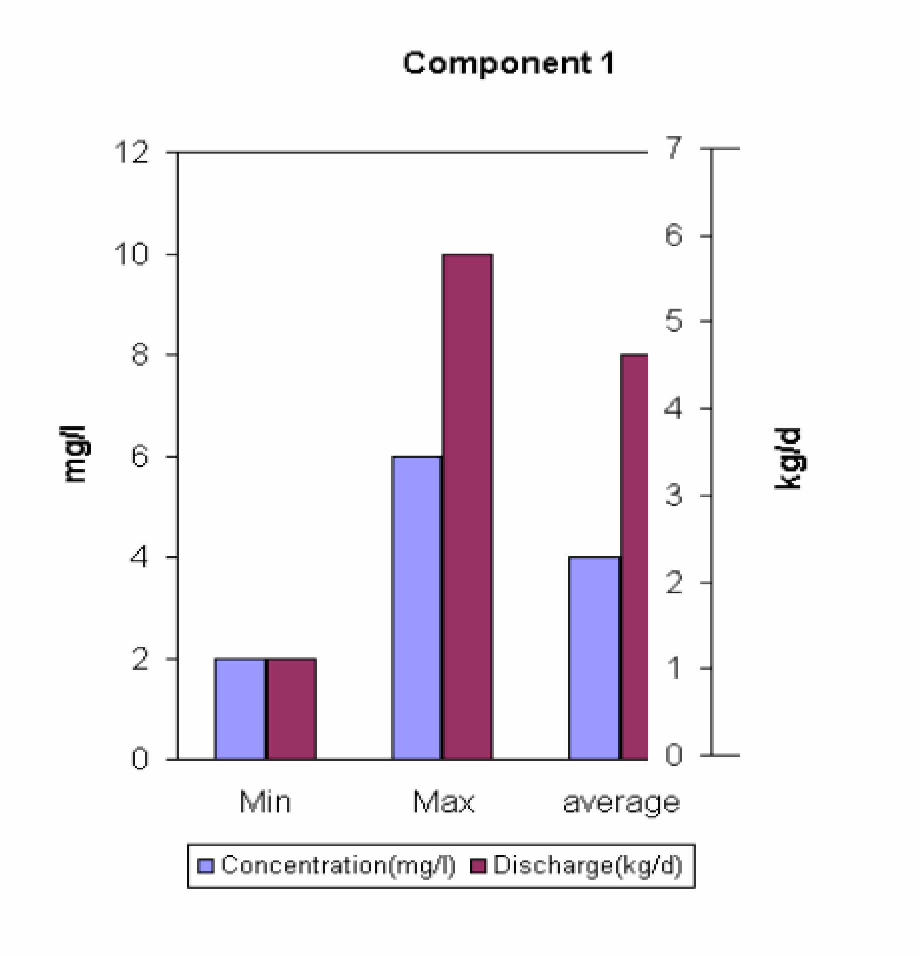
- Select measurement point (the available measurement point to graph will depend on the checks at the top of this form)
- Only validity periods for the selected measurement point(S) will be listed
- The user needs to check if he/she wants to display both discharge data and concentration /flow data. If both are selected concentration flow will be on the right y axis and discharge at the left y axis.
  The user need to select which component to be graphed from the check list. The components listed/available will be those which are valid for the measurement point and which have data in the selected validity period.

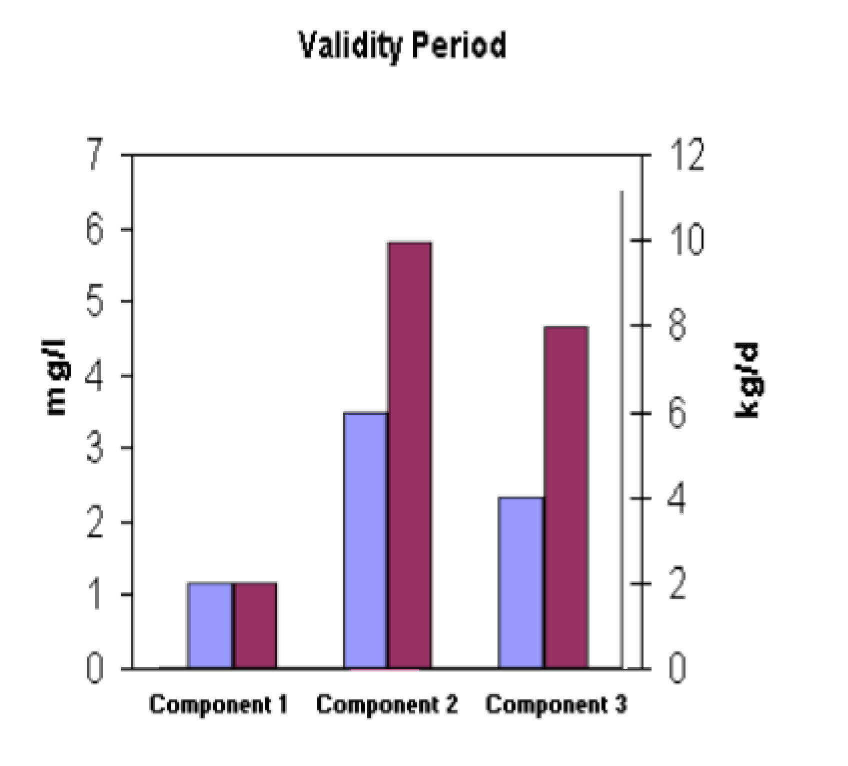
The graphics will lead the user to a bar diagram, where the values are graphed on the y axis and the component is listed on the x axis. If the user has selected only one component, the component is graphed with average, min, max for both the concentration and the discharge This type of graph result in 6 bars The user can turn of min, max or average (check list) in the graph.. If flow is selected as the component , there will be no equivalent discharge (3 bars only).

If several components have been selected maximum two bars are shown for each component (average concentration/flow and average discharge). Max and min is not available

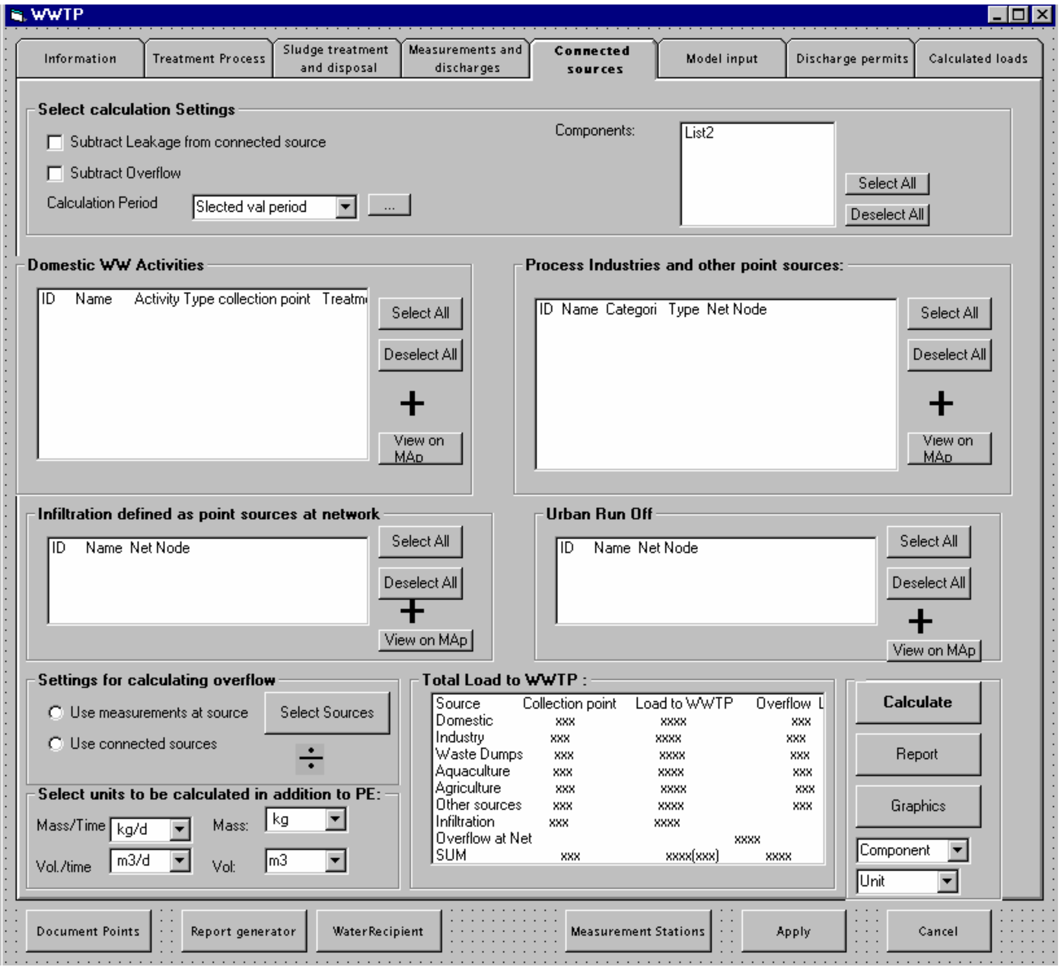
The user can graph the discharge permits together with the aggregated data, as described above.

It is not all components the discharge permits are valid for.


Component 1
mg/l
kg/d
12
10
8
6
4
2
0
7
6
5
4
3
2
1
0
Min
Max
average
Concentration(mg/l)
Discharge(kg/d)


Validity Period
mg/l
kg/d
7
6
5
4
3
2
1
0
12
10
8
6
4
2
0
Component 1
Component 2
Component 3

2.5.8 WWTP-TAB: CONNECTED SOURCES



General

The purpose of this Tab “connected Sources” is to give the user a possibility to calculate the load which comes into the WWTP. This information is of relevance for reporting purposes, but will also give the user an overview of how well the calculated data for inflow correspond to the measured value of inflow.

This will again give the user an idea of which data to be used for model calculation, or/and how discharge factors given for domestic WW activities, industry and other sources connected might need to get calibrated.

It shall be possible to save the calculated results to the database in order to use these numbers in the calculation of discharges from the WWTP in the case when the user does not have representative measurements at the WWTP (see tab input to model)

The idea of saving the numbers to the database is to reduce the complexity of pollution budget model (and thereby also the calculation errors of the model). It shall not be necessary to loop through all connected sources when running this for a WWTP, and also the user have the possibility to filter out data which he/she does not believe is representative for the calculation of load from the WWTP.

The data for each linked source are calculated based on the calculation routines for the pollution load model. The priority of which data to be used in model calculations for each of the connected sources are given on these sources..

It is not possible to create new linked sources from this entry of the application. If the user wants to link more sources to the WWTP (through netnode). The user needs to go to the respective modules.

However, if the user double click on one item in the lists of linked sources the user will be brought to the respective modul and item. In this manner the user can edit or add information on the connected source.

The information/calculation given on this TAB is also used on TAB ”Treatment processes” in the case when the user wants to calculate/update the last PE connected to the WWTP.

If the user choses to include overflow at network in the calculations (meaning subtracting this from the linked sources), he/she has to determine if he/she wants to use:

1) General overflow figures in % given for each connected source
2) Overflow figures given from measurment at network (separate point source)

The user shall have the possibility to use both type of calculations and save both results to the database..

Select calculations settings

The quality of data to base the calculation on might vary, especially data for leakage and overflow. The user therefore needs to determine if leakage data and overflow data shall be subtracted from the sources connected to the WWTP. By default these two check boxes will be checked.

Thereafter the user selects a calculation period to calculate the data for and the components. The user might do this type of calculation each year. If the user has performed calculation before and saved these data to the database the calculation periods saved will be available from the combo box and the user may view these Results (both for the overflow calculated from connected sources and overflow calculated for measurements at source if he/she has calculated both option, see below)

NB the user may also perform calculations without saving them to the database.

Usually the user wants to calculate all sources connected. This is the default (all sources are checked). If this is the case, the user proceed to additional settings.

If this is not the case (because the user might have some detailed knowledge) the user selects from the list of:

- Domestic WW activities
- Process Industry and other point sources
- Infiltration defined as point sources at network and
- Urban run off

(the user might also not want to select all in order to evaluate the effect of some particular sources)

The user select by the functionality select all(and deselect some) or deselect all (and select only some). As mentioned select all is default.

Domestic WW activities

These are the domestic activities defined in the treatment area module and which are connected to the WWTP through the net node. The activities are listed by.

ID, name, alternative, activity type, collection point, treatment area, and parent treatment area

The view on map will show all collection points of the activities and the treatment area (at the lowest level) these activities belongs to

Process industry and other point sources

These are point sources linked to the domestic waste water network which has some sort of process water which are not characterised as domestic waste water.

All sources shall be listed by ID, name, alternative, categori, type, collection point (=net node), treatment area and parent treatment area.

Process Industry:
The industry sources are defined in the industry module and shall be listed by:

ID, Name, Categori(=Process Industry) Type(= Industry Type), net node etc
One industry will be listed several times if it discharge to two or several net nodes, and these net nodes are connected to the WWTP.

The other point sources shall be listed by ;
Id Name Categori (Pollution Type, i.e Agriculture, aquaculture, waste dumps, user defined) Type (=source type), etc

Overflow and infiltration are listed in separate tables, and overflow as separate source is only included if the user decide to do so (see below)

The view on map will show all sources (and the area they are assigned to if any) and the net nodes of the sources. Right mouse button in the map will give the discharge pipes.

Infiltration
The infiltration is pr definition defined as a point source, and is only listed by ID, name and net node. The view on map will show the infiltration point the infiltration is assigned to.

Urban Run Off
The urban run off will be listed by ID, name and net node

The view on map will show all sources (area) and the net nodes of the sources. Right mouse button in the map will give the discharge pipes.

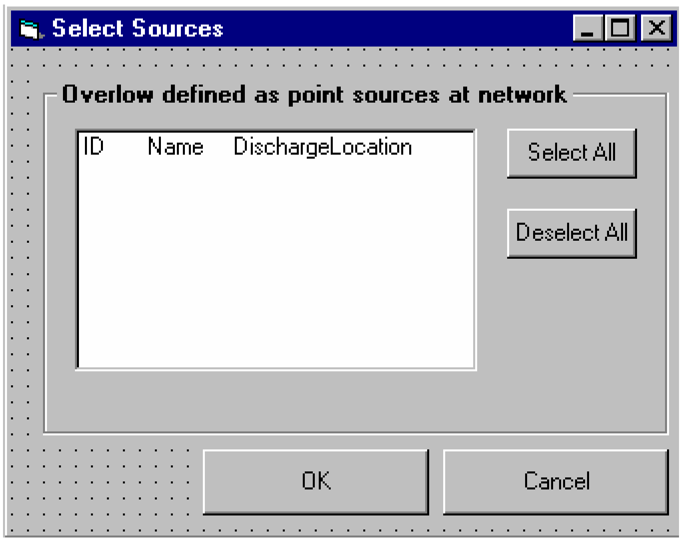
How to calculate overflow?
Overflow may defined as general numbers on each sources where one anticipate that a certain percentage of the source will go in overflow. However there might exist measurements or other detailed information on all overflows. In this case it might be better to use this source of information, and register the source as a separate point source. The overflow figure as well as the leakage figures represents loss figures and not load figures, and needs to be subtracted form the loads which enter the network

The most important issue before proceeding is therefore to decide how to calculate the losses due to overflow at network (subtract from the load from the connected sources) If the user has decided to not include overflow the results on the two tabs will be the same.

As mention above the user may calculate and save both options.

<u>Option 1 Overflow are calcualted based on measurements at source</u>

The button for selecting the overflow sources will be enabled



The user can select/deselect as described for the other connected sources. The source is listed by ID, name, discharge location (=recipient) and treatment area.

The user may also view the overflow sources at the map. The net node and the local recipient will be shown. If the user uses the right mouse button at the map he /she will also see the discharge pipe for the overflow.

Selects units to be calculated in addition to PE

The units selected are only for presentation. In addition it will be possible to present the results as PE. The load will always be calculated as Mass/time and Volume/time and saved to the database as Mass/Time and volume/time. The default presentation units are shown in the form.

Results from selected combination
(option 1 for overflow, measurement at source)

All selected components are calculated, but the user can choose to present one by one. Each component may be presented with different units. The concentration components (those who are calculated to mass/time), may be shown with the default unit selected for mass/time, i.e kg/d, mass (i.e kg) or PE. The calculated numbers are referring to the whole validity period (for this tab it is not possible to select timestep for the calculation) The flow component (defined with unit volume/time) may be shown with units volume/time, PE, and volume for the selected default units and validity period.

The following figures are calculated () :

Source Category	Load to net Net Node, A	Load to WWTP B	Overflow C	Leakage (if included) D
Domestic	A	A-D		D
Industry	A	A-D		D
Waste Dumps	A	A-D		D
Aquaculture	A	A-D		D
Agriculture	A	A-D		D
Infiltration	A	A-D		D
Other point sources	A	A-D		D
Overflow at net			C	
SUM	Sum A	SumA-C-SUMD And (SUM(A-D)	C	SUM D

This means that the load to WWTP for each source category only represents load to collection point –leakage[21]. The total loss of load through overflow is only subtracted from the total load figures(sum load to WWTP= sum load to net node -sum overflow-sum leakage), and sum of load to the WWTP from the sources are therefore in this case different form sum of load to the WWTP calculated from the sum figures.

The sum of load to WWTP calculated from each source category is written in parentheses.

[21] If leakage has been included

Graphics
For each calculated component the user may have access to a set of figures these are listed below.

Load figures (based on overflow as a seaparate source) :

1. One bar graph showing 4 bars (Sum Load to net node, sum Load to WWTP, sum overflow, and sum leakage)
2. One pie diagram showing the load to WWTP contribution from the different sources based on losses from leakage only (load domestic, load Industry, load other sources). The load other sources shall again be splitted up in a new pie showing (load waste dumps, load aquaculture load agriculture, load other sources, load infiltration)

For all figures it must be possible to switch on and of legends and labels (standard graph possibilities)

Results from selected combination
Option 2 Overflow are calculated based on connected source

The tab will be exactly the same as tab 2, but the user does not have to select overflow sources. The result table will be sligthly different as explained

The following figures are calculated:

Source Category	Load to net Net Node, A	Load to WWTP B	Overflow C	Leakage (if included) D
Domestic	A	A-D	C	D
Industry	A	A-D	C	D
Waste Dumps	A	A-D	C	D
Aquaculture	A	A-D	C	D
Agriculture	A	A-D	C	D
Infiltration	A	A-D	C	D
Other point sources	A	A-D	C	D
Overflow at net				
SUM	SUM A	SUMA-SUMC-SUMD	SUM C	SUM D

Graphics
For each calculated component the user may have access to a set of figures these are listed below.

Load figures (based on general figures for overflow)

3. One bar graph showing 4 bars (Sum Load to collection point, sum net Load to WWTP, sum overflow, and sum leakage)
4. One pie diagram showing the net load contribution from the different sources(net load domestic, net load Industry, net load other sources). The net load other sources shall again be splitted up in a new pie showing (net load waste dumps, net load aquaculture net load agriculture, net load other sources, net load infiltration)

Report all components

This report will be very similar to the one described under treament area.
There will be one report based on calculation from general overflow figures and One for calculation based on overflow as a separate source. The figure below shows an example based on general overflow figures. The other will be the same except an extra sub table for overflow at the end and no numbers filled in for overflow at each source.

Total Load figures (general figures from overflow)
Validity Period:

Domestic				Production of pollution				Netto Load to WWTP			Reduction - Treatment at				Reduction - Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Name	Activity Type	Collection Point	Treatment area	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
							1.7(g/pd)																
SUM	#####	######	######	sum	sur	sur	#####	sum	sum	sum	sum	sum	sum	##	sum	sum	sum	###	sum	sum	sum	###	######################

Industry				Production of pollution				Netto Load to WWTP			Reduction - Treatment at				Reduction -Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Name	Type	Collection Point	Treatment area	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
							1.7(g/pd)																
SUM	#####	######	######	sum	sur	sur	#####	sum	sum	sum	sum	sum	sum	##	sum	sum	sum	###	sum	sum	sum	###	######################

Waste Dumps				Production of pollution				Netto Load to WWTP			Reduction - Treatment at				Reduction -Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Name	Type	Collection Point	Treatment area	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
							1.7(g/pd)																
SUM	#####	######	######	sum	sur	sur	#####	sum	sum	sum	sum	sum	sum	##	sum	sum	sum	###	sum	sum	sum	###	######################

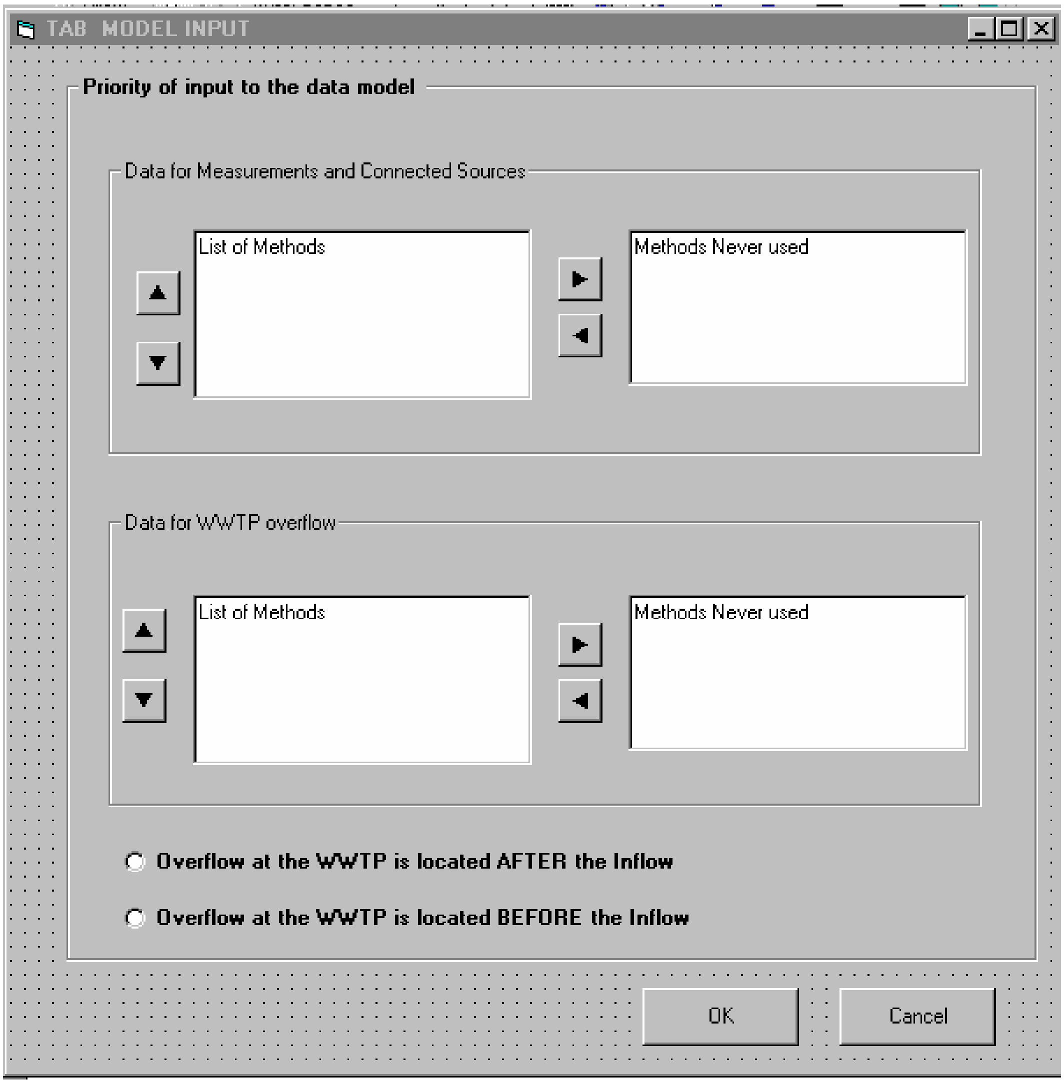
Aquaculture				Production of pollution				Netto Load to WWTP			Reduction - Treatment at				Reduction -Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Name	Type	Collection Point	Treatment area	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
							1.7(g/pd)																
SUM	#####	######	######	sum	sur	sur	#####	sum	sum	sum	sum	sum	sum	##	sum	sum	sum	###	sum	sum	sum	###	######################

Agriculture				Production of pollution				Netto Load to WWTP			Reduction - Treatment at				Reduction -Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Name	Type	Collection Point	Treatment area	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
							1.7(g/pd)																
SUM	xxxxx	xxxxxx	xxxxxx	sum	sur	sur	xxxxx	sum	sum	sum	sum	sum	sum	xx	sum	sum	sum	xxx	sum	sum	sum	xxx	xxxxxxxxxxxxxxxxxxxxxx

Other sources				Production of pollution				Netto Load to WWTP			Reduction - Treatment at				Reduction -Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Name	Type	Collection Point	Treatment area	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
							1.7(g/pd)																
SUM	xxxxx	xxxxxx	xxxxxx	sum	sur	sur	xxxxx	sum	sum	sum	sum	sum	sum	xx	sum	sum	sum	xxx	sum	sum	sum	xxx	xxxxxxxxxxxxxxxxxxxxxx

Infiltration				Production of pollution				Netto Load to WWTP			Reduction - Treatment at				Reduction -Leakage				Reduction - Overflow				Recipients receiving leakage and overflow
Name	Type	Collection Point	Treatment area	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%	kg/d	kg	PE	%	
							1.7(g/pd)																
SUM	xxxxx	xxxxxx	xxxxxx	sum	sur	sur	xxxxx	sum	sum	sum	sum	sum	sum	xx	sum	sum	sum	xxx	sum	sum	sum	xxx	xxxxxxxxxxxxxxxxxxxxxx
SUM TOTAL	xxxxx	xxxxxx	xxxxxx	sum	sur	sur	xxxxx	sum	sum	sum	sum	sum	sum	xx	sum	sum	sum	xxx	sum	sum	sum	xxx	xxxxxxxxxxxxxxxxxxxxxx

2.5.9 WWTP-TAB: MODEL INPUT



This is the TAB where the user defines which data that shall be used in the calculation of discharges from the plant (water pollution budget model). The idea of this is similar to the one already implemented on the water industry.

The arrows if for prioritising among methods and for excluding methods.

This functionality needs to be implemented for each source in order to select the most appropriate methods according to which data the user have or not have.

I.e the user might have measurement data on the wwtp, and will in this case probably use the measurements in the calculations. In case
When the user lacks measurement data he/she will probably use information about connected sources or connected PE together with treatment efficiencies to calculate the discharges.

The following list is a list of all methods, or ways to enter data, related to the discharge data of a WWTP. The list also gives the default order of priority. By default, all these methods shall be listed in the list to the left. The calculation routine itself is explained later.

1. Discharge Timeseries at outlet
2. Discharge time series at inlet
3. Aggregated Discharge data at outlet
4. Aggregated Discharge data at inlet
5. Load from connected sources (based on measured overflow)
6. Load from connected sources (based on general overflow data)
7. Load based on last PE connection registration

Data on WWTP overflow: Overflow related to the WWTP is registered as a measurement point at the WWTP (see tab measurements). Data on these sources can be present in different ways (timeseries or aggregated data). The user shall be able to prioritise the data from these sources. The following list is a list of all methods, or ways to enter data, related to the discharge data of a WWTP overflow. The list also gives the default order of priority. By default, all these methods shall be listed in the list to the left. The calculation routine itself is explained later.

1. Discharge Time Series at **outlet**
2. Aggregated Discharge data at **outlet**

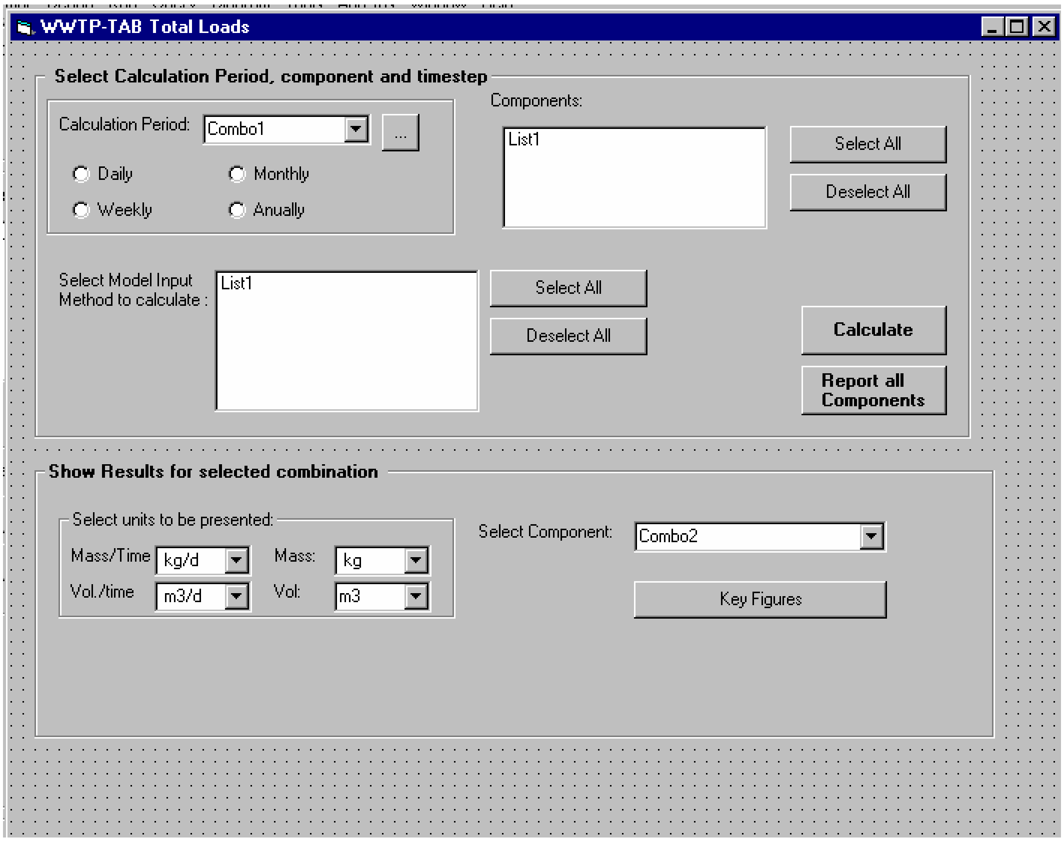
In addition to define the priority of the input data to the model, the user also needs to define where the overflow discharge point is located compared to the inflow to the WWTP. This is required in order for the model to calculate the necessary load figures (see explanation on the TAB calculation of load)

The two options the user can chose between are:

1. "Overflow at the WWTP is located <u>after</u> the Inflow" or
2. "Overflow at the WWTP is located <u>before</u> the Inflow"

The model always function in the manner that if no data are found for a particular time step for method 1, the model search on method 2, method 3 and so on.

2.5.10 WWTP_TAB Total Loads



This tab is for reporting purpose only, and to compare results from the different calculation methods. However the pollution load model uses the same approach.

The user has access to calculate discharges Mass/time and flow data Volume /time.

The result tables will be depend on if the user has checked the radio button “Overflow at the WWTP is located after the Inflow” or “Overflow at the WWTP is located before the Inflow”. Which of the two cases that are applicable for the WWTP in question is defined at the model input TAB.

The equations for the two alternatives are described below. If the WWTP is a direct discharge the interface will be the same but there will be no reduction of load due to treatment.

None of the results are saved to the database

Select calculation period, time step, model input methods and components ca

The user selects the period he wants to calculate the result for. This may be any period. The user also need to give the timestep to calculate and present the results.

Even though the user has set a prority of which method to use for model calculations, the user may when it comes to calculations for a source, compare the result based on different approaches. The user select one or several of the methods he /she want to use . The one prioritised will be in bold[22].

1) Discharge Timeseries at outlet
2) Discharge time series at inlet
3) Aggregated Discharge data at outlet
4) Aggregated Discharge data at inlet
5) Load from connected sources (based on measured overflow)
6) Load from connected sources (based on general overflow data)
7) Load based on last PE connection registration

By default all are selected. If the user deselect some of the methods these results will not be calculated and the key results tables (accessed by the key figures button) will not be available (the frames for these methods will be blank with NA (Not available)).

The user also select which component(s) that should be calculated.

When the user push calculate all selected components for all selected calculation methods will be calculated.

The equations for calculation are described below. The model functions as elsewhere if no data are found on timestep 1 for priority method 1, the model goes to method 2 and so on[23]. The model also use interpoaltion and extrapolation routines as described elsewhere in the application.

In the case of method 5 and 6 the model uses the calculated results on TAB Connected sources and does not go to the source of the data. In the case of method 7 the user goes to the treatment process TAB to get the input .

[22] Maybe it is not necessary to present the different priorities in the same report. Alternatively the user may change the prioritisation and re-run.
[23] I.e for instance if the user calculates by the method “aggregated discharge data at outlet” and does not find data , the system will search for data according to the prioritized list given at the model input TAB.

Calculation of figures for alternative (overflow at WWTP is located after inflow)

Equations are valid for the model input alternatives: **1) Discharge Timeseries at outlet (method 1)** **2) Aggregated Discharge data at outlet (method 3)**			Equation
Load to WWTP	A	Calculated by model	A=B+C
Overflow at WWTreatment	B	Model Input	
Load to Treatment	C		C=D+E
Treatment at WWTP	D	Calculated by model	D=E/(1-Treffi/100)
Load from WWTP	E	Model Input	
Local Losses	F	Calculated by model	F=E(1-Loss%/100)
Load to WWTP recipient	G	Calculated by model	G=E-F+B

Trefficiency = 0-100% and is read from the list of treatment efficiency for the given timestep , Local losses are given as % at the discharge pipe for the WWTP.

Equations are valid for the model input alternatives: **1) Discharge timeseries at inlet (method 2)** **2) Aggregated discharge data at inlet (method 4)** **3) Connected sources-overflow figures from net (method 5)** **4) Connected sources-overflow figures as general figures(method 6** 5) **Connected sources-based on last updated PE regsitration(method 7***			Equation
Load to WWTP	A	Model Input	
Overflow at WWTreatment	B	Model Input	
Load to Treatment	C		C=A-B
Treatment at WWTP	D	Calculated by model	D=C*(1-Treffi/100)
Load from WWTP	E	Calculated by model	E=C-D
Local Losses	F	Calculated by model	F=E(1-sumLoss/100)
Load to WWTP recipient	G	Calculated by model	G=E-F+B

* Method 7 has input in PE, PE is transformed to Mass/time by the Default Domestic Pollution production factors

Calculation of figures for alternative (overflow at WWTP is located **before** inflow)

Equations are valid for the model input alternatives: 1) Discharge Timeseries at outlet (method 1) 2) Aggregated Discharge data at outlet (method 3)			Equation
Load to WWTP	A	Calculated by model	A=B+C
Overflow at WWTreatment	B	Model Input	
Load to Treatment	C		C=D+E
Treatment at WWTP	D	Calculated by model	D=E/(1-Treffi/100)
Load from WWTP	E	Model Input	
Local Losses	F	Calculated by model	F=E(1-sumLoss/100)
Load to WWTP recipient	G	Calculated by model	G=E-F+B

Trefficiency = 0-100%, Sum loss=losses given as % at the discharge pipe.

1) Discharge timeseries at inlet (method 2) 2) Aggregated discharge data at inlet (method 4)			Equation
Load to WWTP	A	Calculated by model	A=B+C
Overflow at WWTreatment	B	Model Input	
Load to Treatment	C	Model Input	
Treatment at WWTP	D	Calculated by model	D=C*(1-Treffi/100)
Load from WWTP	E	Calculated by model	E=C-D
Local Losses	F	Calculated by model	F=E(1-sumLoss/100)
Load to WWTP recipient	G	Calculated by model	G=E-F+B

Equations are valid for the model input alternatives: **1) Connected sources-overflow figures from net (method 5)** **2) Connected sources-overflow figures as general figures(method 6** 3)**Connected sources-based on last updated PE egsitration(method 7***			Equation
Load to WWTP *	A	Model Input	
Overflow at WWTreatment*	B	Model Input	
Load to Treatment	C		C=A-B
Treatment at WWTP	D	Calculated by model	D=C*(1-Treffi/100)
Load from WWTP	E	Calculated by model	E=C-D
Local Losses	F	Calculated by model	F=E(1-sumLoss/100)
Load to WWTP recipient	G	Calculated by model	G=E-F+B

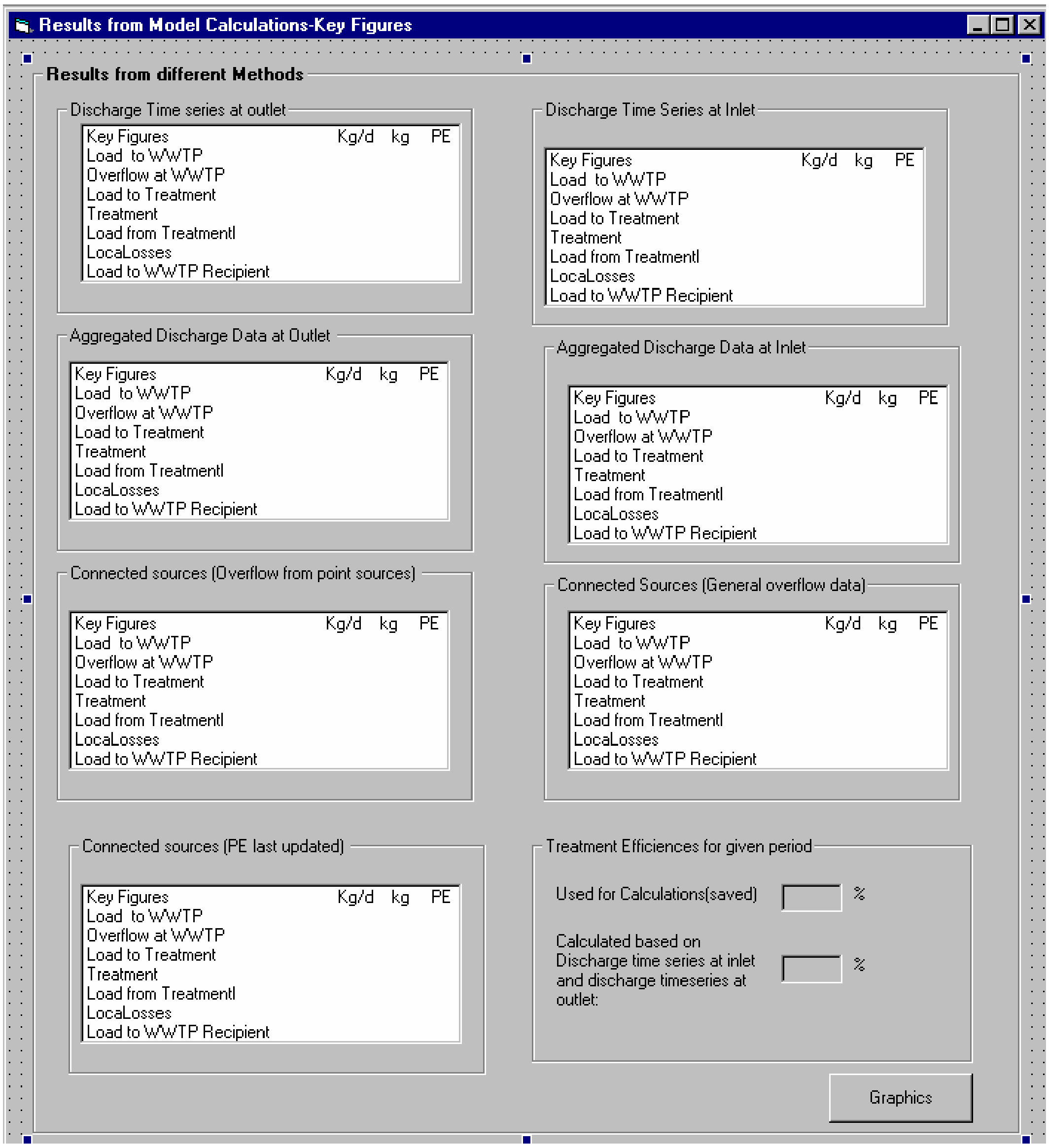
Show results for selected combination

The user may report all components (see table below) or choose to present key figures for each component.

In any case the user needs to select units for presentation as described elsewhere in the application. The default units are shown in the table.

The discharge components (those which are defined with unit mass/time), will be shown with the unit kg/d, kg and PE. The calculated numbers are referring to the whole calculation period. The flow component (defined with unit volume/time) will be shown with units PE, m3/s or m3.

<Key Figures>



If the user enter the key figure form he/she will come to the following form where the key results calculated for the selected component with the valid units.

In addition to the key figures for each method the average treatment efficiency for the calculation method is calculated. This is a check based on two different methods

1) The treatment efficiencies saved at the WW treatment process TAB and which is used in the calculations above, and
2) the one which is calculated form the equation (Discharge Timeseries at inlet-Discharge Timeseries at outlet/Discharge timeseries at inlet)*100 using the calculation period and time weigthed interpolated average (?).

If these two figures varies it indicates that the user has not updated the treatment efficiencies on TAB treament processes with the discharge data which is available in the database.

<Graphics>

Graphs representing the whole calculation period

The key figures calculated above represents the whole calculation period, and may be presented as:

- One bar graph showing the load to WWTP recipient . Each bar represent a model method.
- One pie diagram for each model method showing the different key figures: Load to WWTP, Overflow, Load to Treatment, Treatment, Load from WWTP, Local Losses, Load to WWTP recipient.

Time series graph graph
The user shall also be able to get a time series graph which shows the total load to WWTP recipients for each time step using the prioritised calculation method.

If the user chooses to do so both the calculated discharge data and the calculated flow data may be shown together. This graph will read the values form the table below.

The user may also present these numbers with the real measurements of flow and concentration, in addition to the discharge timeseries saved on TAB Measurement and discharges.

Report all components and timesteps

The report all component option will give one table for each component and each method. The time step (time period will be shown to the left.

The units in the table will depend on what the user has set on the presentation settings.

Since the model uses the method which is availabe with data on each time step (in the case when the prioritised method does not have data) also the method used for each timestep will be given as information.

Also the figure Mass/(Time*100PE)will be available in the figure.

Total Load figures

Method 1(calculation period xxxxxx, Timestep xxxxxx)

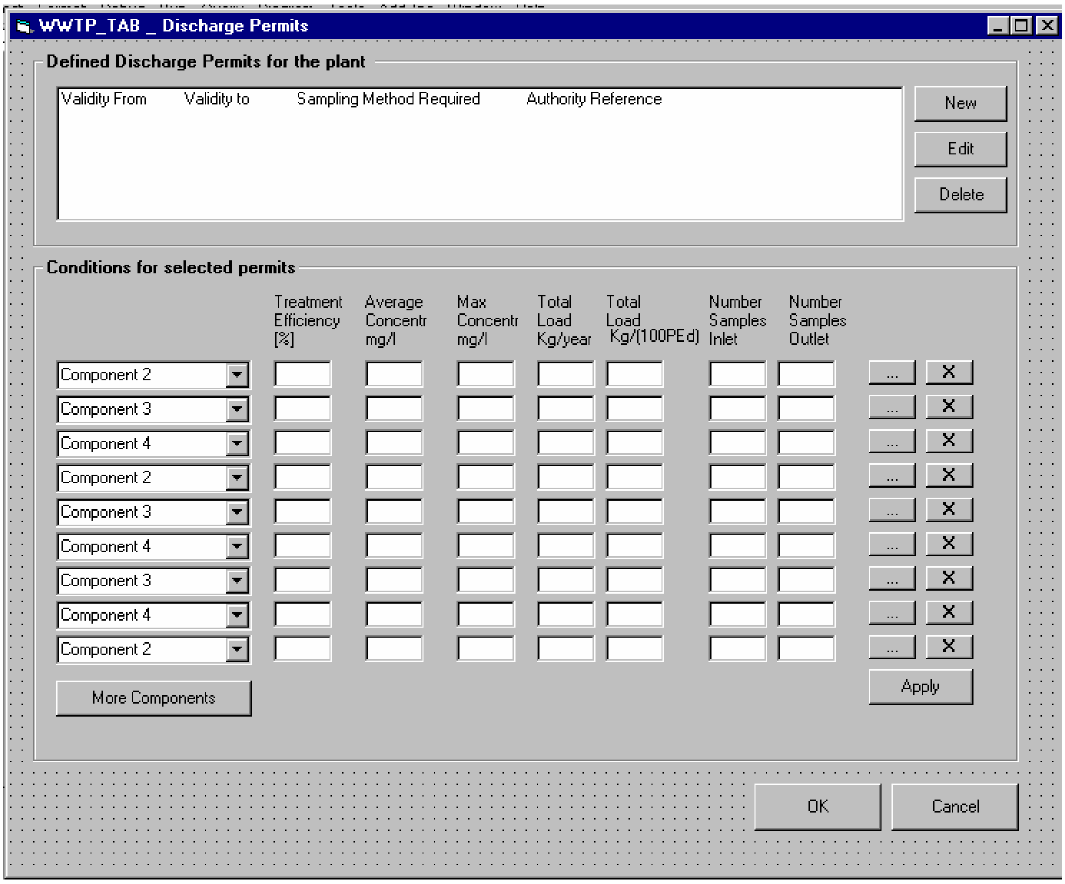
Component 1	**Load to WWTP**				**Load to WWTP Recipient**				**Overflow at WWTP**			**Load to treatment**			**Treatment**				**Local Losses**				**Recipients receiving leakage and overflow**	**Calculation Method Used**
Timeperiod	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/(d 100 P	kg/d	kg	PE	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%		
				1.7(g/pd)																				
SUM	**sum**	**sur**	**sur**	**xxxxx**					**sum**	**sum**	**sum**				**sum**	**sum**	**sum**	**xx**	**sum**	**sum**	**sum**	**xxx**	xxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxx

Component2	**Load to WWTP**				**Load to WWTP Recipient**				**Overflow at WWTP**			**Load to treatment**			**Treatment**				**Local Losses**				**Recipients receiving leakage and overflow**	**Calculation Method Used**
Timeperiod	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/(d 100 P	kg/d	kg	PE	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%		
SUM	**sum**	**sur**	**sur**	**xxxxx**					**sum**	**sum**	**sum**				**sum**	**sum**	**sum**	**xx**	**sum**	**sum**	**sum**	**xxx**	xxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxx

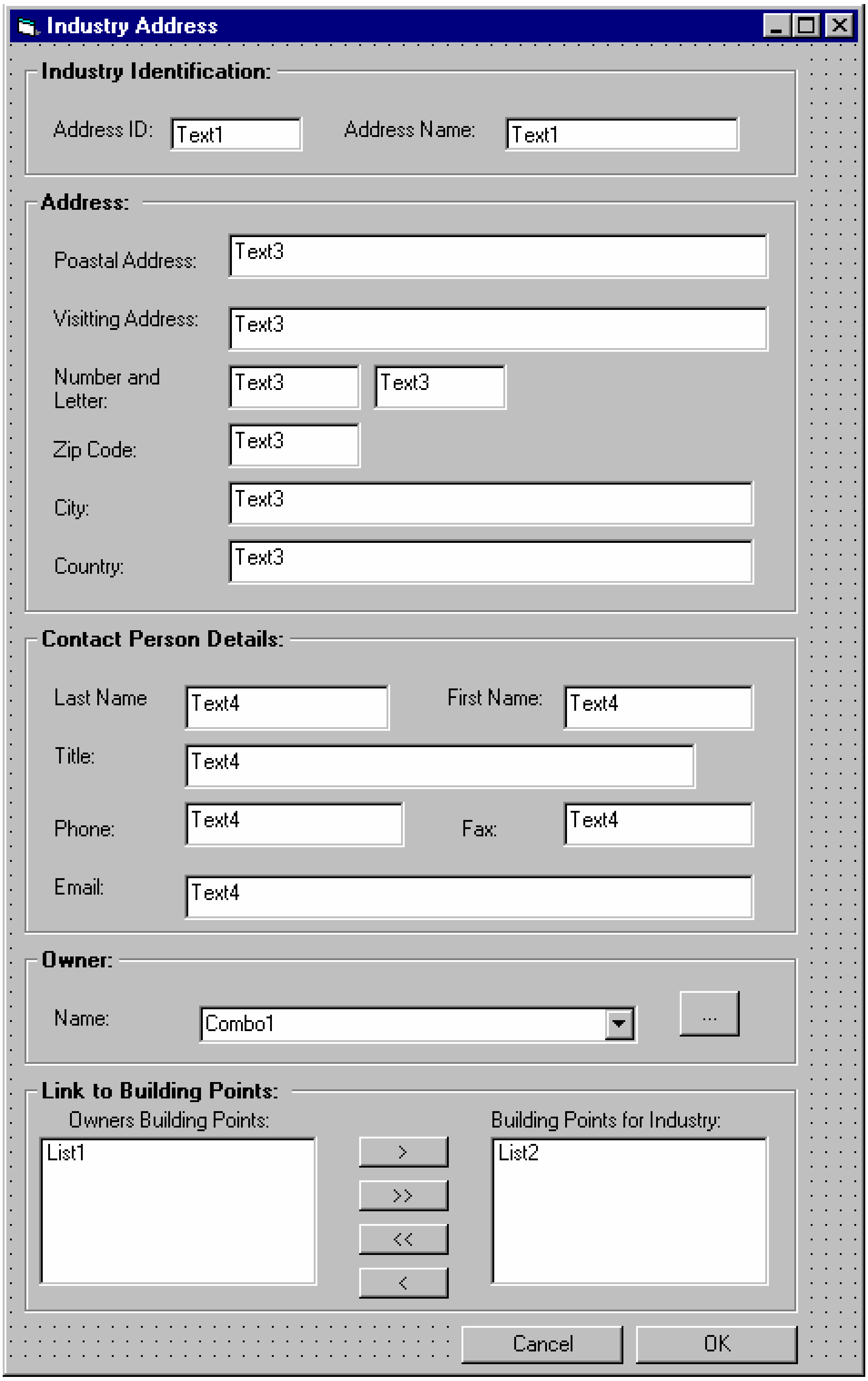
Component3	**Load to WWTP**				**Load to WWTP Recipient**				**Overflow at WWTP**			**Load to treatment**			**Treatment**				**Local Losses**				**Recipients receiving leakage and overflow**	**Calculation Method Used**
Timeperiod	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/(d 100 P	kg/d	kg	PE	kg/d	kg	PE	kg/d	kg	PE	%	kg/d	kg	PE	%		
SUM	**sum**	**sur**	**sur**	**xxxxx**					**sum**	**sum**	**sum**				**sum**	**sum**	**sum**	**xx**	**sum**	**sum**	**sum**	**xxx**	xxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxx

Component 4	**Load to WWTP**				**Load to WWTP Recipient**				**Overflow at WWTP**			**Load to treatment**			**Treatment**				**Local Losses**				**Recipients receiving leakage and overflow**	**Calculation Method Used**
Timeperiod	kg/d	kg	PE	Factor	kg/d	kg	PE	kg/(d 100 P	m3/d	m3	PE	m3/d	m3	PE	m3/d	m3	PE	%	m3/d	m3	PE	%		
SUM	**sum**	**sur**	**sur**	**xxxxx**					**sum**	**sum**	**sum**				**sum**	**sum**	**sum**	**xx**	**sum**	**sum**	**sum**	**xxx**	xxxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxxxxxx

2.5.11 WWTP-TAB: DISCHARGE PERMIT



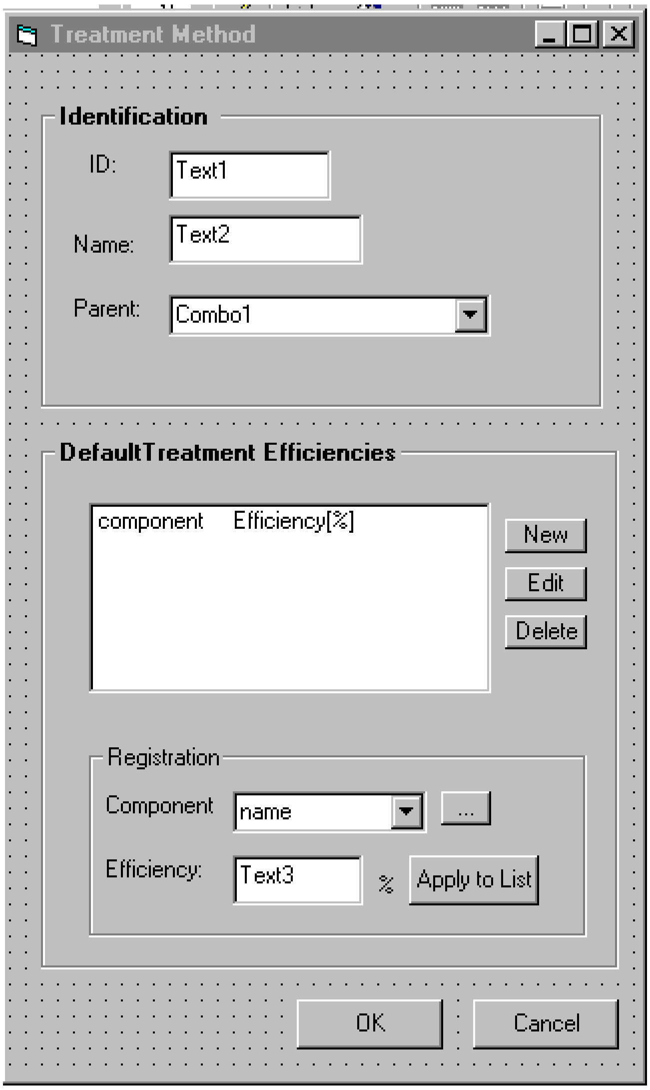
2.5.12 WWTP_Address



The WWTP address form shall be identical to the address form for industri. The link to building points is a result of owner registration, but an owner can owe several building and the user needs to select those relevant for the WWTP.

2.5.13 WWTP Treatment Method

Remember to include a Identification alternative.



2.5.14 Type of solid waste

A look up table with name and ID only

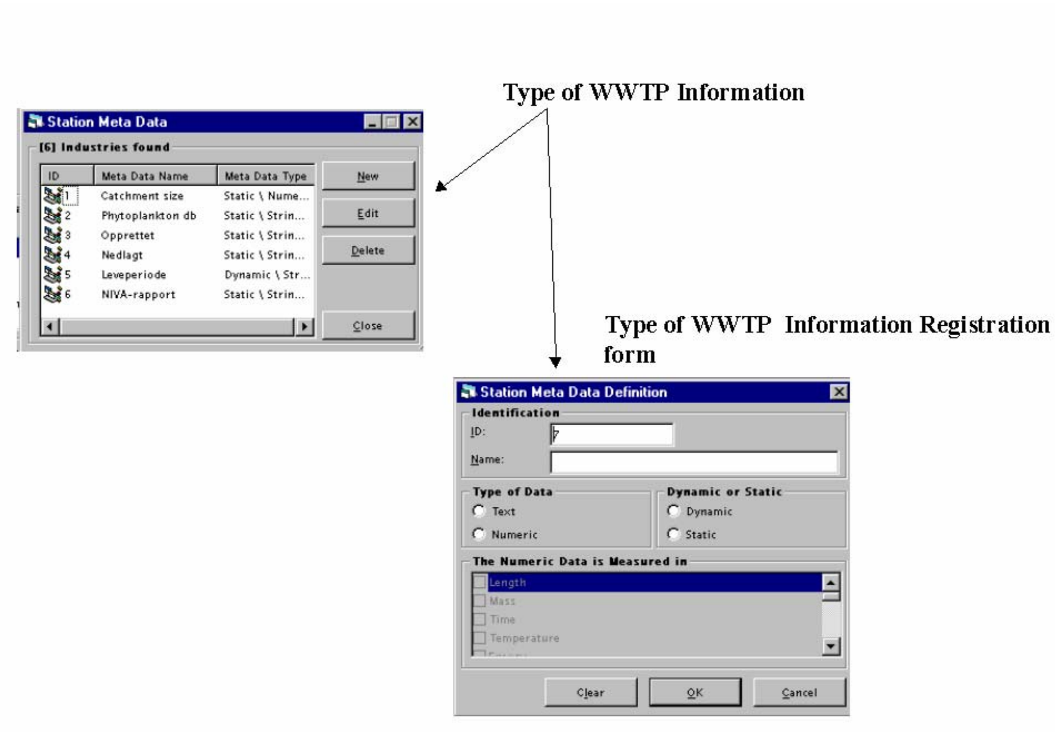
2.5.15 WWTP chemical

A look up table with name and ID only

2.5.16 TYPE of sludge and solid waste disposal

This is the old type of sludge handling which shall be kept but renamed

2.5.17 Type of WWTP Information



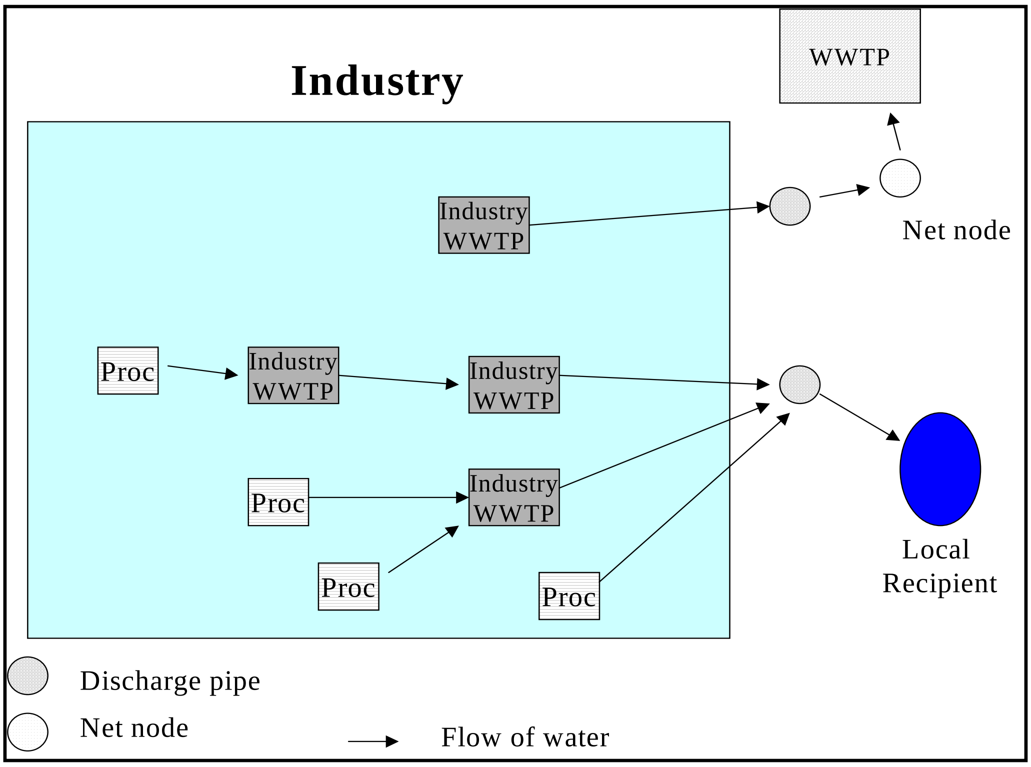
2.6 Industry

2.6.1 Introduction

A process Industry discharge either to

- Domestic WW Network (through net node) or
- To local recipients

Before the sources reaches the final destination some of the pollution discharged to the network are lost due to leakage/retention and overflows.



The changes from ENSIS 2.05 are explained in detail in this specification and are very similar to the changes at the WWTP module, the major changes for the Industry module are:

- The search for Industry and the presentation of the found items are done as elsewhere in the application with the possibility of view on map and links to other parts of the application is possible.
- The industry is identified by ID, name and alternative.
- The Tabs has been rearranged and some additional tabs have been added.
- There has been included and info tab which holds some basic information about the Industry including a link to adddresses.

The discharge pipe has been somewhat modified according to the changes on treatment area.

- The possibility of drawing A diagram for the industry (the production lines), and detailed process diagram for treatment plants at the industry has been introduced. The user has also been given the opportunity to give some more details about the treatment plant and the sludge handling.

- The data for calculating discharges has been separated on two tabs.
One TAB contains the processes and the theoretical discharges based on production/consumption discharge factors, and the second TAB contains measurements/discharge data resulting from measurements and either taken at the processes or the treatment plant .

- The Measurements are presented as both time series and aggregated data as in the current application, however some modification has been introduced especially for the aggregated data. These changes are equivalent with the changes done under WWTP

- Also the user has been given the possibility to introduce several measurement points at the industry and not only for inlet, outlet of treatment plant and the outlet of a production process.

- The model input tab has been modified in order to prioritse the data to be used in model calculation. The bypass at a treatment plant is of relevance and need to be counted for.

- The content of the discharge permits tab has been changed.

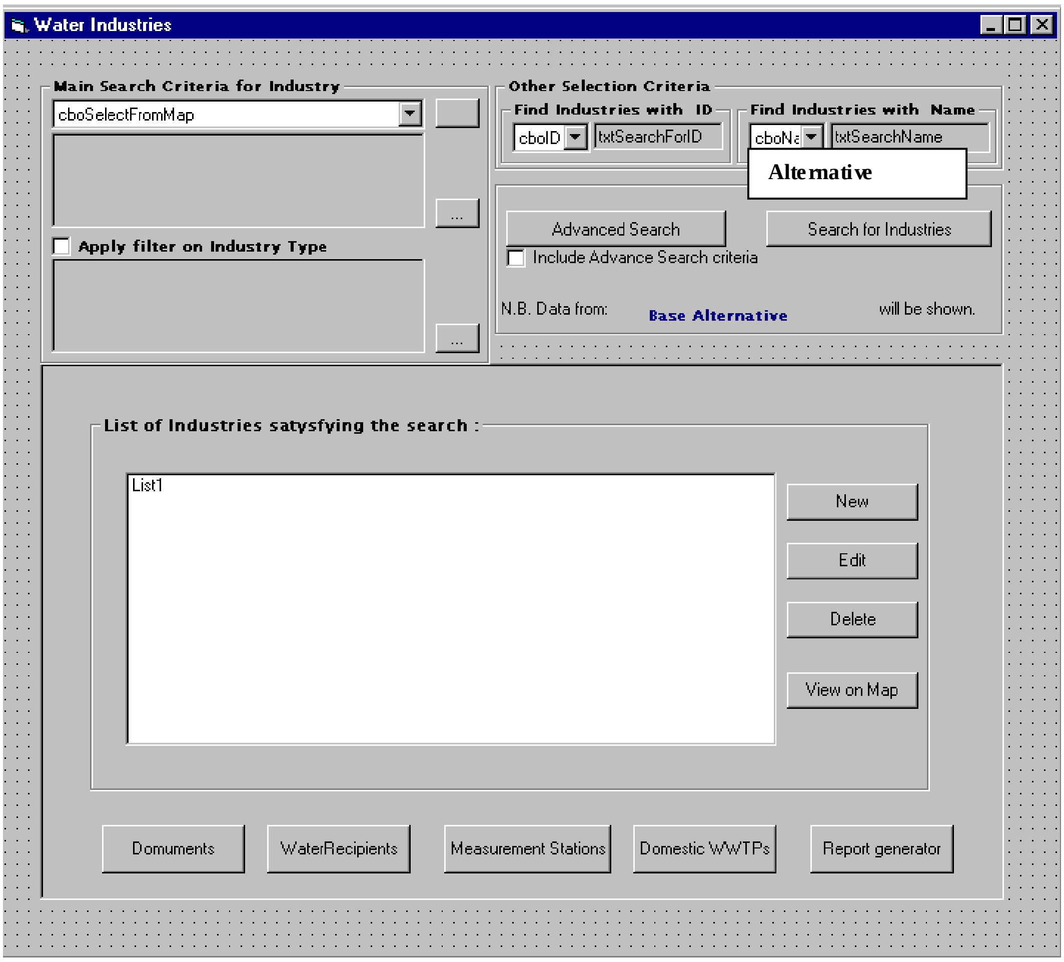
- A new load TAB with the possibility to calculate the load for the particular source has been introduced

- Several graphics and report has been introduced. Defaults have been suggested for the graphics, but it shall be possible to change the default. It shall be possible to save the reports and the graphics to documents linked to the treatment plant, and access the report generator from the industry.

- The industry uses the same functionality as the WWTP when it comes to the internal treatment plants at an industry, however the look up tables shall be separated. Among other because of modularization and because the entries of the look up tables will typically vary a bit from the domestic WWTP

- Line of business has been renamed to Industry Type and Activity Type as been renamed to Industry process type.

2.6.2 Main Search Form



This is the main Industry form search criteria have been kept, however there shall as in the rest of the application be a list resulting from the search (not a combobox)

Meaning:

- Standard geographical search (by selecting in the tree view and marking an area on the map)
- Search for industry as a function of defined industry type (identical to present search criteria but change name of Line of Business)
- Search for industry a function of ID, name or alternative (standard ENSIS functionality)
- Advanced search as in the current application

From the found list of Industries there shall be link to other relevant information which is valid for the found items.

Documents: When the user presses this button, the document handling system shall be opened with only those document points that are linked (are made valid for) to the found Industries.

Water recipients: This is a link to the water recipients the selected Industries discharge to. A filtered list of Lakes, coastal area and river links (Based on the upstream node) will be opened (if relevant).

Measurement stations: This will open a link to Measurement stations located within or linked to the recipients described above.

WWTP: The domestic waste water plant(s) the found industries are connected to (through net node).

Report generator: The user may enter the report generator with the selected industries already selected.

Other links will be available when the user enters the specific for each treatment plant.

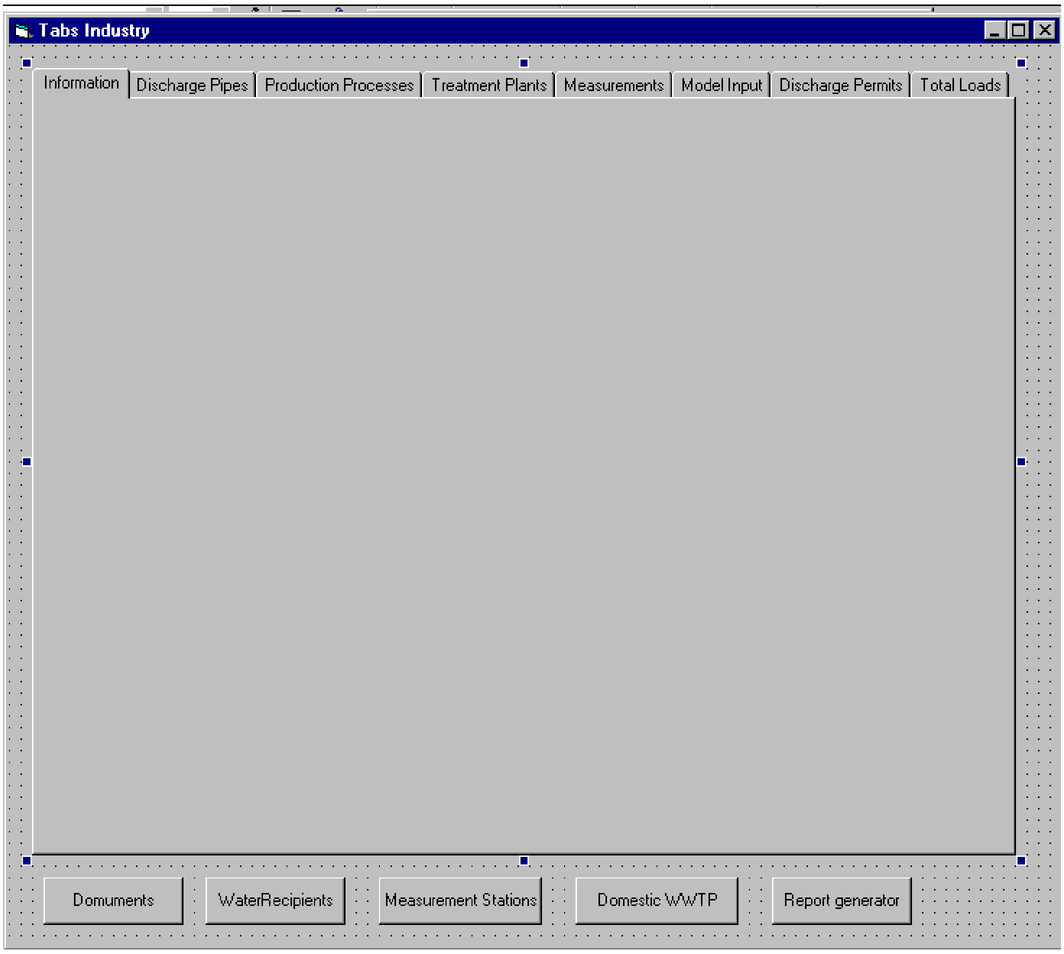
If the user wants to create a new Industry he enabled new. If the user wants to edit or view details about one of the found industries he/she double click on the item or push edit.

View on map shows the found industries on the map. The right mouse button applied on the map gives also the discharge pipes and the recipients.

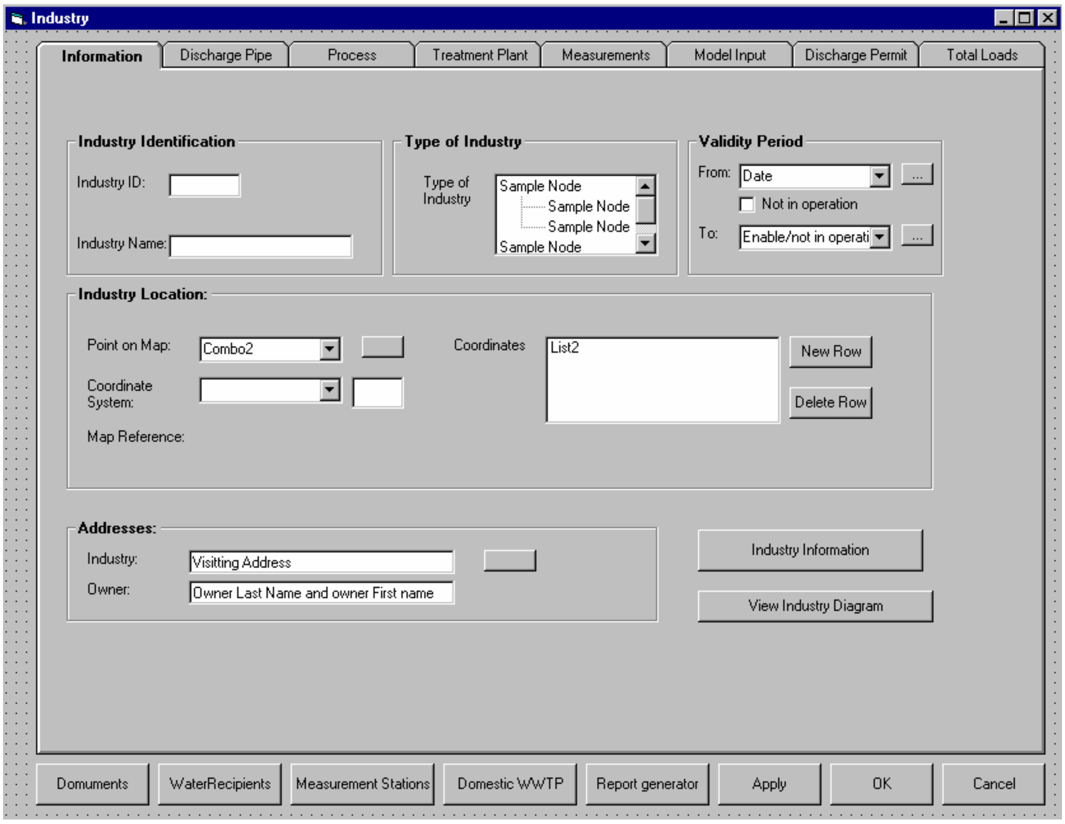
2.6.3 Overview of TABs

An Industry shall have the following TABS

- INFORMATION
- DISCHARGE PIPES
- PRODUCTION PROCESSES
- TREATMENTPLANTS
- MEASURMENTS AND DISCHARGES
- MODEL INPUT
- DISCHARGE PERMIT
- CALCULATED LOADS



2.6.4 TAB 1:Info



The form functions very similar as to the info tab on the Domestic WWTP.

The main changes from the current application is that the Industry information registration is done in the industry form and not on the address form. The address information is only a part of the industry information.

Industry Identification
The Industry is identified by ID and Name and alternative. Include a combo box for alternative in the form.

Validity Period
Only the validity from is filled in by the user as long as the Industry still is in operation. The validity period to is disabled. As soon as the not in operation is checked the “to” validity period is enabled.

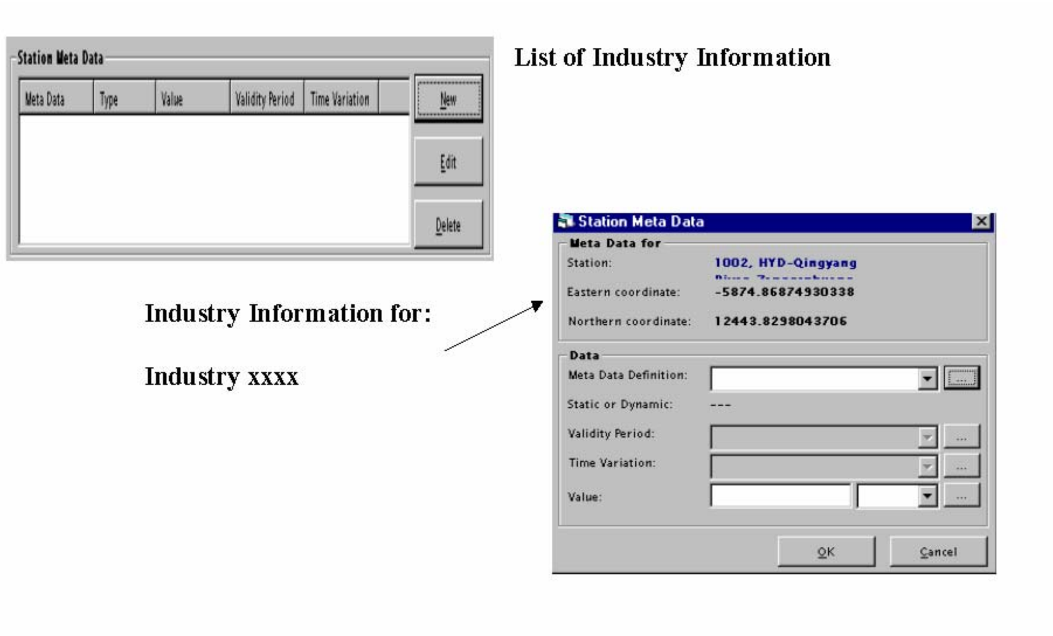
Industry Location
This is the location of the Industry. A main change from the current application is that the location is defined as an area and not as a single point. The functionality for defining the industry as an area and not as a point shall be as elsewhere in the application (ref i.e. adm region definition)

Addresses
The user can link address information for the industry and owner information. As soon the user has registered the address information the visiting address will be filled in for industry and the owner name for the owner linked to the industry. . For definition of address see chapter later in this document.

Details for Industry

The user register the type of industry as in the current application (old line of buiseness).

<Industry Information>
Also the user has access to register any type of static or variable information. This function in the same manner as for station meta data and require a new look up table “Industry Information Type”



<Industry Diagram>

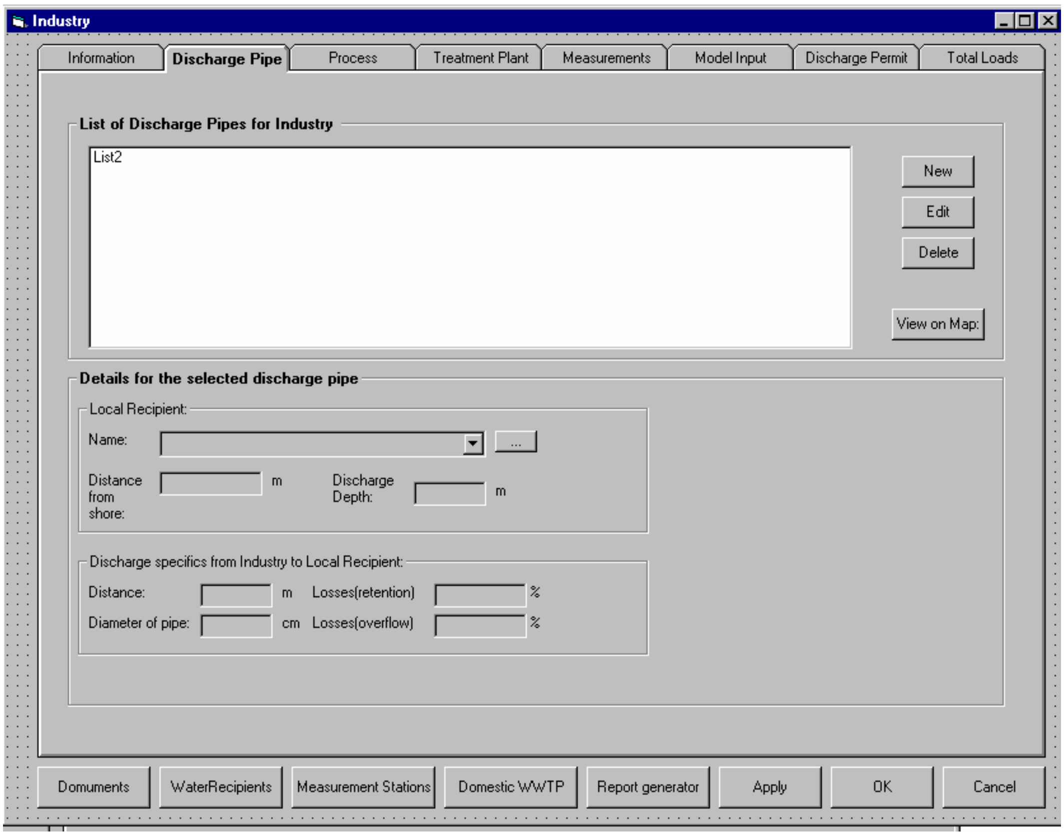
The user may also get an overview (a diagram) of the Industry based on the registration of Production processes, treatment plants and how these are linked together and how they are linked to local recipients or net node.

It shall exist symbols for the following Items:

- Process
- Treatment Plant
- Discharge pipe
- River Nodes
- Lakes
- Coastal object
- Net Node

The diagram might get drawn in a similar fashion as described in the figure of introduction. The name of the process, disharge pipe, traetment plant etc shall be written within the symbol.

2.6.5 Tab: Discharge pipes



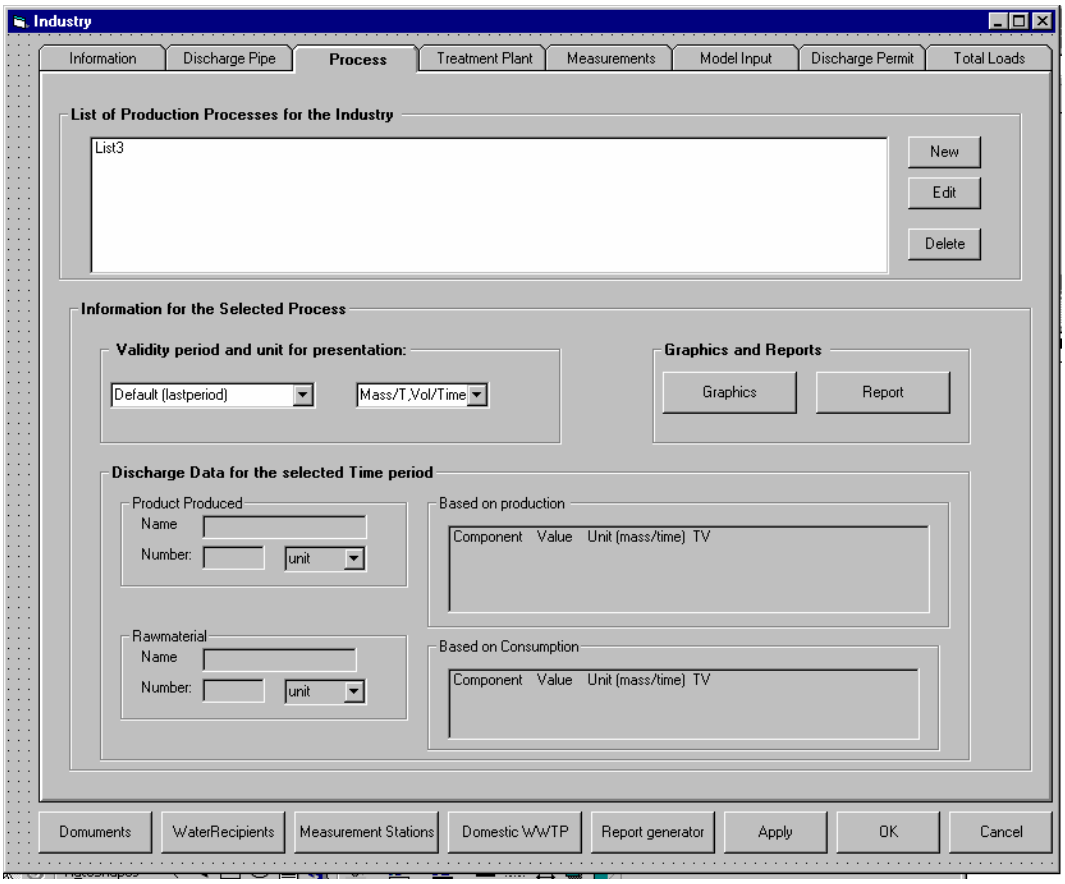
All discharge pipes are listed, and depending of which pipe the user has selected, information which is disabled will change (one display if a discharge pipe to local recipient is selected and one display for the alternative that the discharge pipe goes to net node). This is the same type of functionality as described under treatment area. View on map shows all discharge pipes and the links to both the local and secondary recipients as desribed under treatment area.

The discharge pipes shall be listed with the following properties:

ID, name, alternative, validity from., validity to, discharge alternative, discharge to (name of recipient or net node)

The registration of the discharge pipes function in the same manner as described under WWTP including the general modifications (i.e. possibilities of assigning losses).

2.6.6 Production processes



Changes from ENSIS 2.05

The functionality described is the same type of functionality described under Domestic activity registration (treatment area module)

The functionality is based on the functionality under the process and discharge data tab in the ENSIS 2.05 application with some modifications. The main change is that the measurement time series and the calculated timeseries tabs are moved to the TAB measurements in this functionality description, and only the production data and discharges resulting from them are kept on this TAB (Production processes).

List of Production Processes for the Industry

All production processes defined for the industry are listed. The information on rest of the TAB is a result of registrations for each process and the content of the information will therefore be updated when the user select another process in the list.

The user may double click on the process to edit the process information or the data connected to the process, or create a complete new process.

Data for the selected process (process name)

Validity period and unit for presentation

This tab is not used for model calculations, but only to show the calculated discharge data for the validity period the data are registered for (The user can not select whatever period and chose time step, for this type of calculation go to the load TAB).

Calculation of discharge and flow data on this tab are based on information on production or/and consumption of raw material and the calculation is explained for the registration of data (see below). The user can therefore only select among those data periods defined for the selected process.

However the user may choose to show data in several unit valid for the selected period. The user can choose between units of

Mass/time, volume/time, mass and volume. If the user chooses mass or volume these numbers will be calculated based on the saved mass/time(volume/time) figure and the selected validity period.

Graphics and reports

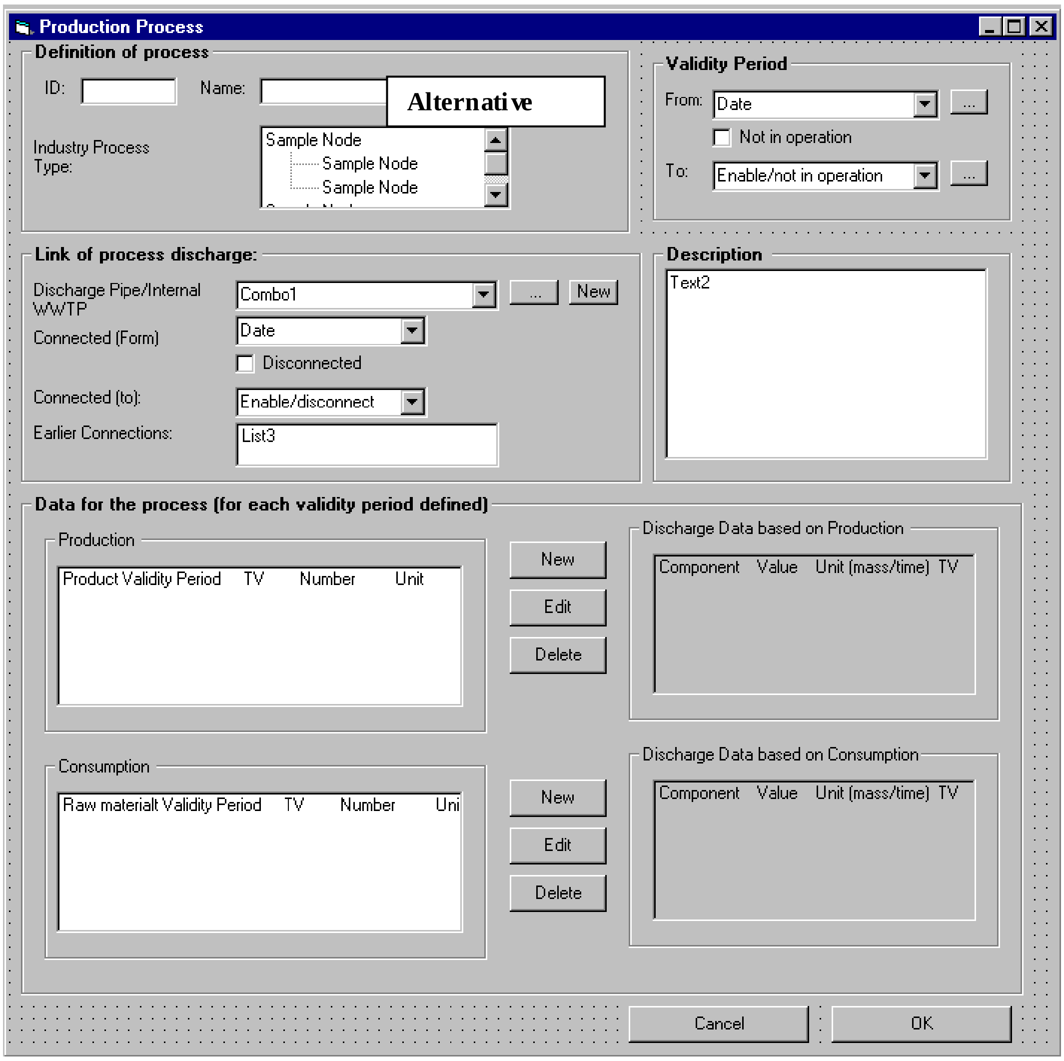
Will come

Discharge data for the selected time period and unit

Discharge data/Flow data will be shown and depends on the selected period and unit.

The product and raw material which is the basis for the calculations will be shown together with the data for each component.

2.6.6.1 Registration of Processes and production and consumption data



When the user wants to register data for the process for the first time or to add data to the process the user goes through edit or new to come to the registration form.

The first part of the form is for registration of the process and the second half is for registration of data connected to the process.

The changes from ENSIS 2.05 is that the definition of the process is closer linked to the production and consumption data for the process.

Definition of process, validity period, link of process discharge, and description

This is equivalent to the Process form in the ENSIS 2.05 with some adjustments. Production process is identified by ID, Name and Alternative.

The validity period has a from and to date and shall function as earlier described in this application.

Activity type is renamed to Industry process type:

The link of process discharge function in the same manner as in ENSIS 2.05 except for one modification. When a discharge pipe or internal treatment plant is not in operation any more the user will get a warning when opening the form. The user needs to change the connections (the user might want to change the connections for other reasons as well)

The changing of connection shall function in the same manner as described for WWTP processes.

Data for the process for each validity period defined.

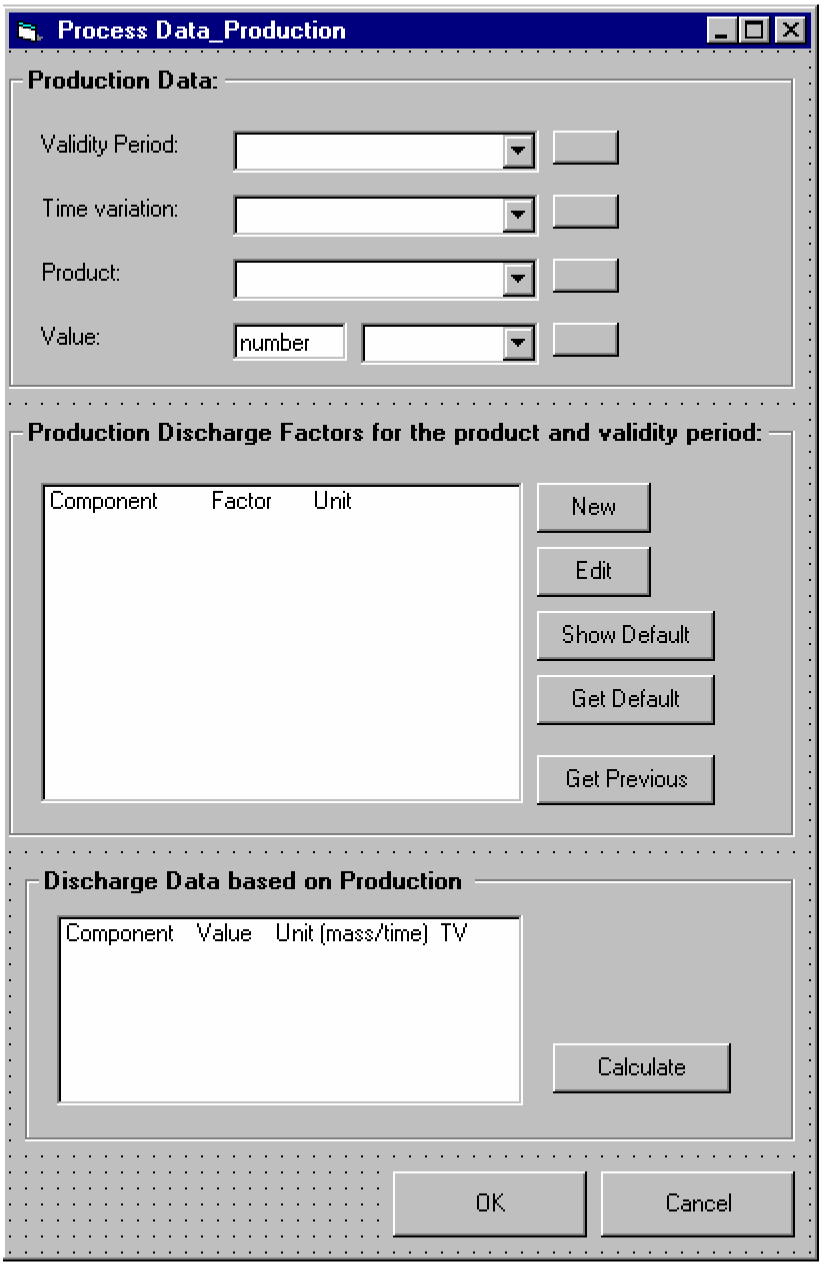
The contents of the TAB Production and consumption data for the process in ENSIS 2.05 is in this specification moved to this location.

In addition the user will get access to the calculated data for the process based on these data. The discharge data based on production will be disabled and a result of the calculation done when entering the production data (see below). This is also the case for the discharge data based on the consumption. Also flow data might get calculated (volume/time).

The discharge data based on production and consumption (the two frames) will change accordingly to which validity period is selected in the production and consumption table. The discharge data/flow data will be listed wit all components relevant, value, unit (mass/time or volume/time) and the Time variation. If one validity period is selected for production data, and the same validity period exist for the raw material (consumption data) these data will be shown as well and vice a versa.

If the user wants to edit or create new data he/she pushes new or edit.

Production Data (New and edit)



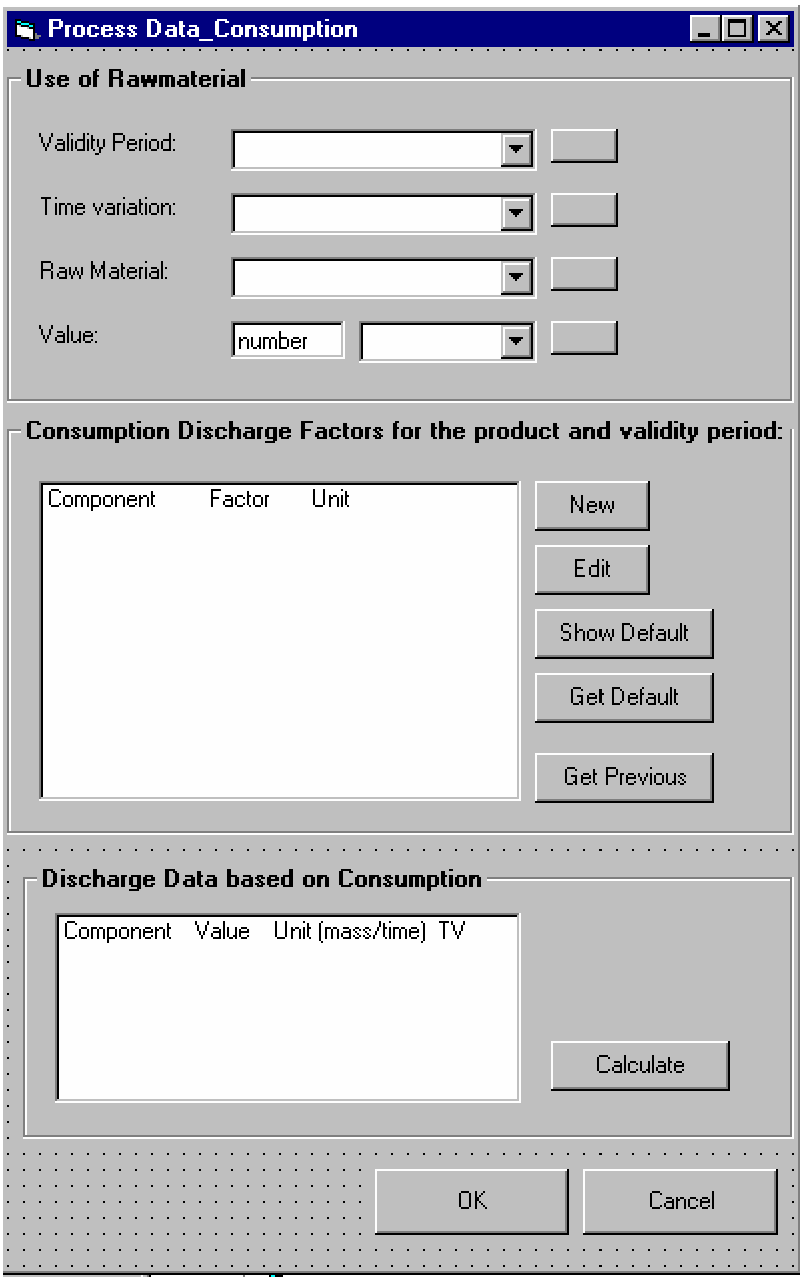
This is the same form as the process discharge data in the ENSIS 2.05 except for the fact that the discharge factors are connected to the data in this form and not on a separate button on the process TAB. See also the equivalent for the Domestic WW activity data in the treatment area module .

The user enter the validity period for the production data, the TV if any, the actual product and the value. For the validity period and product defined the user also enter discharge factors. To enhance the registration the user may get default factors (Depending on the validity period, see description of default consumption and discharge factors) or get the previous defined discharge factors (the set of discharge factors defined for the same process and product for the last validity period defined). The user may also edit some of these factors or create completely new ones.

Discharge data/flow data for the defined production data

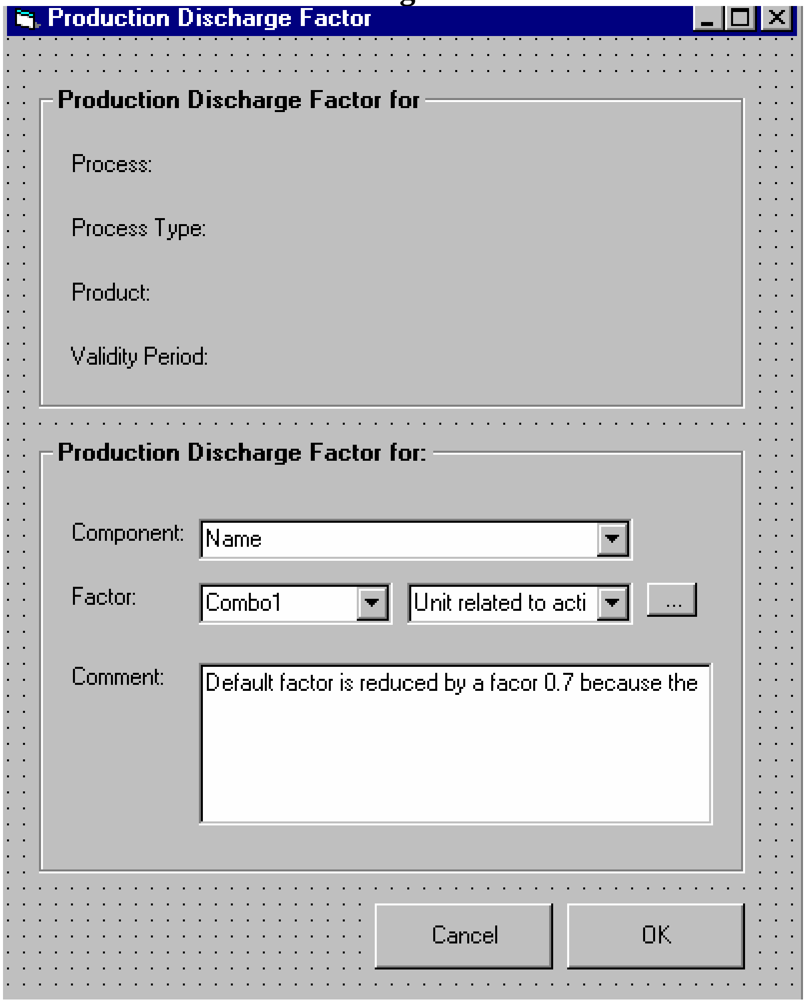
Based on the registration above the user may calculate the discharge/flow data. The idea behind this is to simplify the calculation of the model since one operation is already performed.

<u>Consumption of rawmaterial (new and edit)</u>



This function exactly the same as for production. The only difference is that the user define the raw material and uses the default factors for consumption.

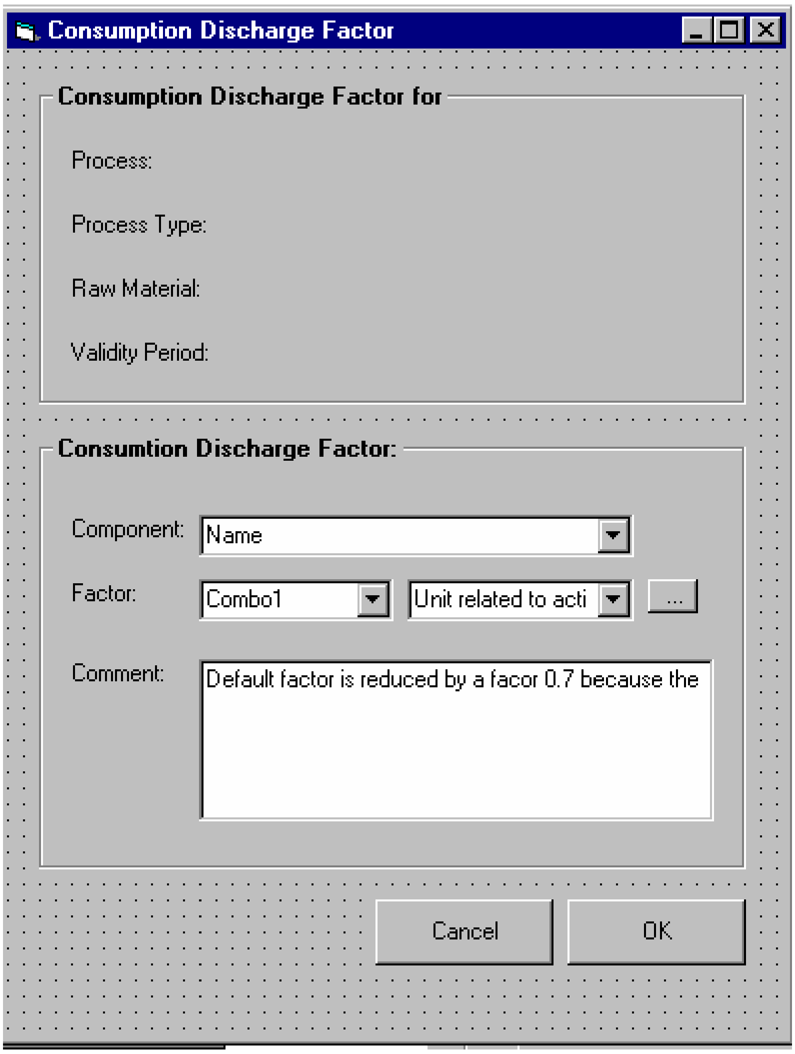
New/edit Production Discharge Factor



If the user wants to edit the factors or create new factors the user reach this form. The available units for the factors are the same as those derived from the unit types in ENSIS 2.05. In addition the following unit types shall be available:

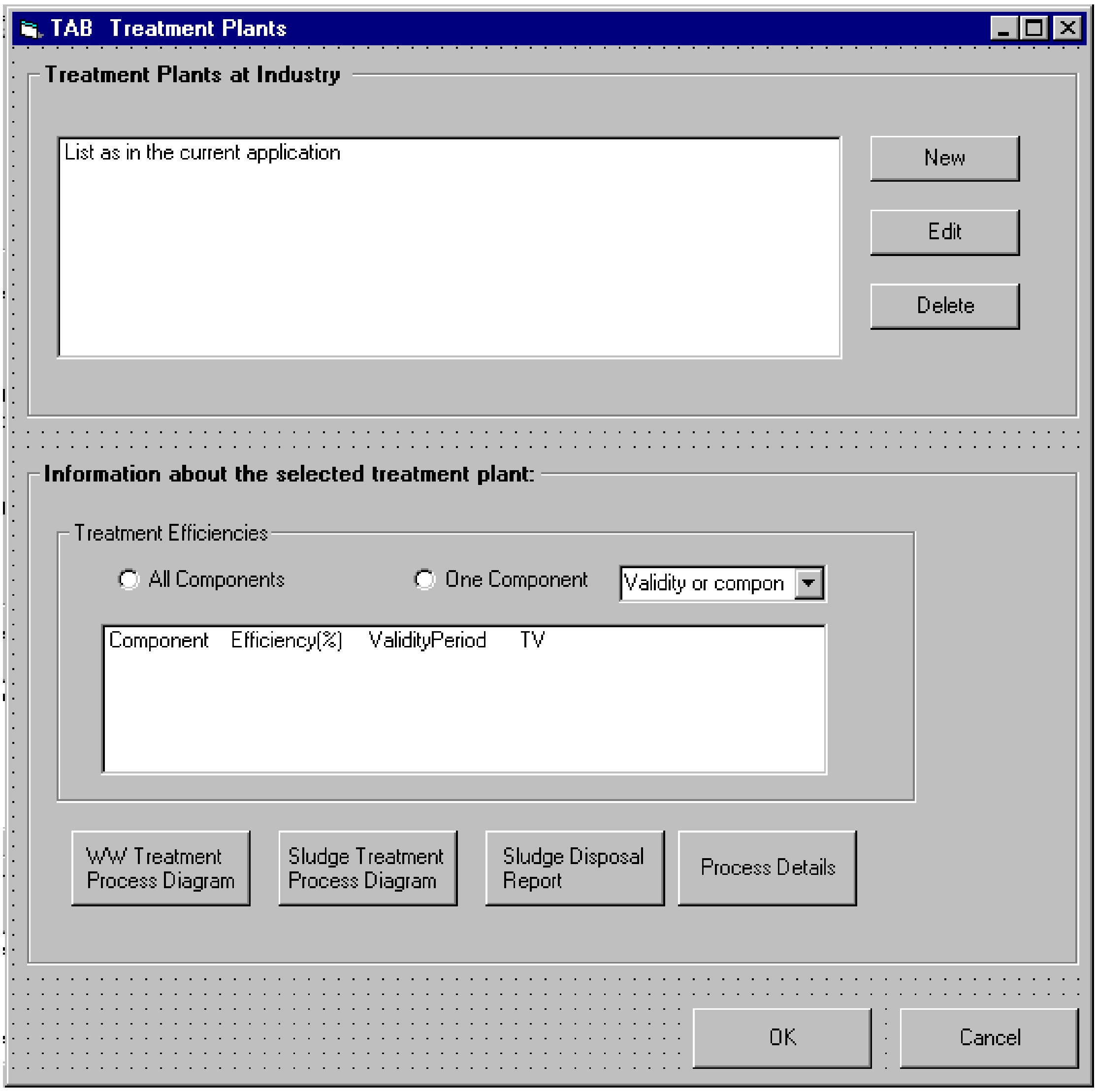
- Volume/mass (for the flow component)
- Volume/volum (for the flow component)

New/edit Consumption Discharge Factor



This function exactly in the same manner as described above for the production factor, and the same units from the same unit types are available.

2.6.7 TAB Treatment Plants



The treatment plants tab give and overview of the internal treatment plants at the industry including sludge treatment, and sludge and waste disposal.

This is the same functionality as described under the Treatment and discharge tab in ENSIS 2.05. The main changes is that the measurements and discharges data are moved to the tab measurement.

The functionality described is approximately the same as described under WWTP (tab Treatment processes and sludge), and hence the modification done in this module is also implemented for industry.

Other specific changes are described under each section below.

Treatment plants at Industry

All treatment plants defined for the industry is listed with the same properties as in the current ENSIS 2.05 application. In addition the property Alternative should be listed.

The user can edit the plant or create a new one.

Information about the selected treatment plant

If the user has selected a plant the user will get access to information registered for each of the selected plant .

<u>Treatment Efficiencies</u>
By default the user will get listed the treatment efficiencies for all components for the last validity entered on treatment efficiency. The user may change the validity period to be viewed.

The user may however view treatment efficiencies for all validity periods for one of the components. The user may for this option change the component to be viewed

<u>WW treatment Process Diagram</u>
This is the process diagram for the waste water treatment process at the plant, and is a result of the detailed process registration at the plant (see process details)

<u>Sludge treatment Process Diagram</u>
This is the process diagram for the sludge treatment processes at the plant, and is a result of the detailed process registration at the plant.

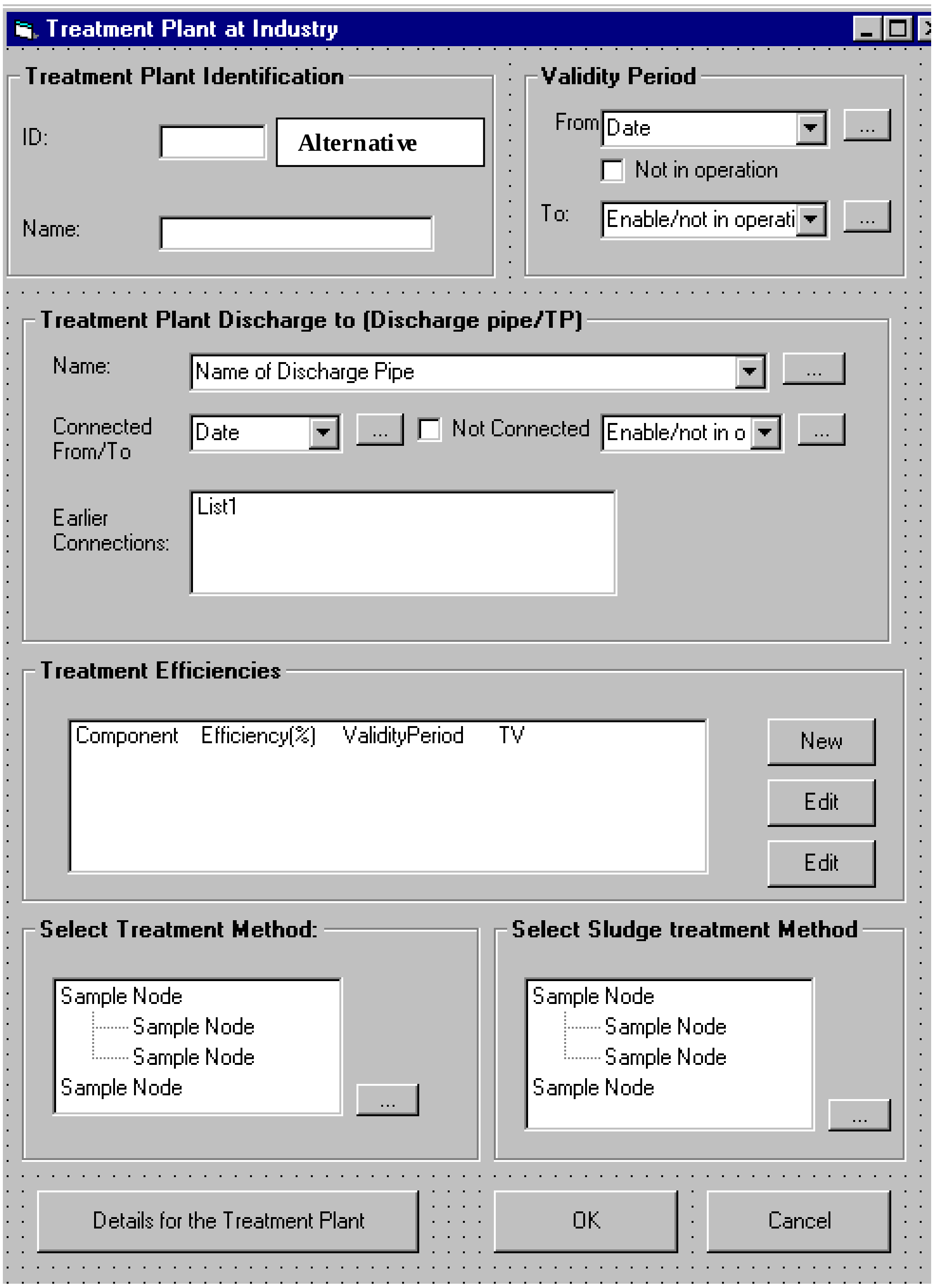
<u>Sludge Disposal report</u>
This is the sludge disposal report generated from the detailed registration on the treatment plant.

<u>Process details</u>

The user may edit or view the process details for the selected plant (see form below Details for the Industry Treatment plant). The user may reach this form from this location or under the for Treatment plant for industry (see below).

The form contains basically the same information as stored behind the Treatment proceess button in ENSIS 2.05.

2.6.7.1 Industry Treatment Plant (new/edit)



This is the same form as in ENSIS 2.05 except that the registration of treatment efficiency is directly linked to this form and not on a separate button.

Treatment plant identification should be done by ID, Name and Alternative.

<u>Validity priod of Treatment plant</u>
The validity period is connected to the treatment plant and has a ”from” and a ”to” period. Functioning in the same way as described elsewhere in this specification.

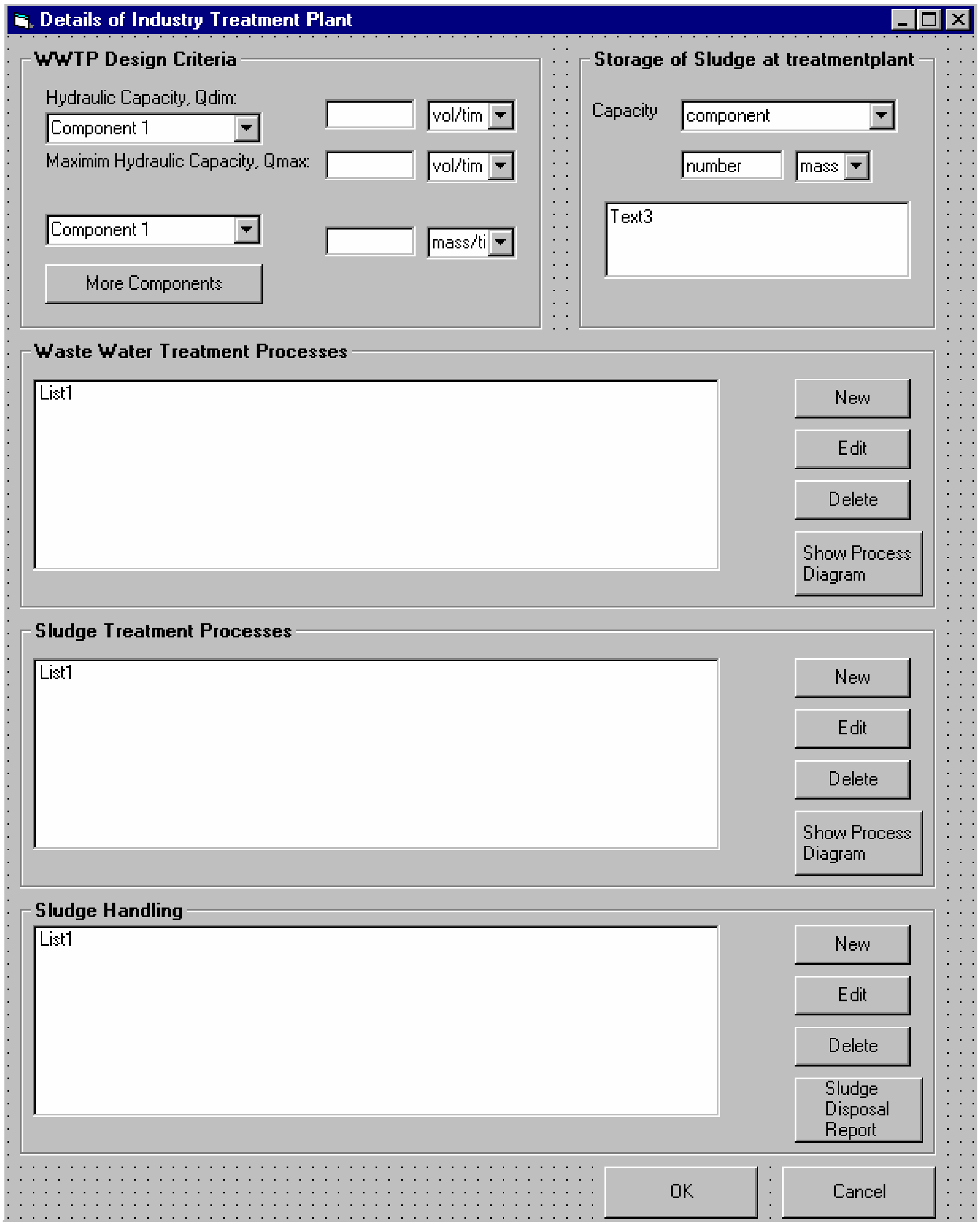
<u>Treatment plant discharge to:</u>
A treatment plant can discharge to another treatment plant or a discharge pipe. The connection may change over time i.e. to a new discharge pipe, to another internal treatment plant etc.

The user register the connection and when the connection is valid from. If the use change connection he/she would have to enable not connected and fill in the to date. The discharge pipe will jump down to the earlier connection list and the new connection will get a from date = ” To date” from the last connection.

<u>Treatment Efficiencies</u>
The user may enter treatment efficiency for the relevant components.
The functionality shall be exactly the same as described in the WWTP module.

<u>Select treatment method and sludge treatment method</u>
This is the same functionality as in the current ENSIS 2.05, but it shall be modified as described under WWTP. However, the treatment method and thesludge treatment method is two separated look up tables belonging to the industry module and not only the WWTP module.

2.6.7.2 Details for the Industry treatment plant



This functionality is described under the WWTP module and shall function in exactly the same manner.

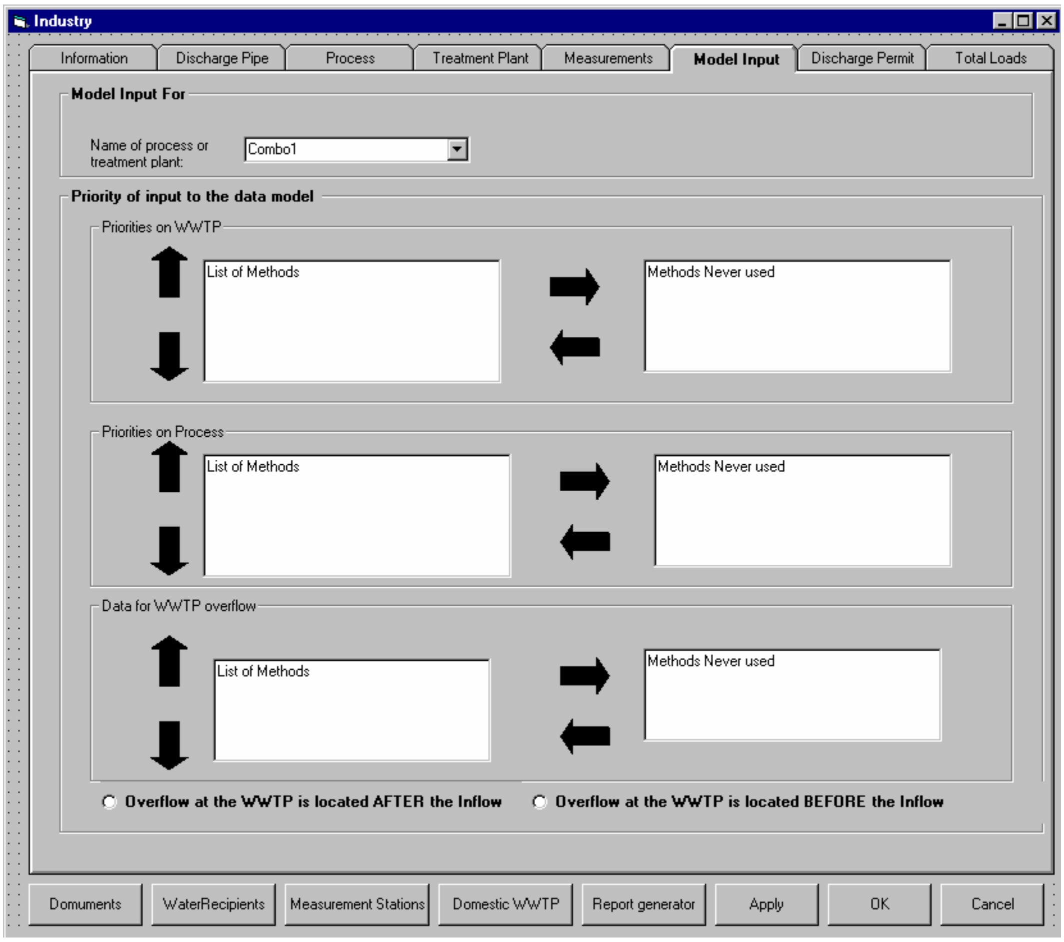
2.6.8 TAB Measurements and discharges

This will function exactly in the same manner as described under WWTP except for the fact that the station reference will be a fixed list, but contain all treatment plant and processes defined at the Industry. The objects shall be listed with Industry name, Process/treatment plant name.

Under the option Measurement/discharges Timeseries this will affect the dataseries definition form (station will not be disabled) and under "Aggregated Measurement and Discharge data" Station must be implemented as a property in all list and registration forms where measurement position is a property.

If the station is a "process" the process can not be linked to a measurement at inlet.

2.6.9 Model Input



The model input functionality has been change from the ENSIS 2.05 application and shall function exactly in the same manner as described under WWTP.

The difference is that the priority of the model needs to be given for each process and each treatment plant defined

The user needs to select from a combobox, and use the apply button to register the model input priority for the actual process./treatment plant.

In the cases when the user defines the priority of a process the data on Treatment Plant overflow is disabled.

<u>Treatment Plant</u>

The priority for a treatment plant at an Industry will as default have the following options:

1) Discharge Timeseries at outlet
2) Discharge time series at inlet
3) Aggregated Discharge data at outlet
4) Aggregated Discharge data at inlet
5) Process discharges

If the upstream object of the treatment plant is a process, option 5 will be disabled.

The priority of overflow at the Treatment plant will be

1. Measurement at outlet
2. Aggregated data at outlet

<u>Process</u>

1. Discharge Time series at outlet
2. Aggregated discharge data at outlet
3. Process discharge data based on production
4. Process discharge data based on consumption of raw materials

The model will calculate the discharge "beginning at the disharge pipe". If the first object after a discharge pipe is a treatment plant, the model will calculate the discharge based on the priority given above, except the 5th option. The equations will be as described under WWTP. The model will only go to the next object if no data are found.

If the next item is another treatment plant, and no data were found on item 1, it will loop through the priority given and the output from this second plant will be the input to the downstream treatment plant. The discharge from the first treatment plant (the most downstream) will then be calculated based on the equations given for WWTP (overflow at the WWTP needs to be subtracted and the amount which goes to treatment needs to reduced by (1-treatment%/100)) .

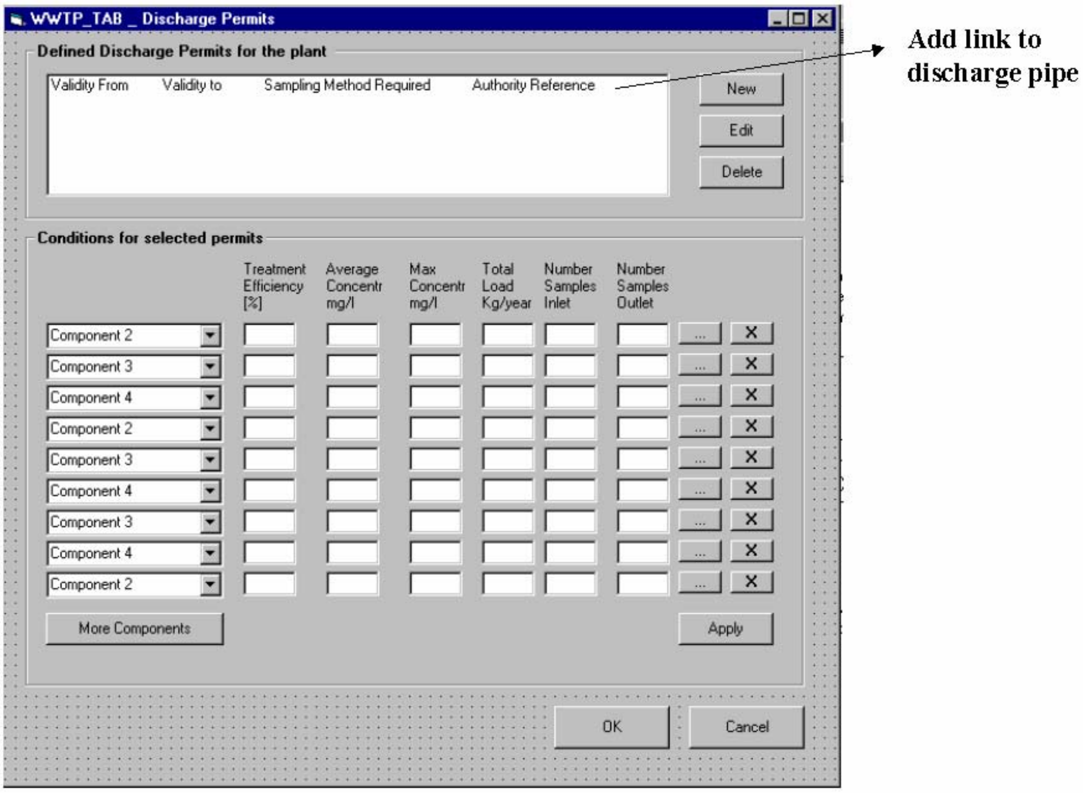
If the upstream object is a process , the system will only go to search for data on the process if none of the 4 other options at the treatment plant have data in the actual period. If it goes to the process the system will use the priorities given for the process.

It is not possible to set priorities like Measurement treatment plant 1, measurement treatment plant 2, and aggregated data process x (unless these other options have been selected as never use). The system will always loop through the priorities given at the first object, than the second, than the third etc, and it will only jump to the next object if there are no data on the priorities given for the first object.

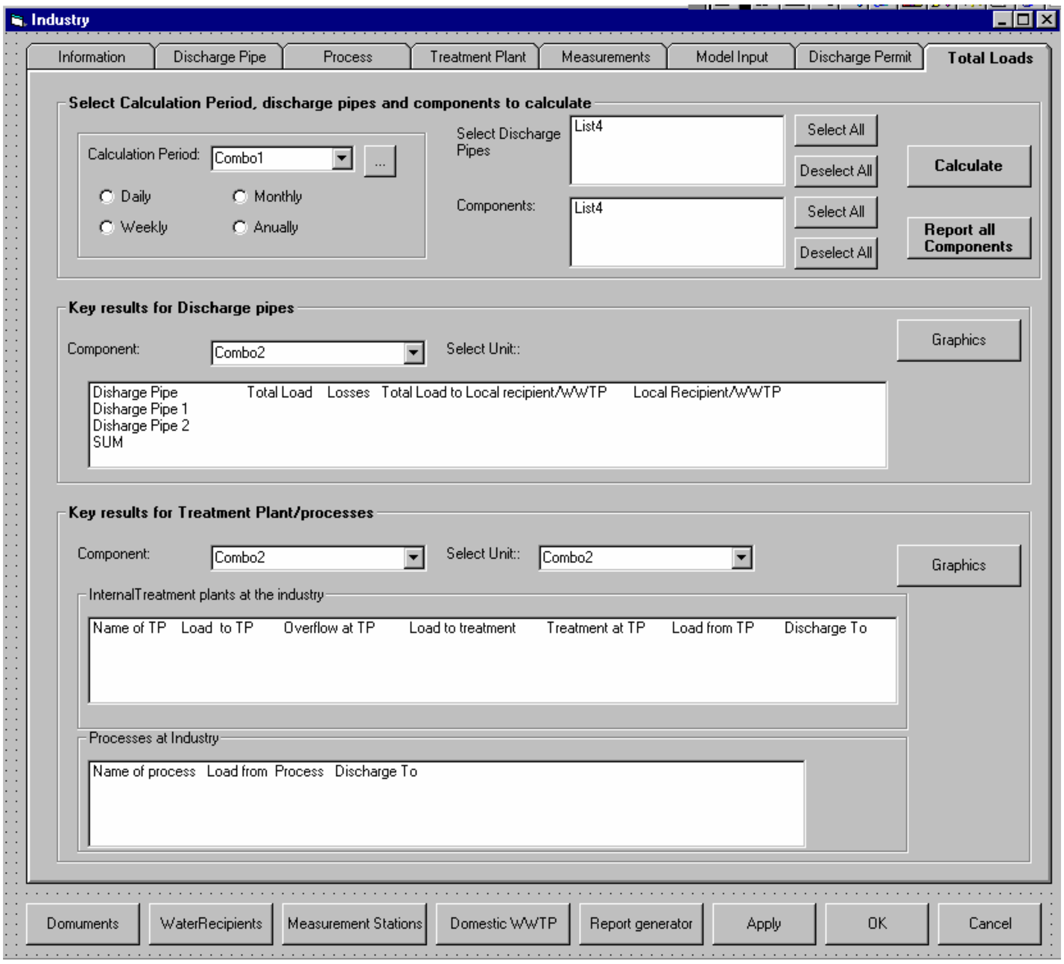
Discharge permit

The functionality for discharge permits will be exactly the same as described for WWTP. Except for the fact that when the user defines the discharge permit he will link it to a discharge pipe. The user can link only one permit to one discharge pipe, unless the permits do not have overlapping periods.

(The discharge limit related to PE shall not be implemented for Industry)

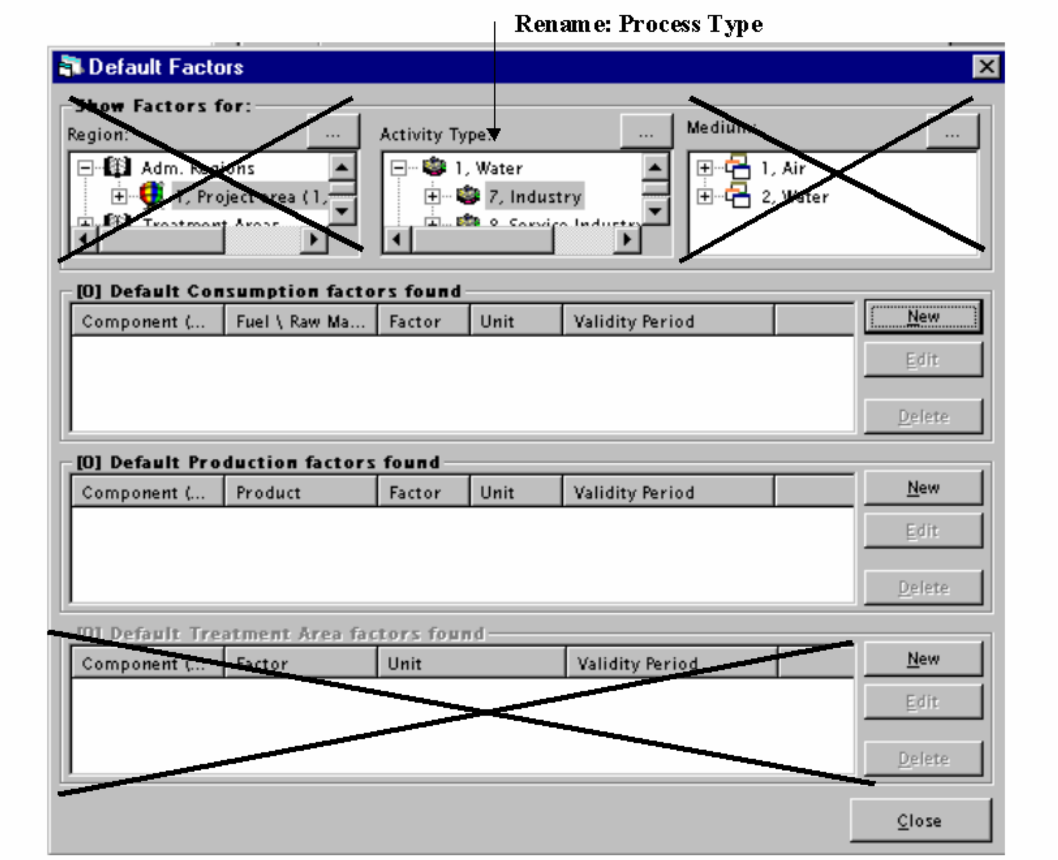


2.6.10 Calculated loads



See reports for WWTP (not posssible to report PE)

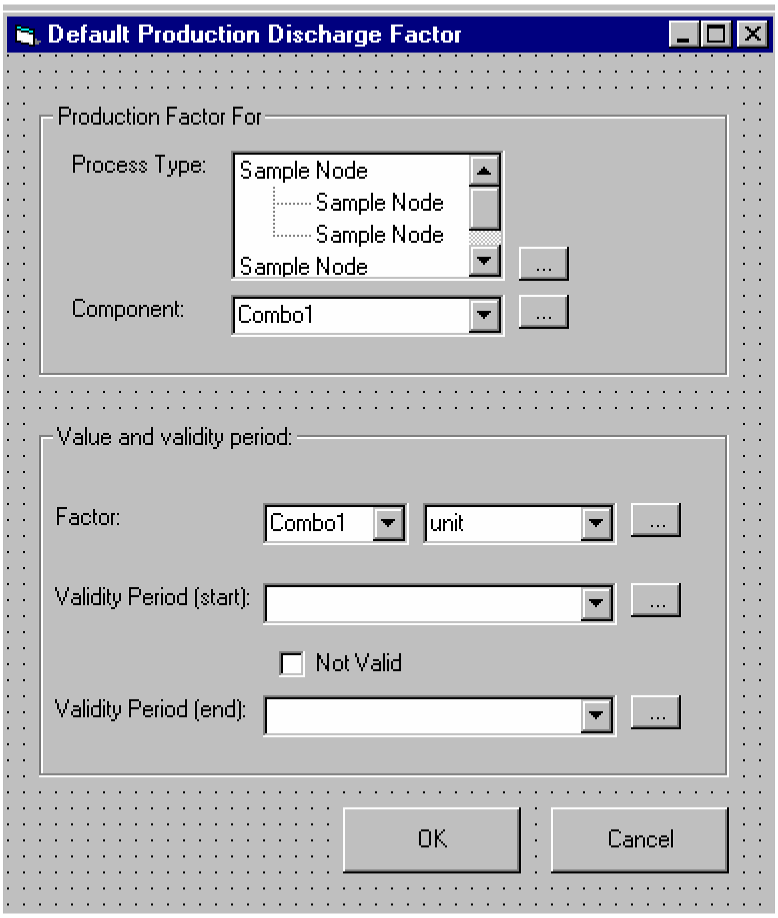
2.6.11 Default Production/Consumption Discharge Factors



Default Production/Consumption discharge Factors

The registration of default factors for production and consumption function the same way as in the current ENSIS 2.05 factor except for that medium is not relevant, the treatment area factors are removed and available on separate forms (see Treatment area module), and the factor shall <u>not be dependent on the region.</u>

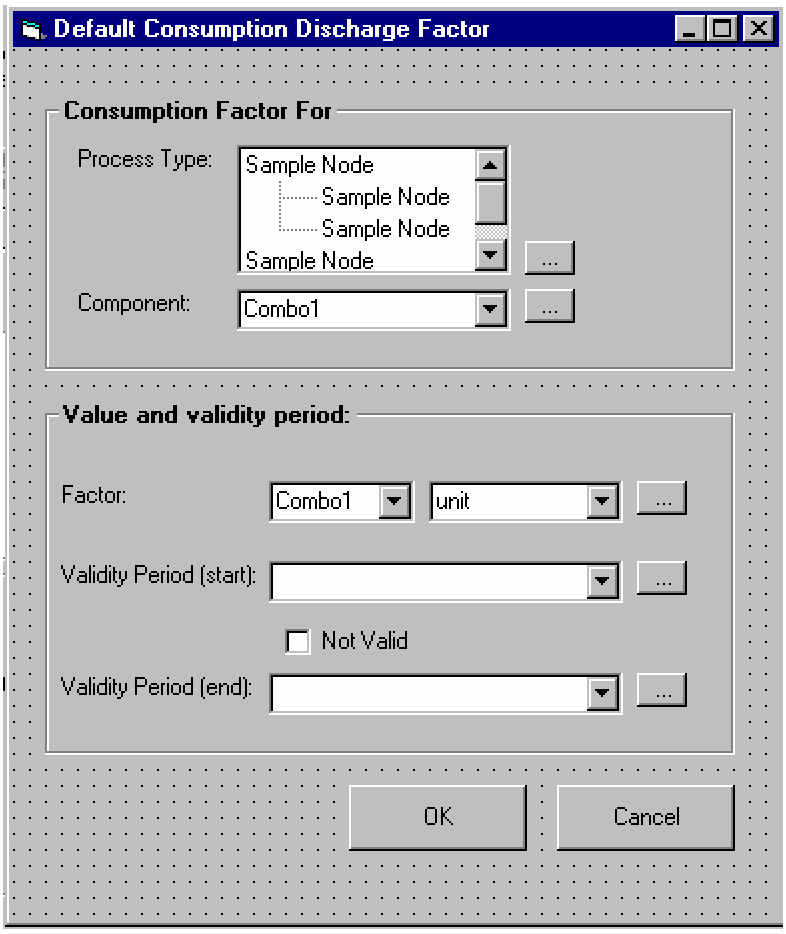
2.6.11.1 Registration of default production Factors:



The registration of the default production factor functions in the same manner as in ENSIS 2.05 except for the fact that the validity period has a from and to period. In this manner default factors may change over time (as in the current application).

The defualt factors for the same Industry process type, and component can not have overlapping periods. If the user define one default factor to not be valid any more, the ”new” default factor must begin where the last one ends. If the user tries to define the default factors with overlapping and not continuous, the user will get a warning and will not be able to store the new default factor.

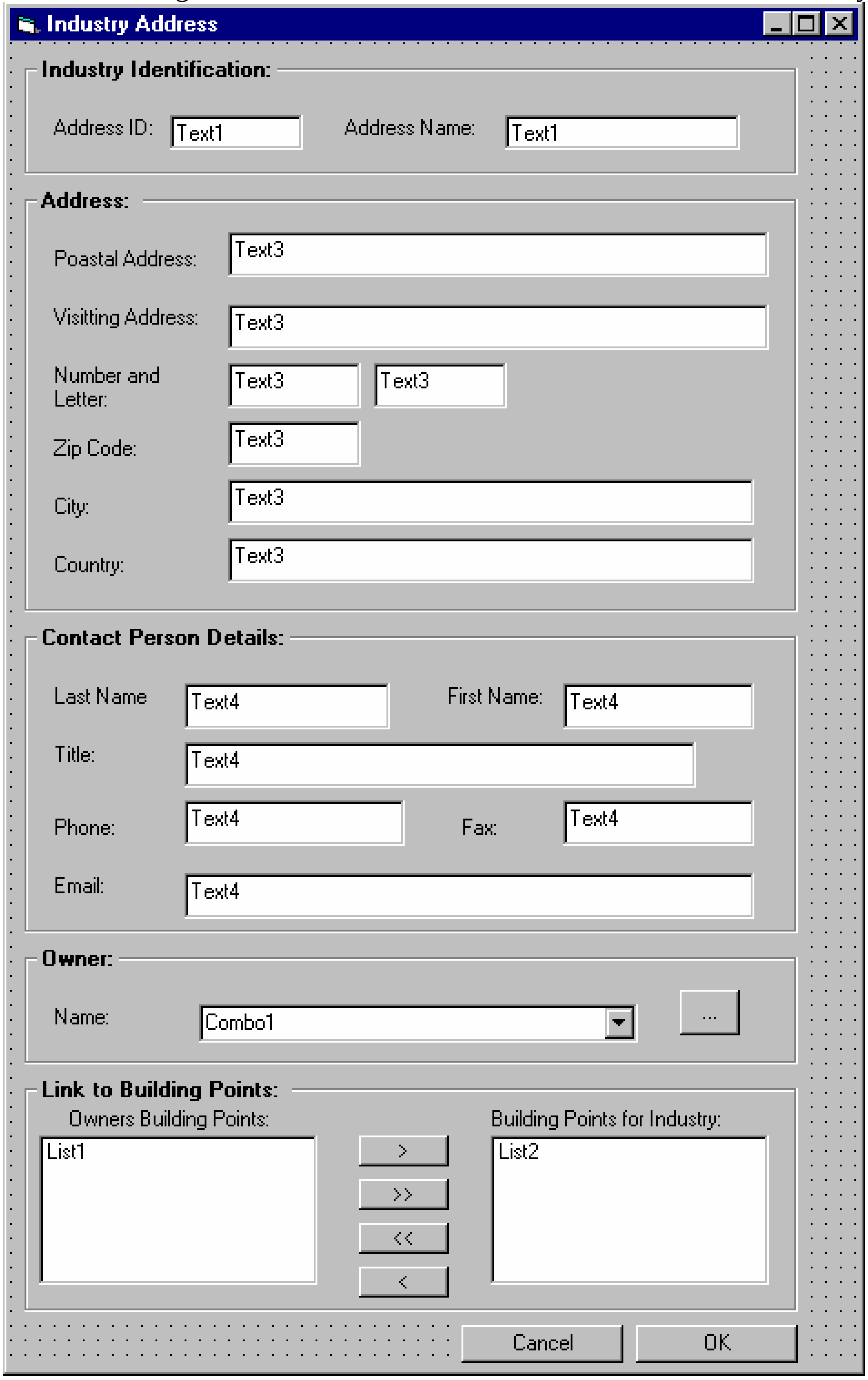
2.6.11.2 Registration of default consumtion Factors:



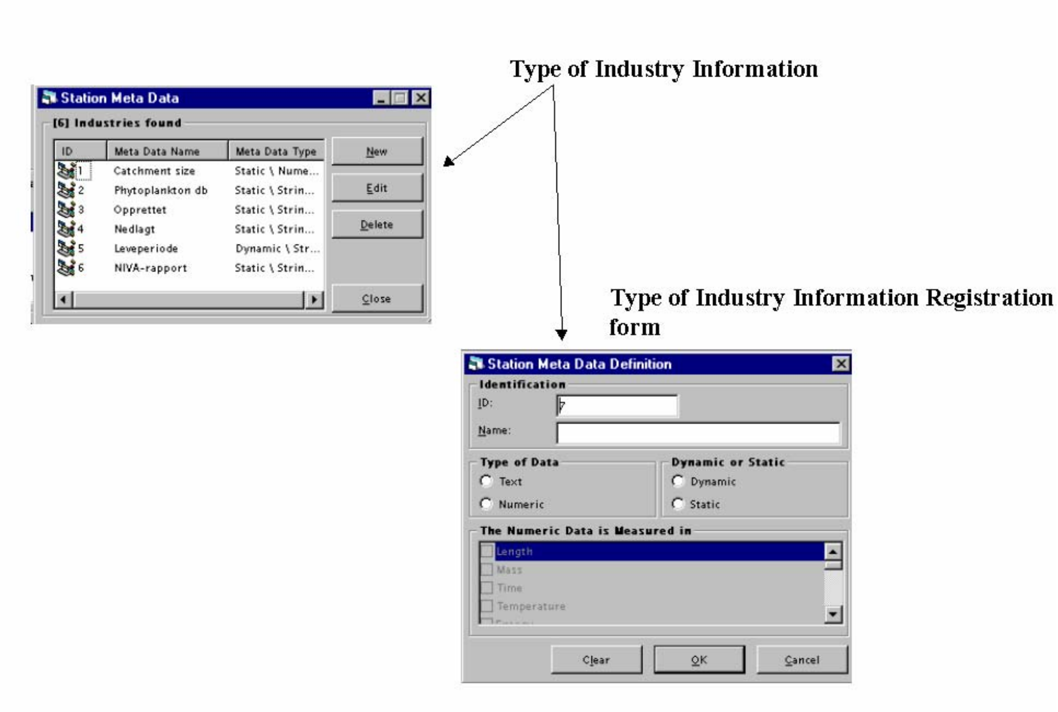
This functions in exactly the same manner as described above.

2.6.12 Industry addresses

The link to building points is a result of owner registration, but an owner can owe several building and the user needs to select those relevant for the industry.



2.6.13 Type of Industry Information



This is a new look up with the same functionality as station meta data definition.

2.7 Overflow, agriculture, aqua culture, deposits and other point sources

2.7.1 The scientific purpose of point pollution sources, and other sources

The idea of the pollution sources is to provide a closer to complete picture of all possible pollution sources discharging to water. Important sources, from a general point of view, are already included in the ENSIS 2.05. In certain areas other sources than the included ones are big contributors of pollution. Examples are:

- areas with intensive agricultural activity representing a point source to pollution, including domestic animals (cows, pigs, hens, etc)
- Areas with poor waste water facilities resulting in large amounts of overflow at the network and the waste water treatment plants.
- Areas with fish farming
- Areas where other point pollution sources contribute significant to the pollution budget

The pollution budget model shall include all existing and all new pollution sources, and hence gives a complete pollution budget to water.

There shall therefore be included a new pollution source called point sources. These sources shall handle pollution related to **overflow at the sewerage network, waste dumps, point sources from agriculture, aqua culture, infiltration and a general "user defined" point sources.**

2.7.2 Common use of forms (point sources)

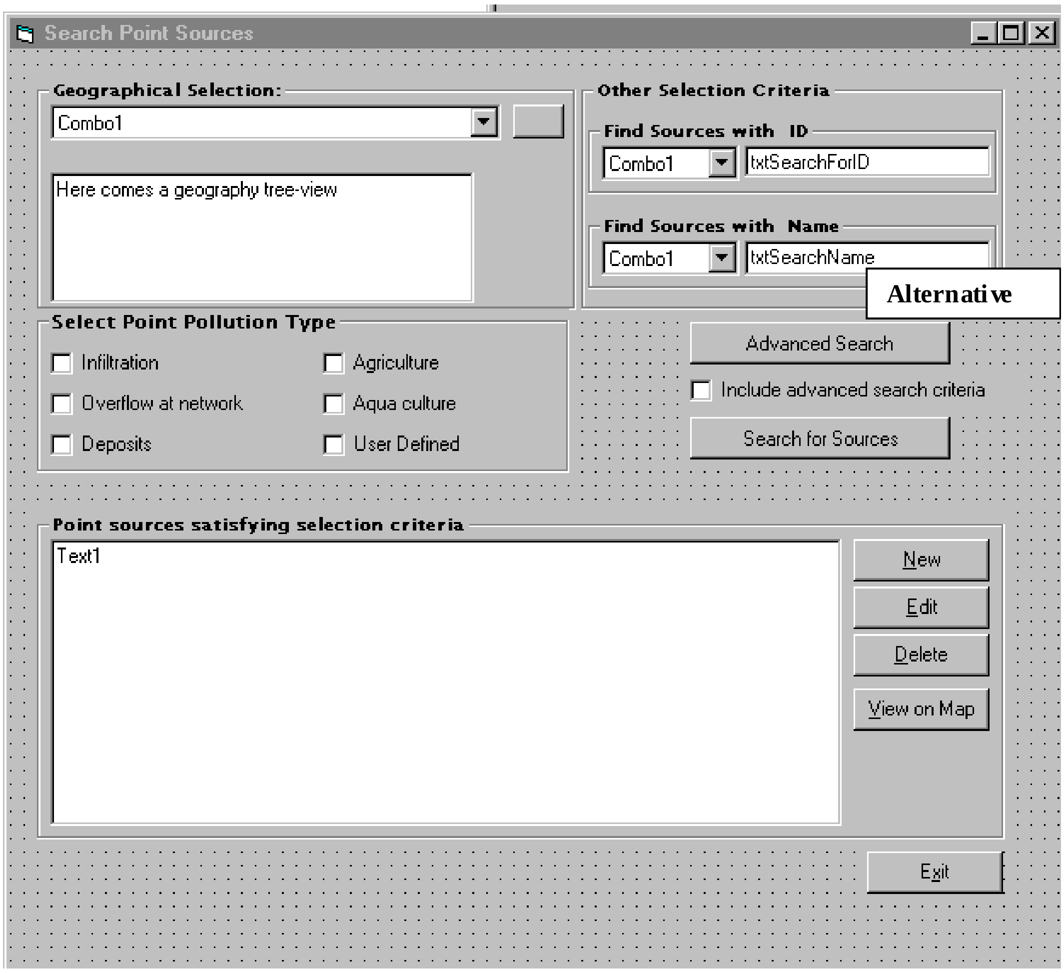
The idea is to use the same form for all the new point pollution sources (overflow at network, agricultural point sources, aqua culture, waste dumps, infiltration, and others). The only difference is that some controls will be disabled as function of from where the form is opened. In a similar manner, default values and content of lists will also vary as a function of from where the form is opened. The details for this are specified later.

The reason for reusing forms is to reduce the amount of working needed for programming, reduce errors, simplify testing and lower the user threshold.

The result of this is that the same registration form is opened several different places in the application, see the proposed new menu structure in the beginning of the specification for location. The places the new registration forms are invoked are indicated by ***NEW registration form***. The registration forms and the related forms (search form) is described only one place in this specification.

The new point pollution sources also need a new look up table. This table is also located several places in the proposed new menu structure. The places the new look up tables are invoked are indicated by ***NEW look up***.

2.7.3 Main search form



Geographical selection:

The geographical search for objects are standard functionality in ENSIS. The user can search both by use of the tree view, containing adm region, catchment, treatment area and user defined area, and the user can search freely via the map, by selecting the map, pressing the map-button and then do a standard search. The co-ordinates of the selected search shall be compared with the co-ordinates of the individual point pollution sources. The geographical search shall work in a way that all points that are within the defined search area (and fulfils the other defined criteria), shall be found.

Id, name and alternative

The user can also search for point pollution sources by use of the ID, name and/or alternative. The ID shall be a numeric and the name and alternative shall be a text string. The combo box search for IDs shall contain "equal to, greater than, ..." (standard items in this list) and the combo box related to name and alternative search shall contain "match entire string" and "Any part of string". In other words, this is standard ENSIS functionality.

Select pollution type: This shall contain the following items:

- Infiltration
- Overflow at network
- Deposits
- Agriculture
- Aqua culture
- User defined

These are the same as the radio buttons in the registration forms. The user shall be able to limit the found objects by checking only the relevant types for the search.

The default checking of pollution types shall be a function of from where the form is invoked. For instance, if the form is invoked via Pollution sources | Agriculture | Point sources, only the Agriculture item shall be checked. If the form is invoked via Pollution sources | Domestic waste water | Overflow at network, the Overflow at network item shall be checked. The user can add more point source types by checking more of the check buttons.

Advanced search: This shall open a form where advanced search criteria are set. The check button "Apply advanced search criteria shall automatically be checked when the user closes the advanced search criteria form.

Search for sources: Pressing this button shall start the search. The button shall switch to "Stop search" as soon as it starts to allow the user to stop the search before it is finished.

The grid control showing the found objects shall list the following properties: ID, name, type of object (infiltration, overflow at network, agriculture, etc), the name of the water element/WWTP it is linked to, eastern and northern co-ordinates, altitude above sea level, and areait represents (if any) It shall be possible to sort the search result by clicking on the top of the column. The ID shall be sorted numeric.

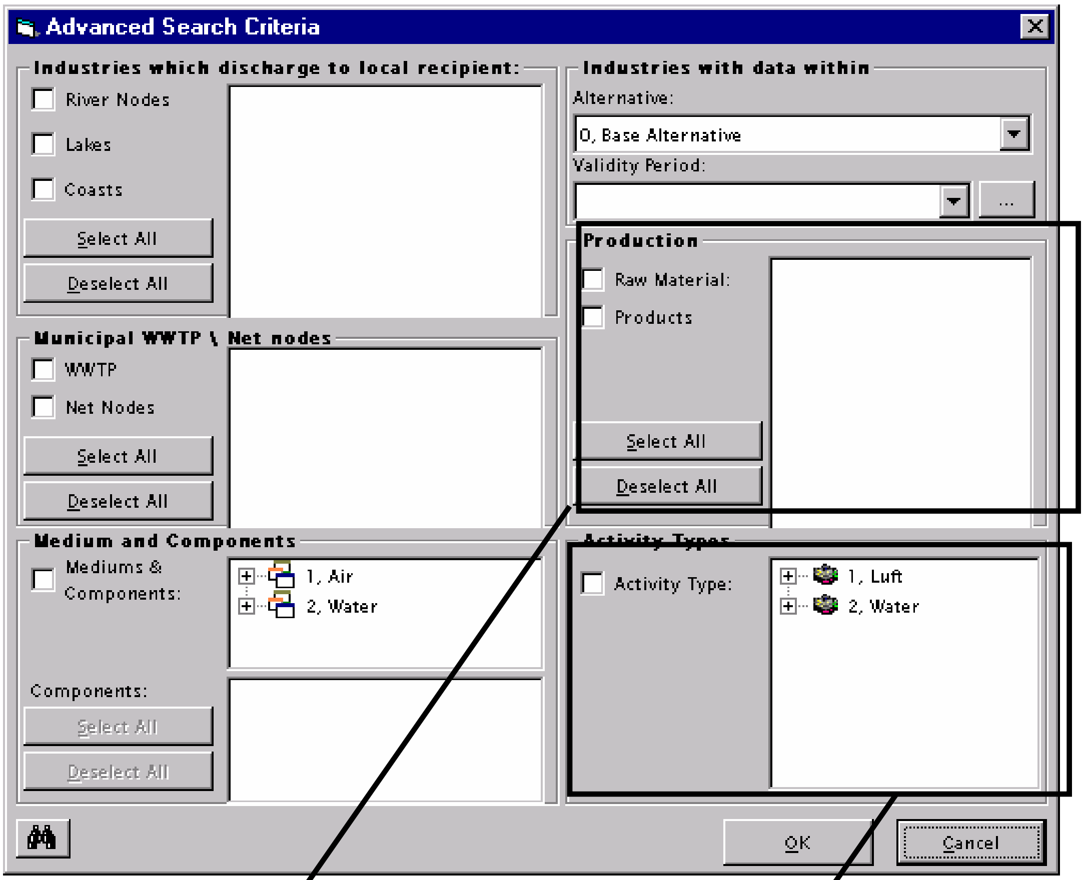
The buttons New and Edit shall open the form for registration of point source with the tab Identification and treatment in focus.

The Delete button shall remove the object, if the user has sufficient rights. If there is data in the "point pollution class", the user shall be prompted with a warning saying this, and be allowed to remove all the data in one job.

View on Map: When the user pushes this button, the point (location of the source) of the selected sources shall be shown on the map. If no maps are open, an open map dialogue shall appear. If one map is open, the points shall be shown directly on this, if several maps are open, the user shall be asked to select among opened maps. The selected points shall be shown with a different layout (or blink) than other shown objects. This type of functionality is present in the current measurement module (station), and is also described her in this specification.

The Exit buttons closes down the form.

<Advanced Search>



Replace this part of the form. It shall be replaced with search for owners (a check list with all registered owners in the project).

Replace this part of the form. It shall be replaced with search for text entered in the description field (free text search). There shall be a combo box with two items ("Match entire string" and "Any part of string"), and a field where the user can type what text he wants to search for. In other words, standard ENSIS functionality for search for name of objects.

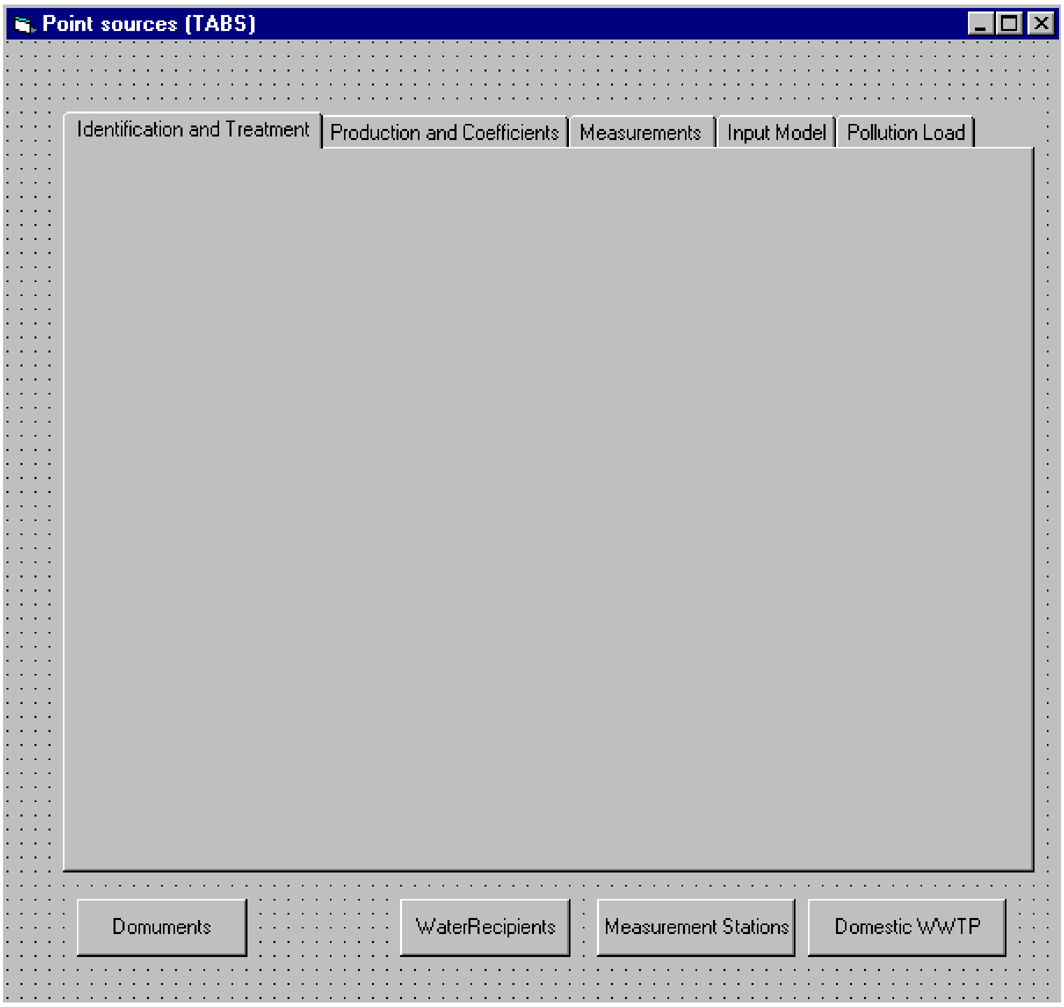
The advanced search criteria for point sources shall be implemented similar to how it is implemented on industry and diffuse source, and how it is specified for WWTP and treatment area.

Change the name in the frames in the upper part from industry to point pollution sources.

2.7.4 Overview if Tabs

A point source shall have the following Tabs.

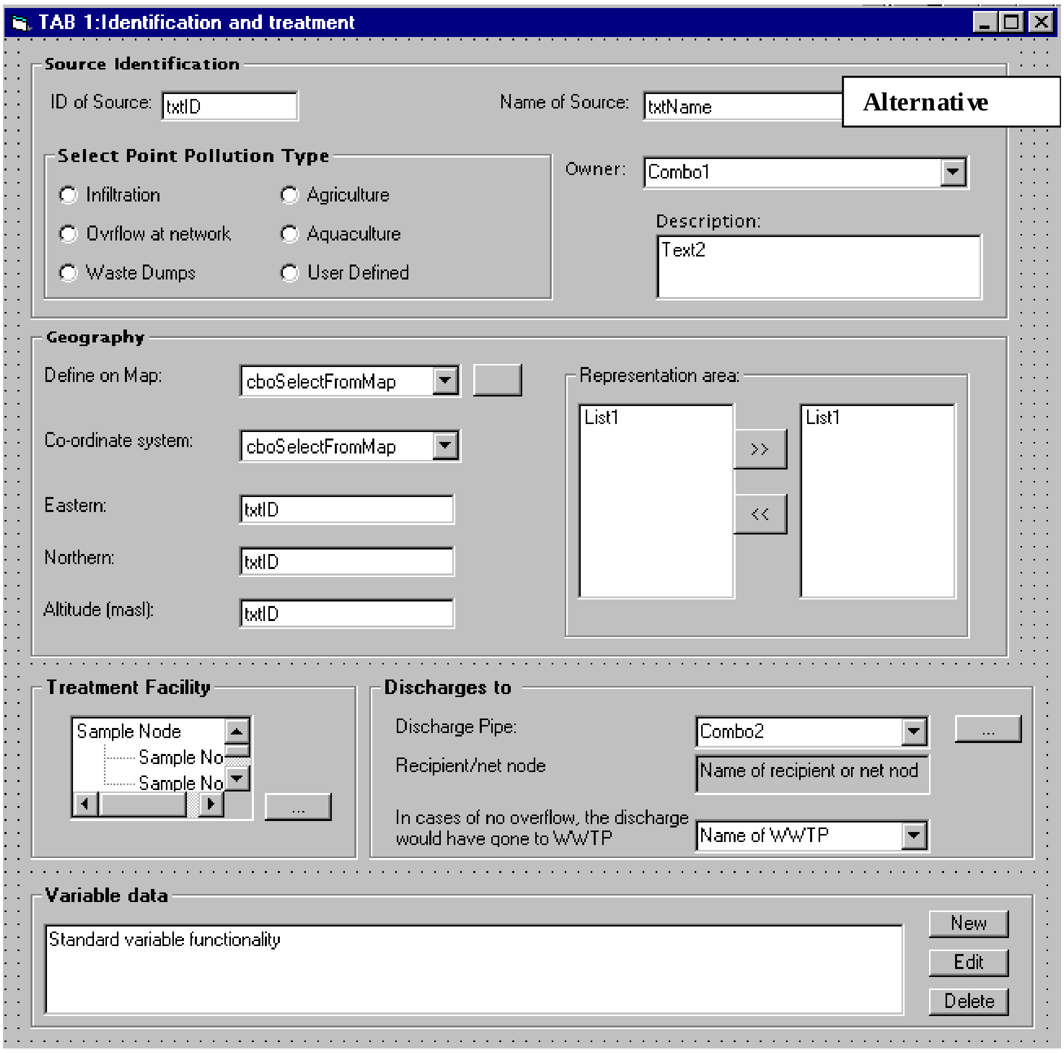
- Identification and treatment (1)
- Production and discharge data (2)
- Measurements and discharges(3)
- Input Model (4)
- Pollution Load (5)



For the point sources Infiltration and overflow at network, tab 2 shall be disabled. In addition it shall not be possible to enter information about treatment at source for these two sources. In the case of infiltration it is not relevant to enter loss figures for the discharge pipe.

There shall be some links established for the point sorce (as shown on the figure). In addition a link to report generator shall be established

2.7.5 TAB: Identification and treatment



This is the first tab, and it describes the geography related to the point source, the treatment facility and the discharge pipe/discharge location.

ID: This shall be a numeric.

Name: The name shall be a long text string.
Alternative: Combo box with alternative as a long text string

Type of source: The user must select what type of point source present object is. This shall be done with use of radio buttons. The following options shall be available: Infiltration, Overflow at network, Waste Dumps, Agriculture, Aqua culture and user defined.

The default checking of pollution types shall be a function of from where the form is invoked. For instance, if the form is invoked via Pollution sources | Agriculture | Point sources, the Agriculture item shall be checked.

The user shall be able to open the point sources form via one menu item (eg. Agriculture), but still store it as another type (eg. wastedumps), by changing the radio button checking.

Owner: The user shall be able to link an owner (from the classOwner), located under Addresses in the menu to the selected point pollution. The control shall be a combo box. There shall be a "New"-button beside the combo box.

Geography

This frame shall be standard ENSIS functionality. The user shall be able to define the point of the object, by clicking on the map or by typing the co-ordinates directly. The first option will make use of standard ENSIS tools, meaning the user selects the map, invokes the draw point mode, clicks a point on the map and paste the co-ordinates back into the form.

The user shall be able to manually type the co-ordinates.

Altitude (m.a.s.l.): The user shall be able to enter the altitude of the point. The control shall take decimal numbers (eg. 22.5)

Representation area

The idea with these controls is to allow the user to define that the point source might actually be valid for an area and not only a point, even though the source in ENSIS is represented as a point. For instance, the discharge data from a "point source" in the agriculture, might be an integration of several minor sources from an administrative area.

The region tree view shall in general contain adm region, catchment, treatment area, user defined area and coast and marine area. But Coast shall only be available in the region tree view when "Aqua culture" and "Others" is selected

The user must be able to select several items from the tree view by clicking them over to the control to the right.

The selection of representative area shall be optional.

Treatment Facility

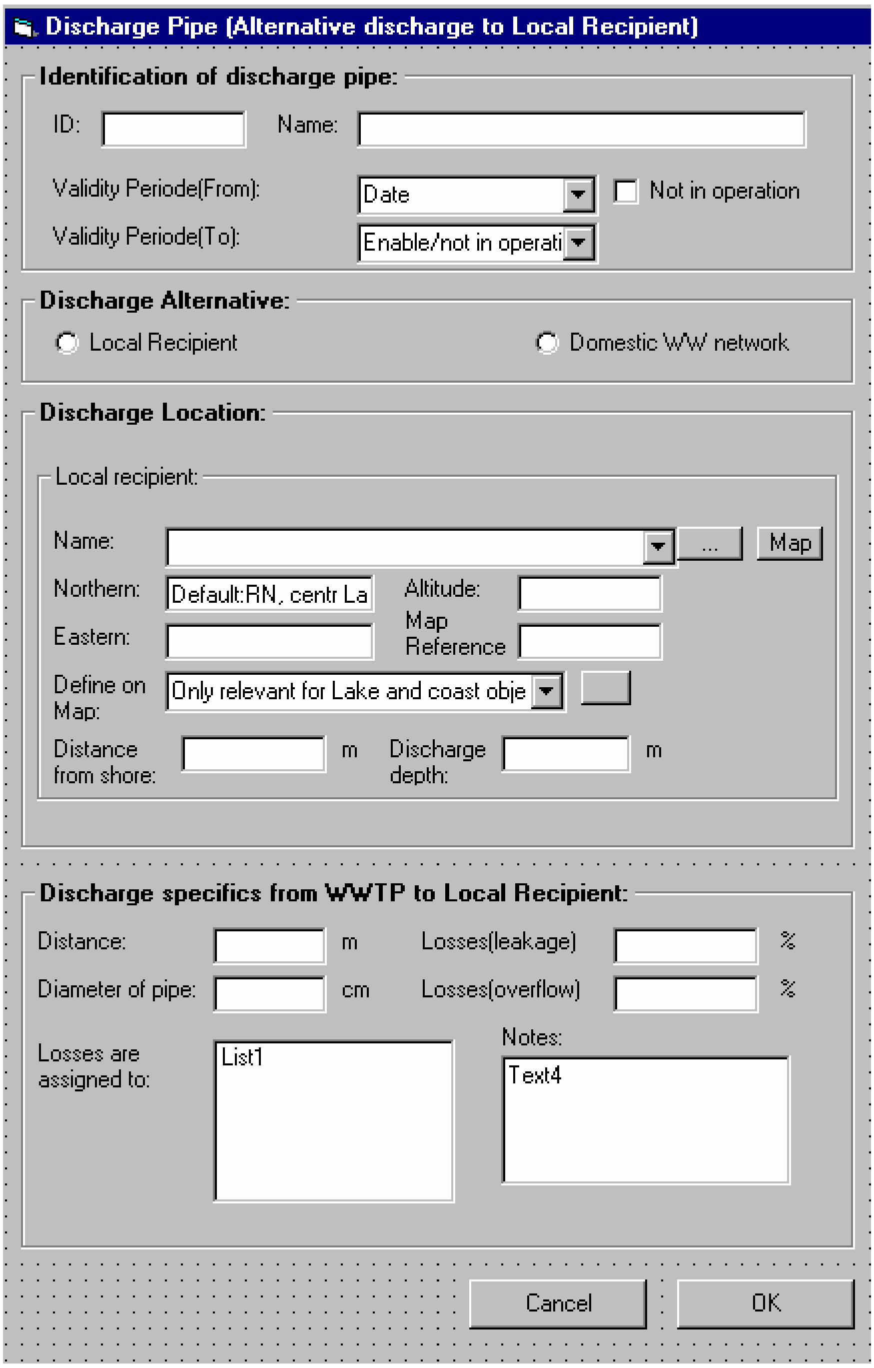
All point sources (except Infiltration) might be linked to treatment facilities. Same functionality as described under treatment area. The treatment facility treeview shall be implemented with the same functionality as described earlier, but it shall be a separate look up table linked to all point sources except domestic WW and industry.

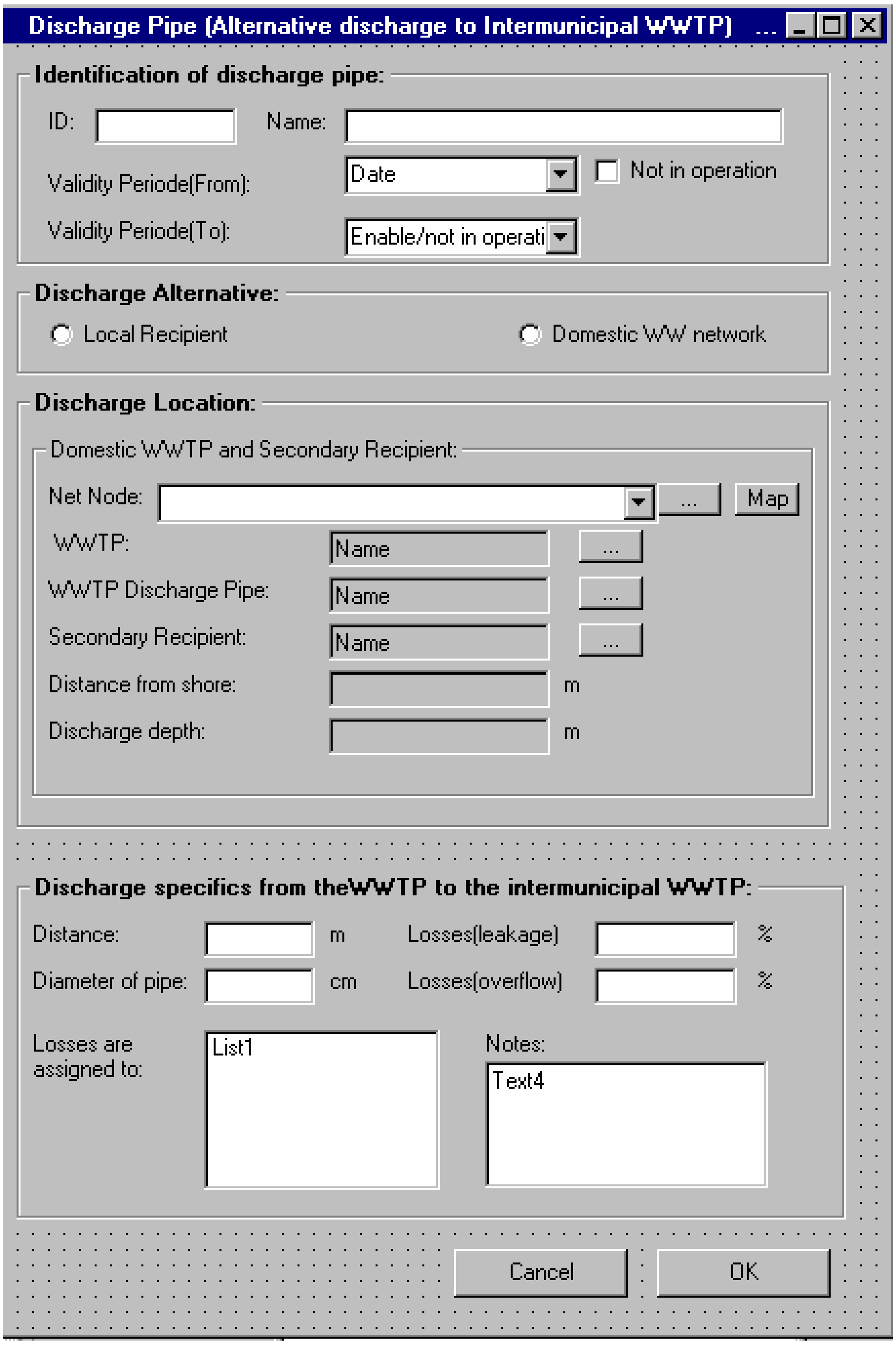
Discharges to:

The user selects the discharge pipe the source is linked to or create a new one. The functionality of the discharge pipe form is exactly the same as described under WWTP (see forms below).

However, when the source is defined as an infiltration source, the option “Local recipient in the discharge pipe registration form shall be disabled. Also the frame where the user assign loss figures to the discharge.

Remember to include a combo box with alternative on the following forms.


Discharge Pipe (Alternative discharge to Local Recipient)
Identification of discharge pipe:
ID:
Name:
Validity Periode(From):
Date
Not in operation
Validity Periode(To):
Enable/not in operati
Discharge Alternative:
Local Recipient
Domestic WW network
Discharge Location:
Local recipient:
Name:
...
Map
Northern:
Default:RN, centr La
Altitude:
Eastern:
Map Reference
Define on Map:
Only relevant for Lake and coast obje
Distance from shore:
m
Discharge depth:
m
Discharge specifics from WWTP to Local Recipient:
Distance:
m
Losses(leakage)
%
Diameter of pipe:
cm
Losses(overflow)
%
Losses are assigned to:
List1
Notes:
Text4
Cancel
OK



When overflow at network is selected, the discharge alternative to net node is always disabled. Also the user in this case has to fill in the WWTP the discharge would have gone to (if not in overflow) .

Since only one discharge pipe can be connected to the point source at a time and the discharge pipe is only valid for that point source. The validity period of the discharge pipe will give the period of connection to. As soon as one discharge pipe is disconnected (not valid) it will be an entry in the look up (This will function exactly in the same manner as described for discharge pipes to WWTP)

Apply: Stores everything to the database without closing down the form.

OK: Stores everything to the database and closes down the form.

Cancel: Closes down the form without any storage.

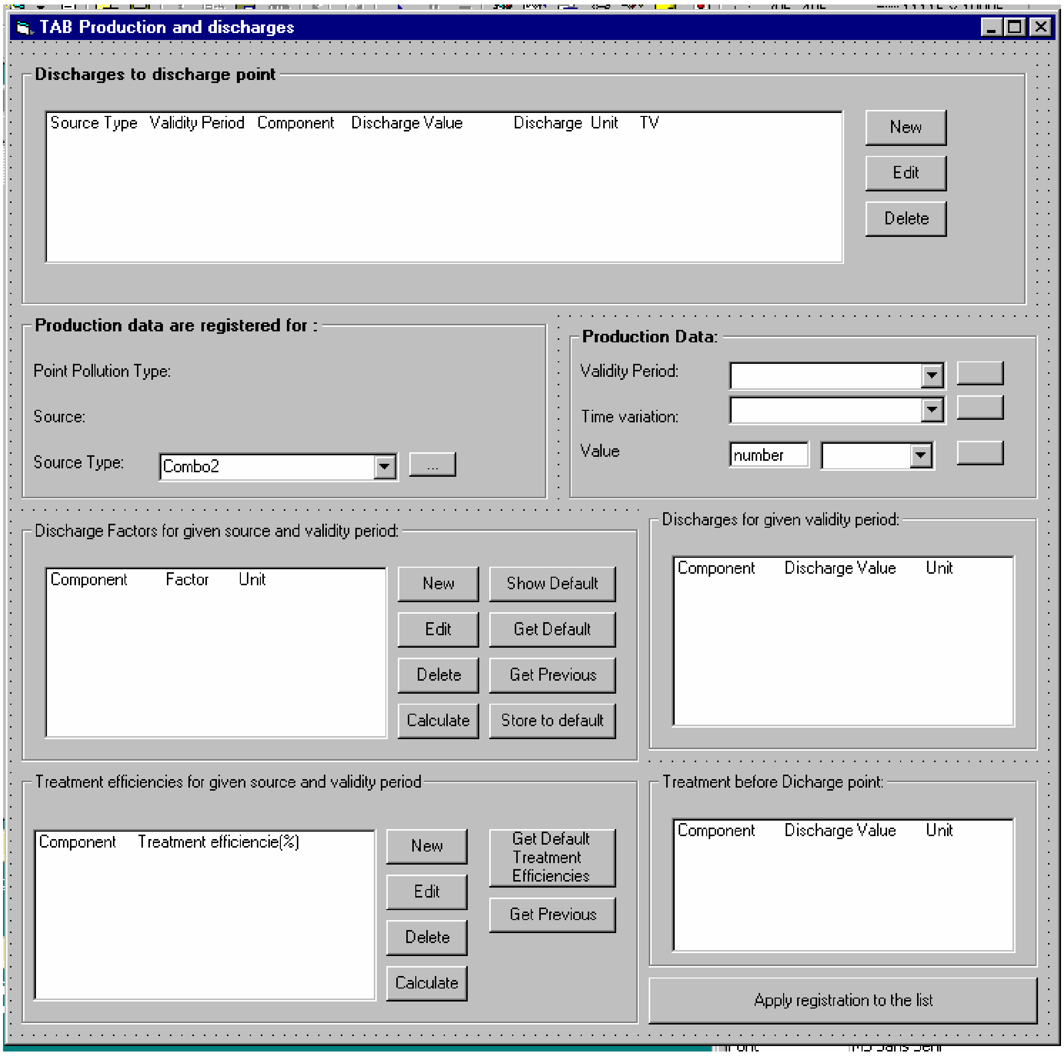
Variable Data

This is standard functionality in the application(but shall be replaced by Point source information ?? as specified for Industry and WWTP)

Required information

ID, name, alternative, type of source, eastern and northern shall be required information. The rest shall be optional. Link to discharge pipe/discharge location shall also be required.

2.7.6 Production and Discharges



This is the second tab of the point sources, named Production and Discharge Data.

This information in this tab is based on the same principle as treatment area when it come to creation of discharges based on theoretical/empirical discharge factors depending on the type of source.

The upper part is the already calculated discharges based on registration in the rest of the form.

If the user select one item in the list the data used to calculate the discharges will automatically be filled in the rest of the form. If the user wants to enter new discharges he/she presses new, and the rest of the form will be left blank If the user wants to edit , he/she can do so but need to recalculate the discharges adn apply the registration to the list.

Production data are registered for

Point pollution type and name of source is given from Tab 1. In addition the user has to register the source type. The source type is a combobox where the user selects one item. The combo box is getting data from a new look up Called point pollution source type. The source type is linked to the point pollution type (i.e agriculture) and is typically manure-hen, manure-cow, siloproduction-cow, salmon production etc. Not all items from this look up table shall be shown, only those that have checked to be relevant for present pollution type (overflow at network, waste dumps, agriculture, aqua culture, others).[24]

Production Data

Validity period: The data entered in this form shall be assigned to a specific time period. There shall be a standard combo box and a <...>-button for defining a validity period which is not available from the combobox.

Time variation: This shall be standard time variation functionality. The time variation will be identical to all the data entered below (not variable data, which has its own time variation) for the given validity period.

The value representative for the source type must be given, the value is given with all units derived from unit types that have time in the denominator (eg. count per time, mass per time, volume per time, etc, and from this kg/day, tonnes/year, etc)

Discharge factors for given source and validity period

Show default: Pressing this button will open the form where the point pollution discharge generator factors are defined (a similar form as the emission/discharge factors, but a separate look up) are defined. The form shall be opened with no selections made.

Get default: Pressing this button will get (retrieve) default factors for the selected source type and component. In addition, the validity period of the point source must fit the validity period of the default discharge factors.

Get previous will allow the user to select the discharge factors which were defined for the same source and source type the last validity period which was defined.

Store to defaults: If the user has defined discharge factors, related to a source type , component and a specific validity period (validity period of the point source), this can be saved as default discharge generator factors The system must check if the combination of source type, component and the specific validity period already exist in the library of default factors. If so, the user must be prompted with a message asking if he wants to overwrite existing combination.

The user may as elsewhere in the application create a new factor, edit an existing factor or delete a factor.

[24] It might be thought through if the production factor should move to the definition TAB in order to have one source per source type, and not a mix for a source

If the user push calculate he/she will transform the production figures and discharge factors to discharge values (mass/time). Automatically unit conversion must be carried out from the "Value unit" and the "Discharge factor unit".

Treatment efficiency for given source and validity period

If the user wants to it is possible to reduce the discharge figures calculated above, because of treatment at source. The default treatment efficiencies is a result of registration of treatment facility. The user may also get the previously defined treatment efficiencies. If the user chooses to create a new/edit the defaults he/she can do so. The form will be the same as defined for the treatment area module.

If the user push calculate he/she will calculate the amount of the discharge above which is treated in unit mass/time according to the formula
=Discharge from source* Treatment %/100.

Apply registration to list

If the user applies the registration to the list the values calculated will be saved to the database. The discharges to discharge pipe/collection point will be calculated by:

Discharge to Discharge Pipe =Discharge from source-Treatment

If the user has not calculated treatment for some of the components the value will be calculated as:

Discharge to Discharge Pipe =Discharge from source

Graphics and reports

Will come

Example 1: Agriculture:

Column name	**Value**
Source type	Silo fluid
Value	2000
Unit	Kg/year
Component	PTOT
Discharge value	24
Discharge unit	Kg/year
Default discharge factor	12
Default discharge factor unit	g/kg (g PTOT per kg silo fluid)
Treatment (%)	50

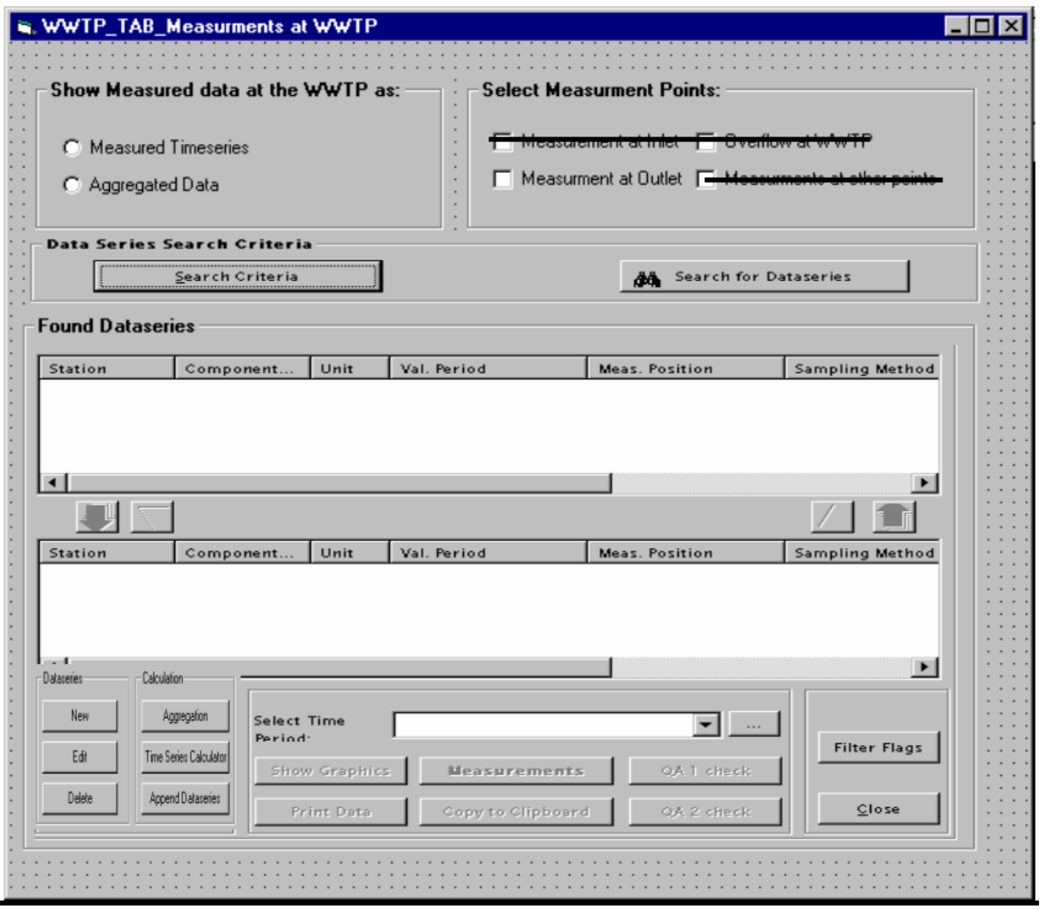
Example 2: Agriculture:

Column name	Value
Source type	Manure from Cows
Value	300
Unit	N/year
Component	PTOT
Discharge value	9
Discharge unit	Kg/year
Default discharge factor	30
Default discharge factor unit	G/n (g PTOT per number of cows)
Treatment (%)	40

Example 3: Aqua culture:

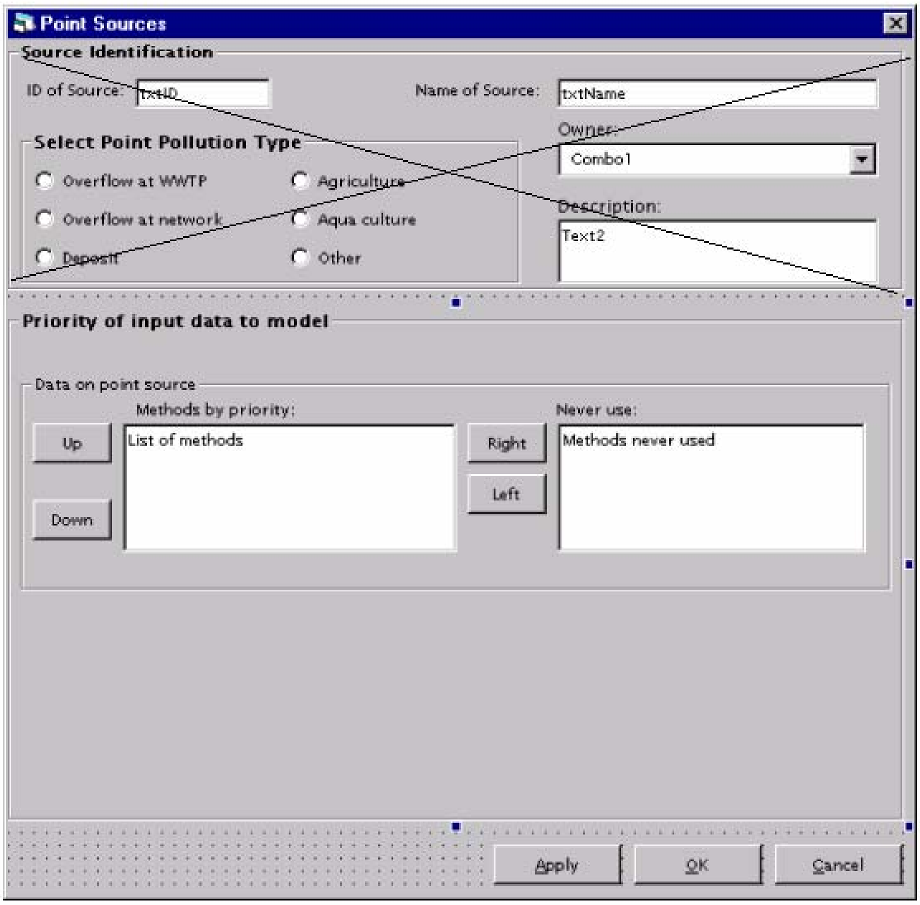
Column name	Value
Source type	Salmon (fish)
Value	20
Unit	Tonnes/day
Component	NTOT
Discharge value	22
Discharge unit	Kg/day
Default discharge factor	1.1
Default discharge factor unit	G/kg (g NTOT per kg of salmon)
Treatment (%)	0

2.7.7 Measurement and discharges



On this TAB the same functionality as described under the WWTP | Measurements shall be implemented. The only difference is that only Measurement at outlet shall be available, and the station reference shall be the name of the point source.

2.7.8 Tab Input data model



This is the tab of the point sources, named Input data model.

Priority of input data to model:
This shall be used for model purpose, and will only have any affect when the pollution budget model that includes all sources is executed (and on the load tab). The list shall have the following content, from top and down (as default). By default, all of the three methods shall be located in the grid control to the left with the following priority:

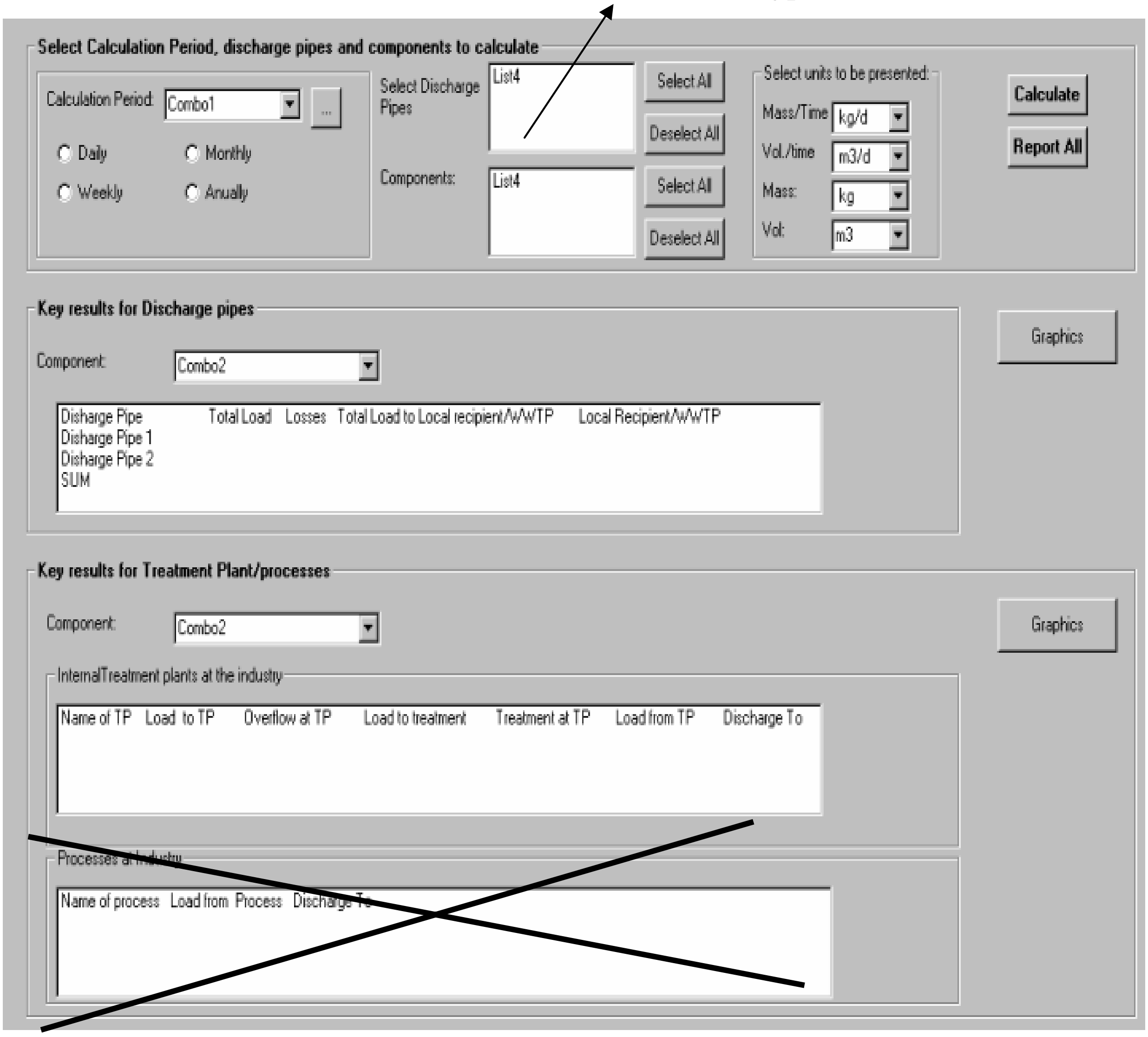
1. Discharge Timeseries at outlet
2. Aggregated discharge data at outlet
3. Discharge data from production figures

The user shall be able to move the items of the list up and down by use of the arrows on the right-hand side of the list. The most upper item shall be used as input when the model is included.

2.7.9 Tab Pollution Load

Same functionality as for Industry. Except replace Discharge pipe with source type and only show discharge from the different source types and the amount removed during treatment.

Select source type



2.7.10 Point Pollution Source type (look up)

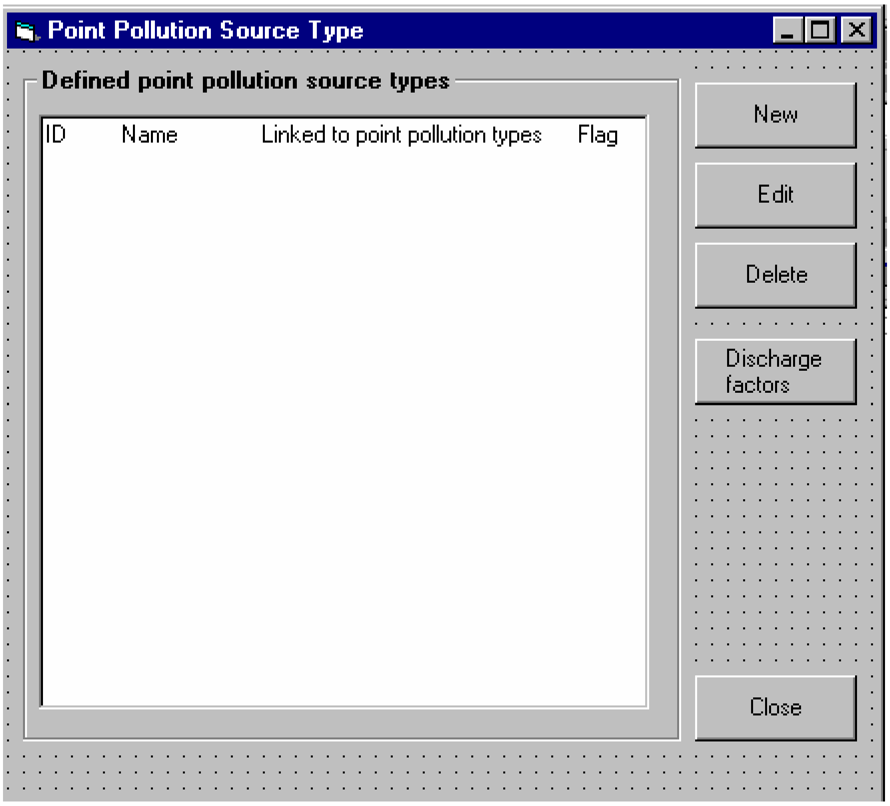
One new look up table has to be constructed to support the new terms. This form shall be used to define what type of pollution that is described, and more detailed than agriculture, aqua culture, domestic, etc. Typical items that will be included in this list will be:

- Manure-Cow
- Manure -Pig
- Manure -Hen
- Or only manure
- silo-Cow
- silo -Pig
- silo -Hen
- or only silo
- Salmon farm
- Etc

There shall be a way to check which of the items that shall be available for what main point pollution type (overflow at network, waste dumps, agriculture, aqua culture, deposits, others).

Discharge factors shall be linked directly to these point source types. It is not relevant to link the factors to geographical region.

2.7.10.1 Point pollution source type, main form



This is the form that lists defined source types. Properties to be listed are ID, name and what point pollution types the source types are linked to (eg, overflow at WWTP, overflow at network, agriculture, aqua culture, deposits, other). The flag shall say if there are discharge factors linked to the source type or not.

It shall be a list that allows the user to sort on the individual properties by clicking on top of the column. The ID shall be sorted numeric, not alpha numeric.

<New>: Opens a blank registration form.

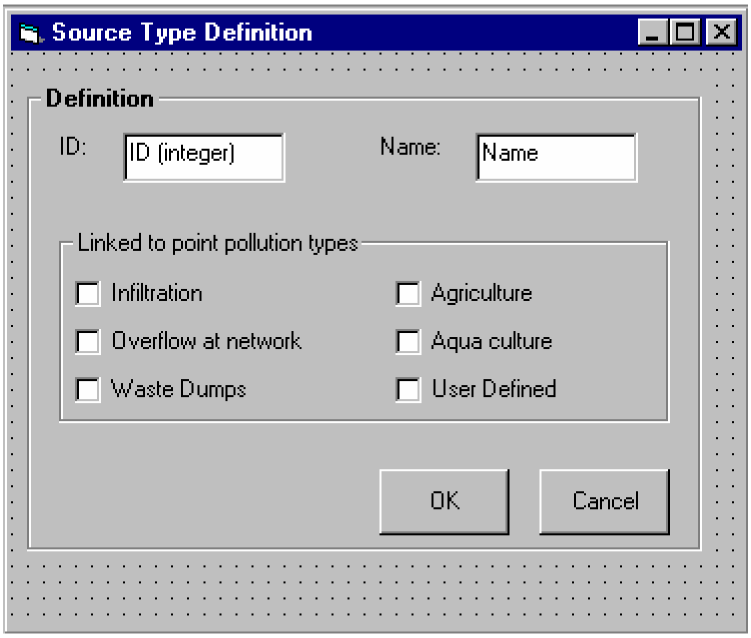
<Edit>: Opens a registration form with selected item read into it.

<Delete>: Delete selected item from the list.

<Discharge factors>: Opens a form where discharge factors can be linked to the selected source type (form described later).

<Close>: Closes down the form.

2.7.10.2 Source Type Definition, <New> and <Edit>



This is the form where new source type definitions are defined. A standard look-up table consisting of ID and name shall be created. The ID shall be of type numeric, and the name shall be of type string.

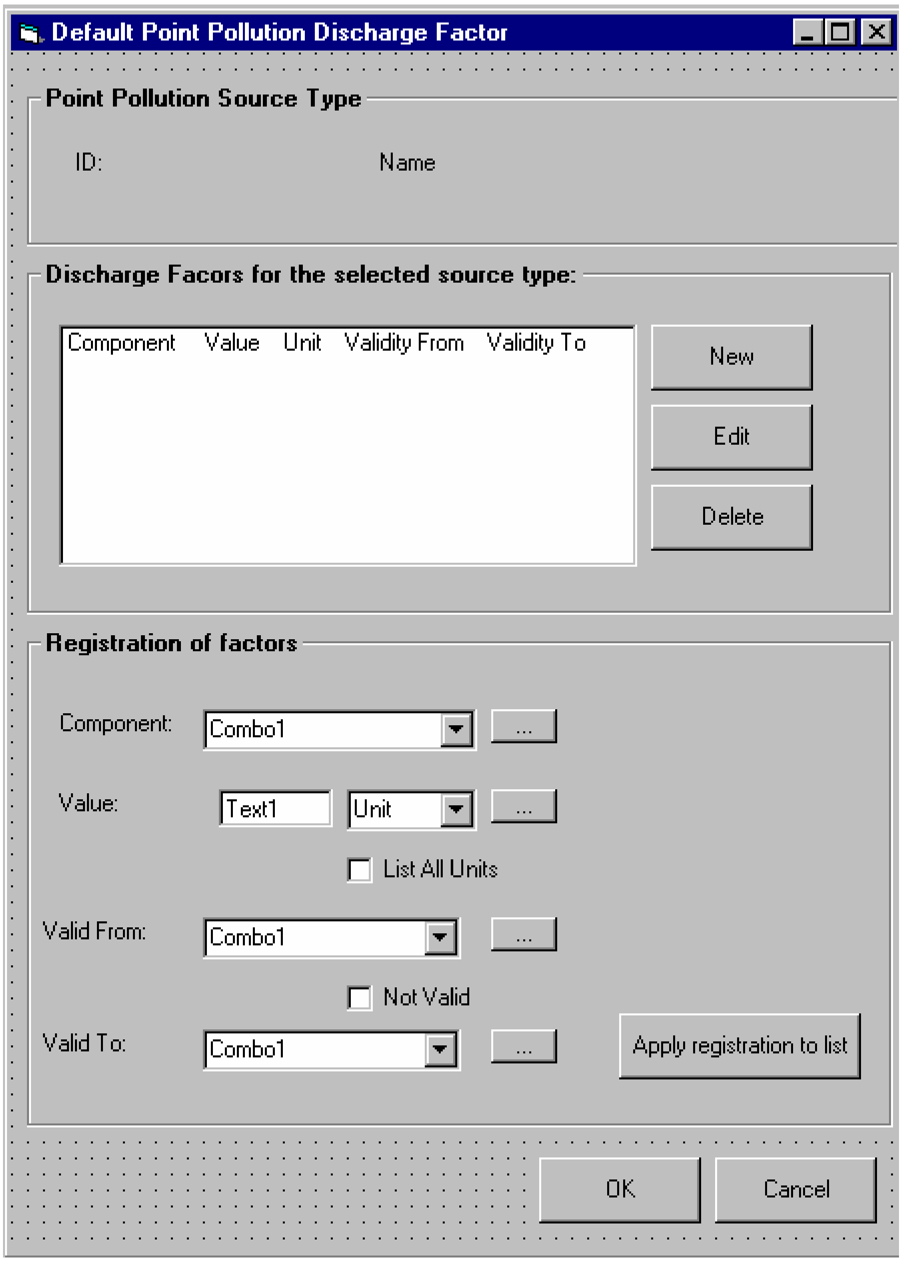
The idea behind linking to a pollution type is to limit the number of items in the list of source types when these are defined for the individual point pollution sources. When the user defines a point pollution of type "Agriculture", only the source types that have agriculture checked will be present in the combo box when the user wants to assign discharges to the point pollution
By default, all pollution types shall be checked.

<Discharge Factors>: This button opens up the form where discharge factors are linked to the selected source type (form described later).

<OK>: Stored the information to the database.

<Cancel>: Closes down the form.

2.7.11 Default Point Pollution Discharge Factors



This is the form where new discharge factors related to the source types can be entered, and existing ones edited. The form shall not be available from the menu line, only from within other forms. For this reason, the source type is already selected when the form is opened.

Source type identification: ID and name are read from the previous selection and shown for information. These fields are not editable.

Discharge factors for the selected source type

All discharge factors valid for the source type are listed in the table.

If the user wants to create a new factor or edit an existing one he/she may do so.

New: the registration of factors part of the form will be blank

Edit, the registration form will be filled with information from the selected item in the list . The user may edit the data and apply the changes.

Component: select from combobox

Value: This shall be a text box where the user can enter a numeric value (float).

Unit: This shall be a combo box by default listing units derived from the following unit types:

Mass/mass
Volume/mass
Count/mass
Mass/volume
Volume/volume
Count/volume
Mass/count
Volume/count
Count/count

We are a bit concerned that this might not be sufficient in some cases. For this reason a check saying, "List all units" is included. This shall by default not be checked.

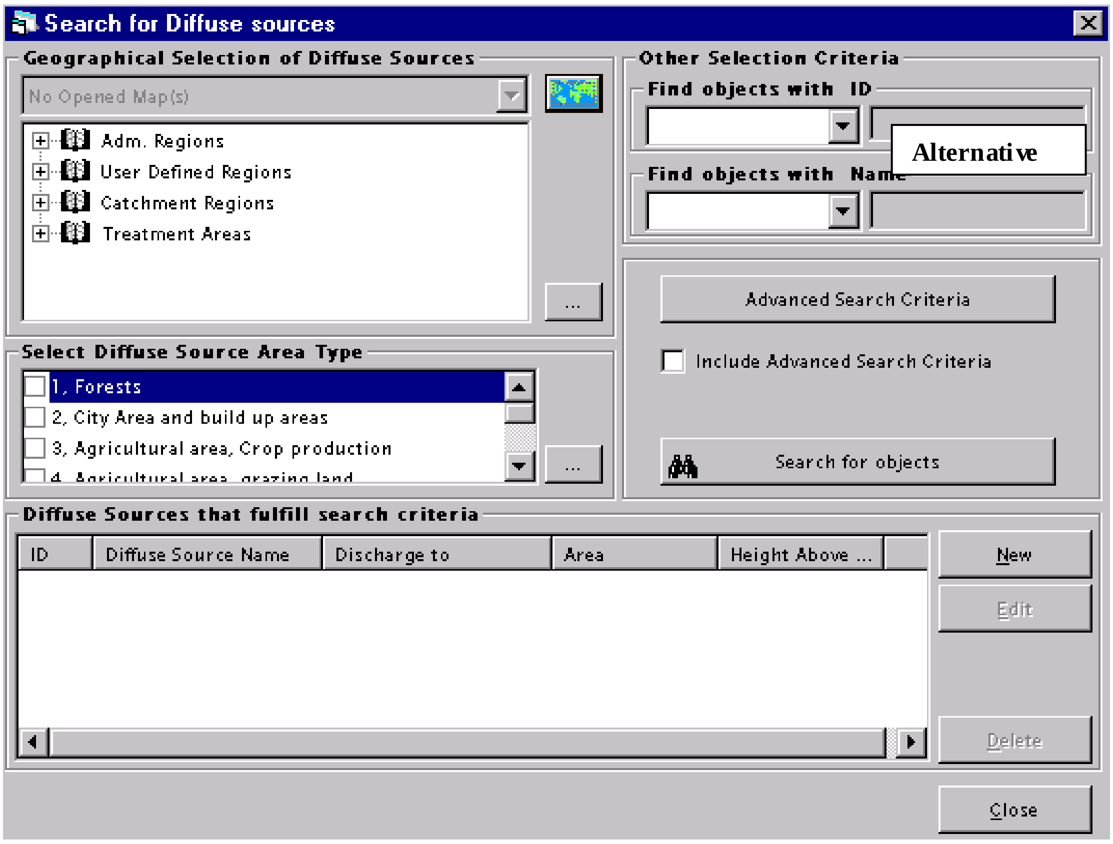
Validity period: This is a validity period with a “from” to “to” date as described elsewhere in this specification.

Apply registration to list: This button will move the selected item in the controls to the list and prepare the form for new selections. Keep the validity period and the unit similar to the previous, and clear the value, value unit and the component.

OK: Pressing this button will save the selections in the Registered factors to the database.

<Cancel>: Closes down the form without saving anything to the database.

2.8 Diffuse sources (agriculture, runoff from urban area and user-defined diffuse sources)



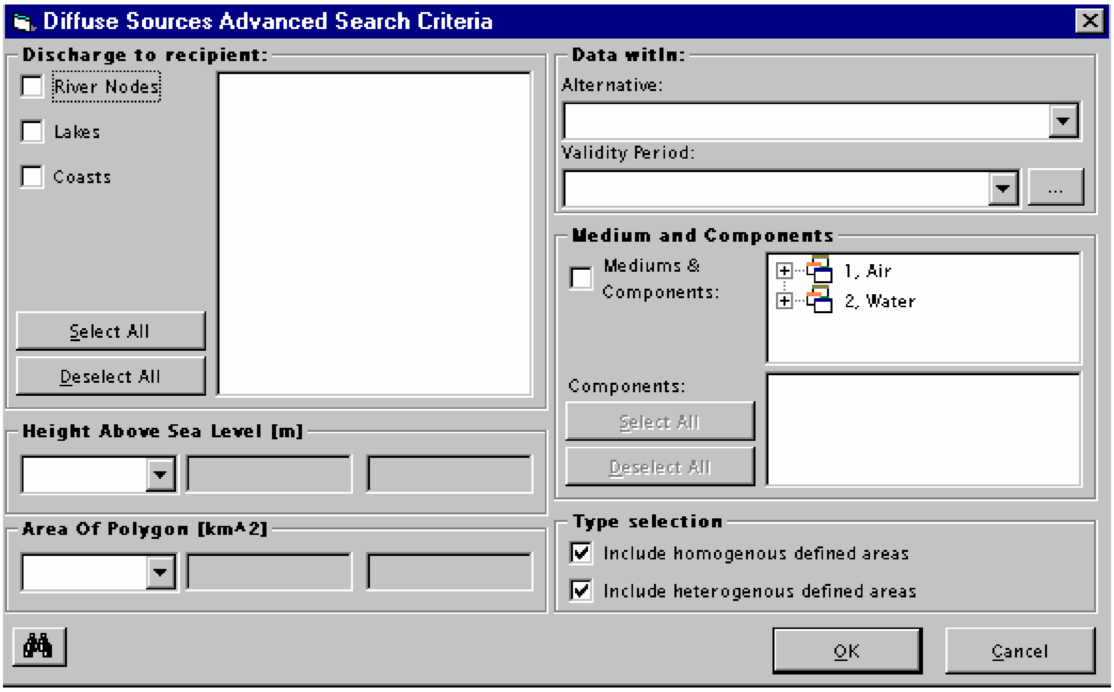
Additional search criteria for diffuse source types. Include check boxes for the three types (agriculture, runoff from urban areas and user-defined diffuse areas).

The property diffuse source type must be shown in the result

This is search list form of the existing diffuse source. It shall be possible to define three different types of diffuse sources, agriculture, runoff from urban areas and user-defined diffuse sources. The existing source and properties shall be of the first type, agriculture. This means that one extra search criteria shall be added in the main search form. It must be possible to search for the three types. By default only one diffuse source type shall be checked when the form is opened. When the form is opened via the menu entry called runoff from agricultural fields, only this check box shall be checked. When opened via the runoff from urban areas, only this on shall be checked, etc. The user shall be able to add the other two types before starting the search.

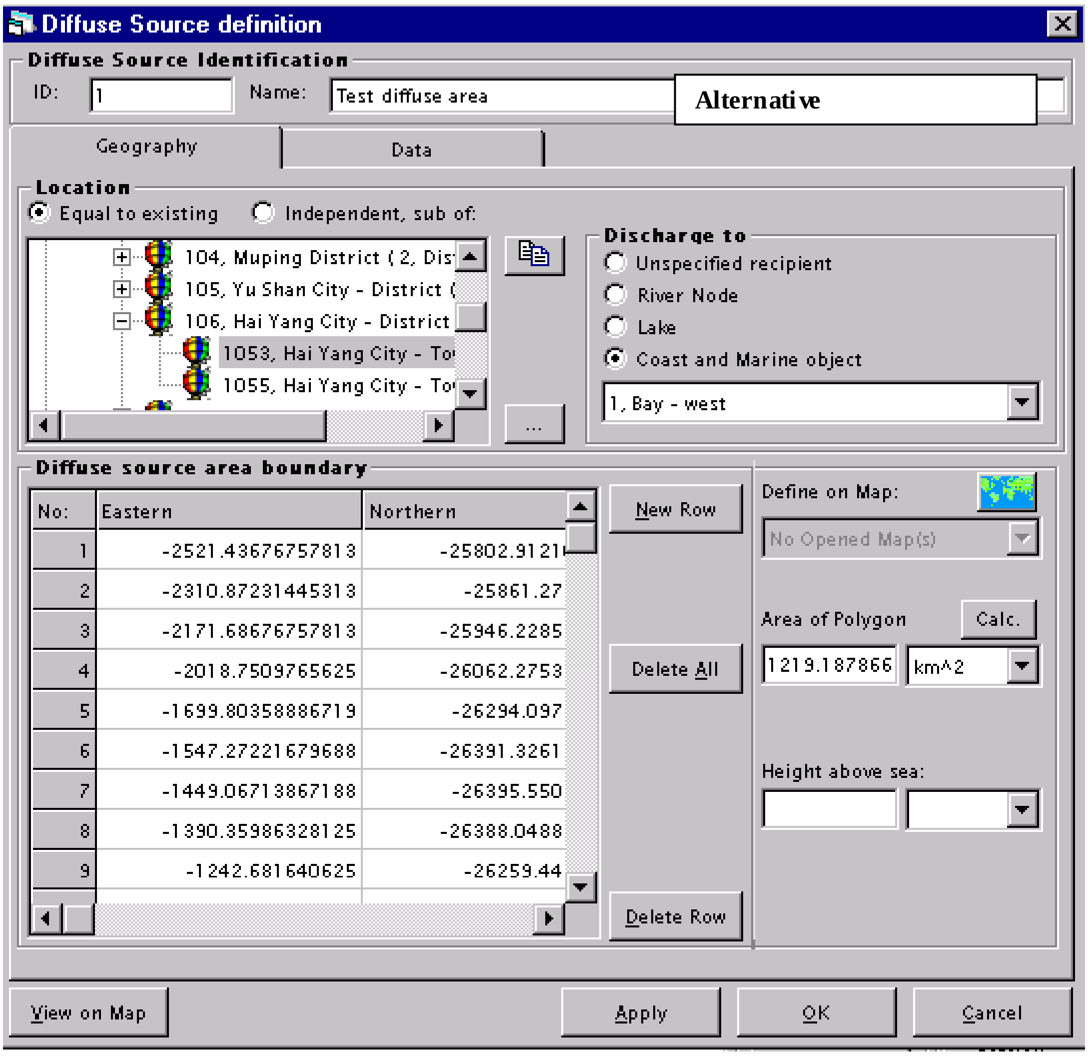
The possibility to store information on three different types will slightly affect the other existing forms on the diffuse source.

2.8.1 Diffuse source - Advanced search criteria



The medium shall be removed. Remember also that the listed river nodes, lakes, etc shall be a function of the geographical selection on the main search form.

2.8.2 Diffuse source - New and Edit - Tab Geography



Include a combo box alternative.

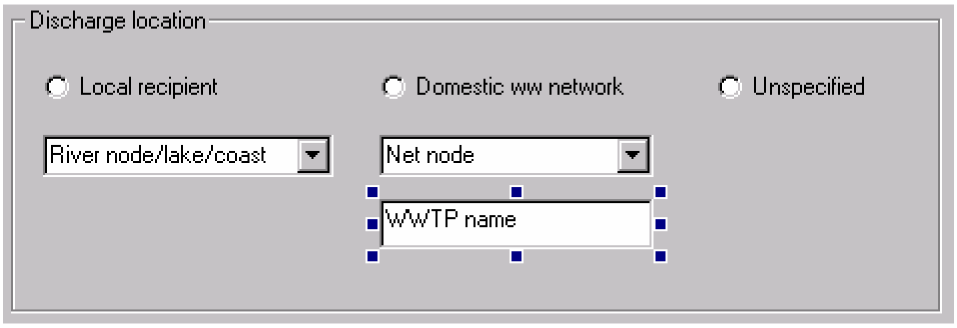
Include a button called View documents, as specified in the general section at the beginning of the specification document.

It must also be included option buttons on this form saying if the source is agriculture, runoff from urban areas or user-defined diffuse sources.

Discharges to:

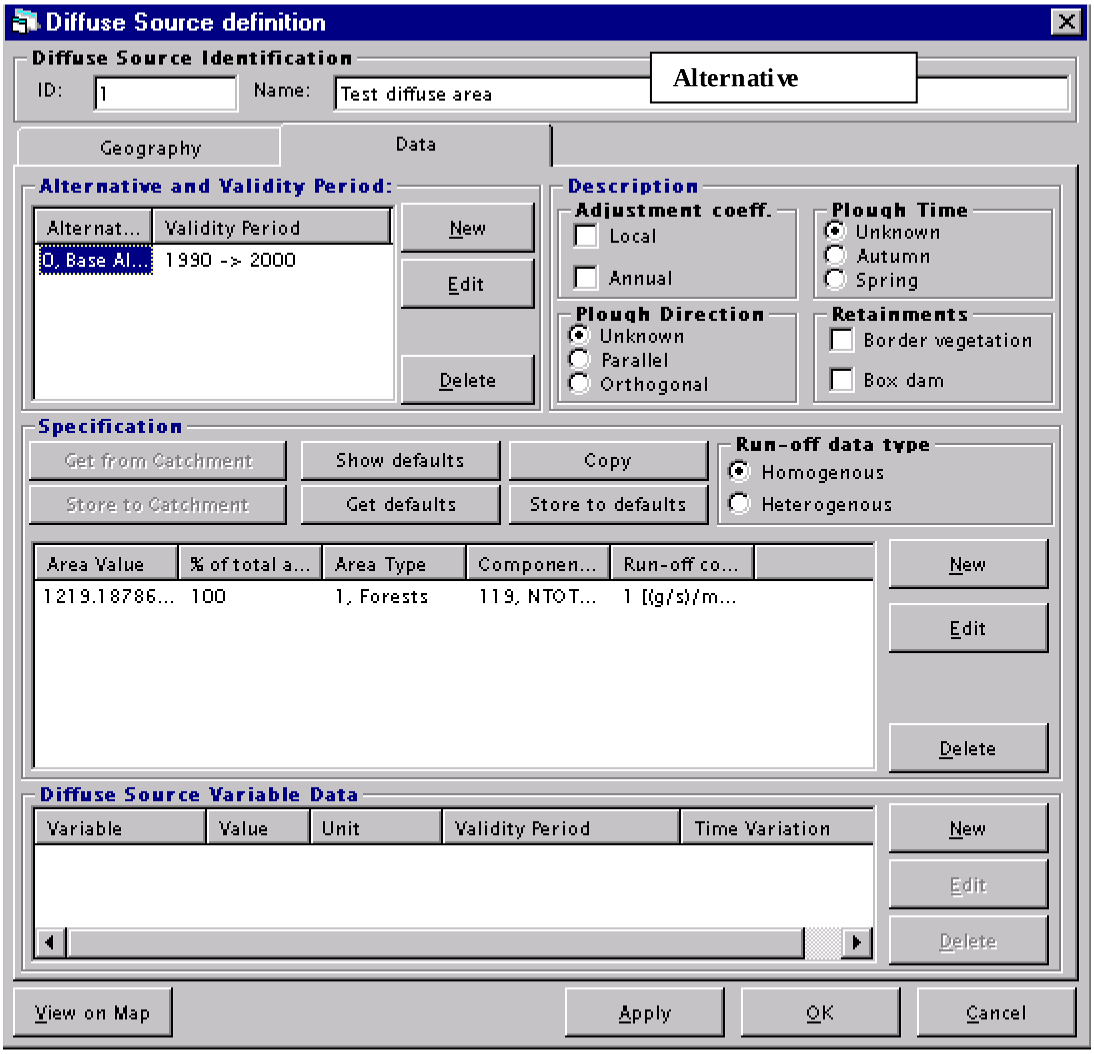
This frame must be changed with the one below because it must be possible to link runoff from urban areas to net node and further to wwtp (as elsewhere in the application).

So, when the option button runoff from urban areas is selected, also the discharges to domestic ww network must be enabled. When agriculture and user-defined diffuse sources is selected, only local recipient and unspecified shall be enabled. The hide/show of the combo boxes and text filed for wwtp must be done in accordance with the selection of the option buttons.



2.8.3 Diffuse source - New and Edit - Tab Data

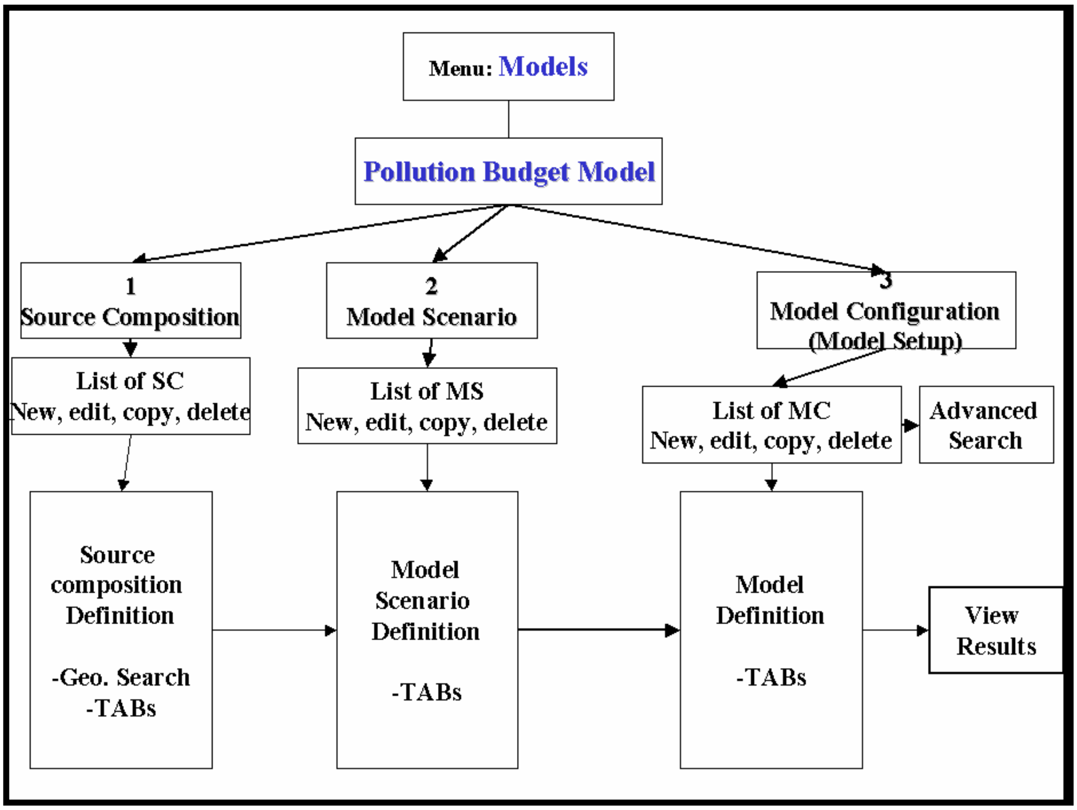
Except for the alternative, that shall be removed from the Data tab and placed in the identification frame, this tab shall be kept identical for the agriculture diffuse source.



For the runoff from urban areas and user defined diffuse areas, the plough time, plough direction and retainments shall not be available (shall be hidden from the form).

The buttons Get from/Store to catchments shall never be enabled for the types runoff from urban areas or user-defined diffuse sources.

3 Pollution budget model - functionality of the model



The complete water pollution budget model shall build on the existing (ENSIS 2.05) version of the pollution budget model. Calculation routines for handling different types of input data (interpolation, extrapolation, aggregation, etc) shall be based on the already implemented routines. This is given in Annex 1. It is also assumed that the existing functionality of ENSIS is known and understood by the programmers. For this reason, implemented functionality is not explained unless this is necessary to make the specification clearer. This specification introduce the following changes and modifications to the existing model:

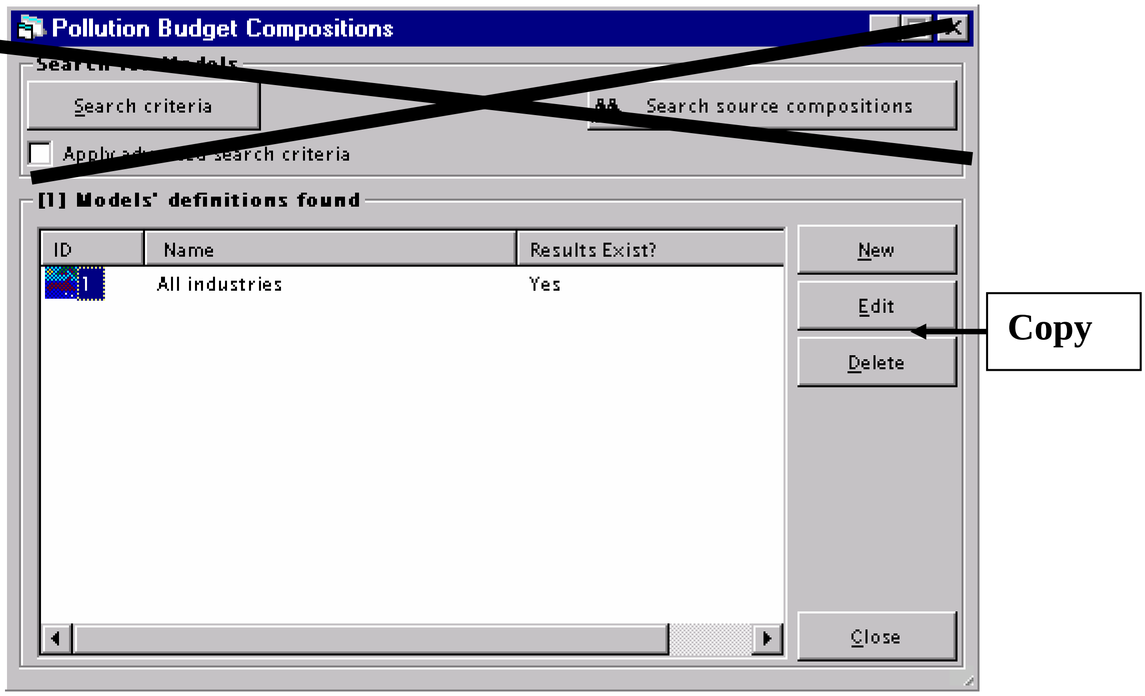
- Inclusion of all the new specified sources in the complete pollution budget model
- Additions/modifications in the functionality to build a source compositions
- Additions/modifications in the selection of data for presentation
- Additions/modifications in the way data is presented
- Inclusion of alternative handling

Yellow tags (tool tips) must be included in all controls where items are listed, and where there is a chance that items might be too long to be completely seen.

The model shall still only operate on the input data based on mass/time. The input data = Discharge data are calculated based on the registration at the sources and the prioritisation of calculation methods defined at the sources.

The alternative/scenario handling as implemented in ENSIS 2.05 will be changed. This is described in detailed in chapter 5. We refer to this chapter to clarify terms and concepts.

3.1 Source composition



This is the existing form for list of source compositions. The functionality shall be kept very similar, but we want to take away the possibility to do advanced search for source composition. We think this is not needed functionality. So, take away the Search criteria button, the form behind, the Apply search criteria and the button to start the search. The list shall be filled as soon as the user opens up the form.

It shall be implemented a button saying "Copy", that takes the selected source composition, except from the ID, name, scenario and model configuration using present source composition (shall be left empty) and pastes it into a new form.

Additional properties to be shown in the list shall be: If sources both Connected and Not connected to WWTP are included (check in the registration form of the source composition).

3.1.1 Major changes in the source composition definition

There must be implemented new tabs to handle the composition of the source. In ENSIS 2.05, only discharge data from industry is included. For this reason, the source composition reflects only the extract of data from the industry inventory. In this specification also discharge data from the other existing sources, and all newly specified (in this document) must be possible to include (as long as they are relevant for running the model).

The following tabs to extract data must be implemented, in the given order (from left to right):

- Domestic WWTP
- Industry
- Point sources
- Domestic ww activities
- Diffuse source

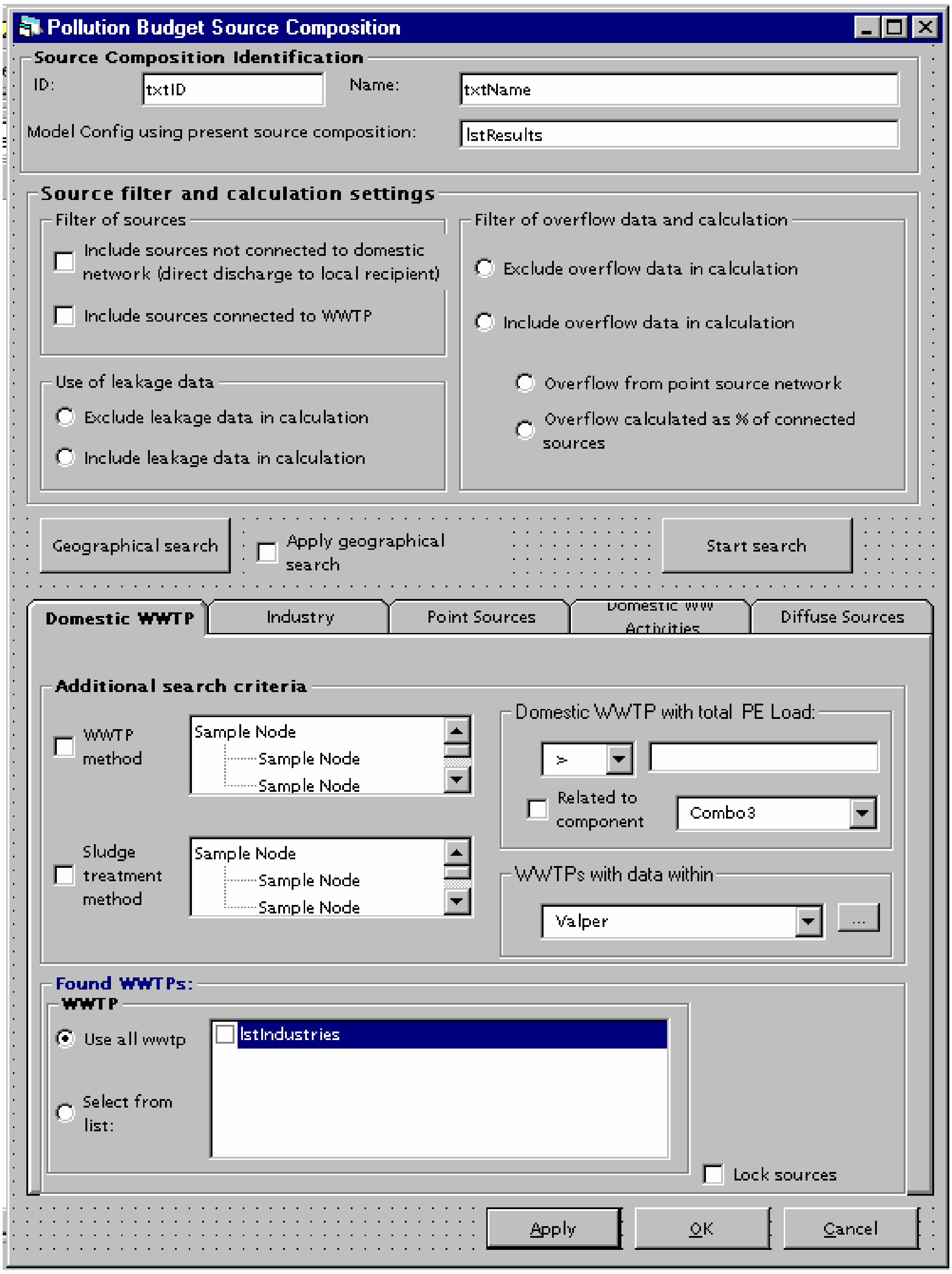
There shall be some "global" information for all tabs like ID, name, Model configure using present source composition and link to scenario. There shall also be some "global" search criteria that are located on the top of the form, or behind a button on a separate form (Geographical search), and some settings that will influence the use of data in the calculation (overflow and leakage). In addition, there are tailor-made search criteria for the different sources stated in the bullets above. The "global" information and search criteria are only specified once.

All the tabs shall have a check box in the upper left corner (similar to the air emission source composition) that indicates if this type of source is included or not.

Found sources should be listed by ID and Name. The alternative of the source should be selected in the Model scenario definition. This is the same for all pollution source tabs.

<u>Lock the sources:</u>
There shall be a check in the lower right on all the tabs saying if the sources are locked or not. The idea of this check is to ensure that additional sources are not included, or some are taken away when the user has finished the preparation of one source and edits another one. If the user has prepared a composition of domestic wwtp sources, he shall be encouraged (by a message coming up) to lock this part of the source composition (check the lock sources), before he goes to the next type of source (eg. industry). When the user goes back to the domestic wwtp tab again, he must uncheck the lock before he can change the domestic wwtp part of the source composition.

3.1.2 Definition of source composition



This upper part of the form is common for all the tabs in the pollution budget source composition.

Global information, meaning identical to all different tabs

<ID>: This shall be a unique ID for the source composition. The control shall be of type integer (numeric value). As implemented in ENSIS 2.05.

<Name>: The user shall in this field be allowed to enter the name of the source composition. It shall be a text field. As implemented in ENSIS 2.05.

< Model Config using present source composition, Results exist/ not exist>: This fild shall list what model configurations that make use of present source composition (This is for information only and a result of registartion at the configuration TAB). It can be one or several configurations.

<OK> and <Apply>: This saves the source composition to the database. If the saving of the composition imply that **a source composition is changed,** the following options shall be prompted to the user as soon as he has clicked OK (before final storage to the database):

1. Keep the link to model configuration and the related results even though there is a mismatch between the source composition and the results.
2. Keep the link to model configuration(s), but delete the related results to avoid mismatch between the input and the results.
3. Delete the model configuration(s) and the related results.
4. Cancel the operation.

OK closes down the form, while Apply stores without closing the form down.

<Cancel>: Pressing this button closes the form. The user shall be prompted a message saying: "Do you want to save the new/edited source composition before closing?" if the user has created a new one or edited an existing one without saving.

<u>Filter of sources</u>
This part of the form is partly to filter out sources when listed on the tabs, and partly to define what data on the individual source to be used in the calculation.

Include sources not connected to domestic network: If this one is checked, all sources that are not connected to a municipal network shall be listed in the list of found items on the different source TABS. This shall by default be checked.

Include sources connected to WWTP: If this one is checked, all sources that are linked to a WWTP via net node shall be found. In many cases these sources are not relevant for the user to list since the pollution load they represent are already included in (connected to) the WWTP. Anyhow, the user might be interested in see how much pollution that goes to a WWTP. This shall by default not be checked.

<u>Use of leakage data:</u>
Exclude leakage data in calculation: If this one is selected, no leakage from the source upstream (=connected to) of a WWTP shall be included in the calculation. (This means that leakage will not be subtracted from the load going to the municipal network)

Include leakage data in calculation: If this one is selected, leakage from the sources upstream (=connected to) of the selected WWTPs shall be included in the calculation (this leakage might represent a discharge load to a recipient, and will be subtracted from the load which goes to the WWTP). This is independent of include connected sources is checked or not. The system shall during the calculation check which WWPTs that are included (here in the source composition), which sources that are connected to these WWTPs, and if leakage figures are given for any of these upstream sources. Based on this information the system can calculate the contribution of leakage to local recipients.

Include leakage data shall by default be checked.

<u>Filter of overflow data and calculation:</u>
Exclude overflow data in calculation: If this is selected, no overflow will be used in the calculation. The option buttons "Overflow from point source network" and "Overflow calculated as % of connected sources" shall never be enabled when this choice is selected. Regarding the point sources tab: It shall not be possible to include any of the pollution sources "Overflow at network" (to be disabled at the point sources tab) when this option is selected.

Include overflow data in calculation[25]: If this one is selected (default selection) overflow upstream of the WWTP shall be included in the calculation. The user must select if the overflow figures (data) shall be calculated based on the % given for each individual source or if it shall be calculated based on overflow registered as point sources at the network (Overflow from point source network). When include overflow data is selected, the controls "Overflow from point source network" and "Overflow calculated as % of connected sources" must be enabled.

Overflow from point source network: If this is selected (which is the default choice), data shall be taken from the separate point sources (overflow at network). These point sources (= overflow at network connected to any of the selected WWTP at the WWTP TAB) shall be automatically checked in the tab "Point sources".

Overflow calculated as % of the connected sources: This option works very similar to the overflow figures for leakage. The system shall find which sources that are upstream of the selected WWTPs, find the overflow figures, and add them to the recipient they are assigned to (if they are assigned to any), and subtract them from the load transferred to the WWTP. Regarding the point sources tab: It

[25] Include means that the amount which goes in overflow will be subtracted from the amount which is discharged from the sources and transferred to the WWTP

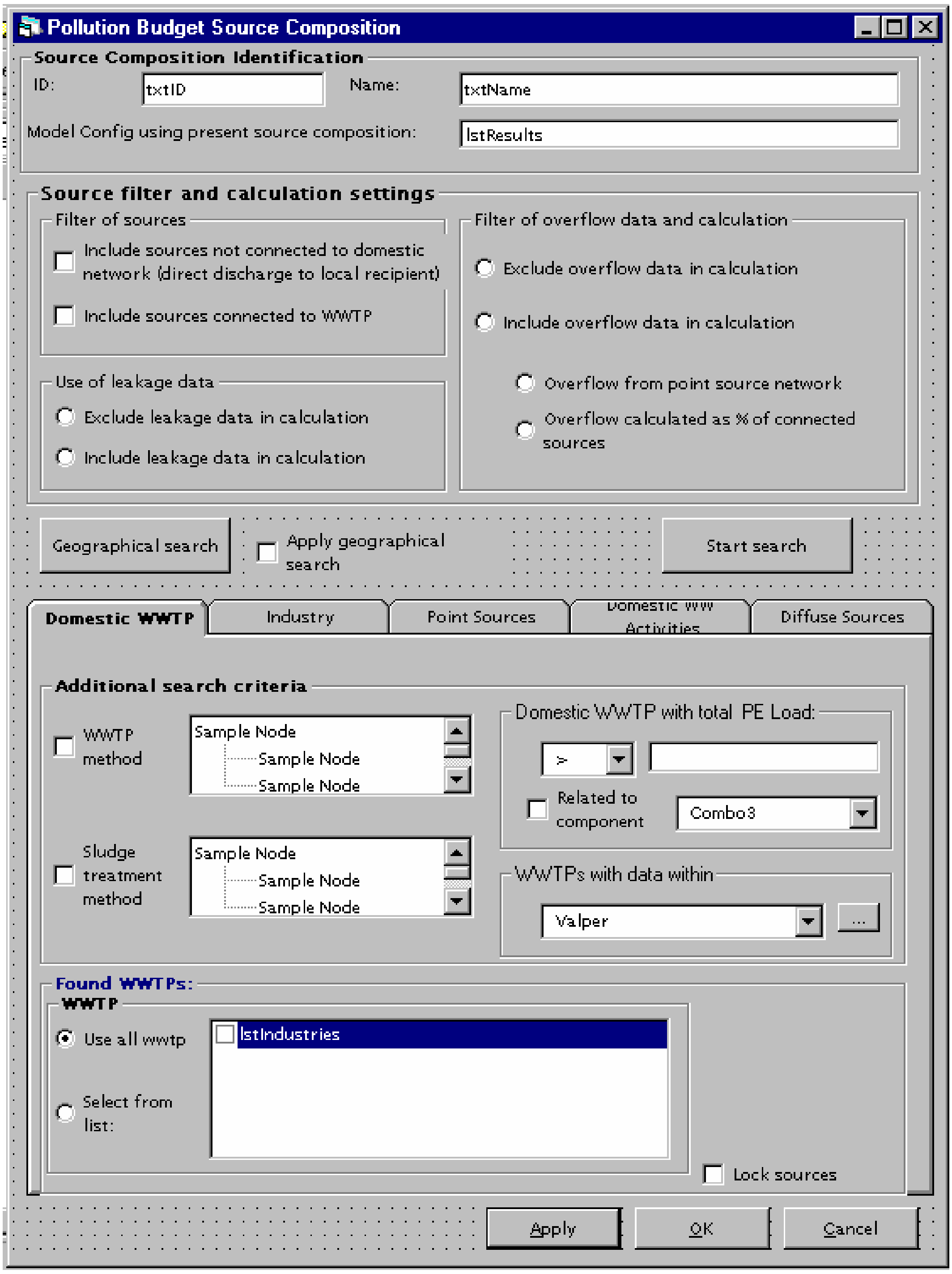
shall not be possible to include any of the pollution sources "Overflow at network" when this option is selected at the WWTP tab.

<Geographical search>: Opens up a form where geographical criteria to filter out pollution sources/recipients are available.

<Apply geographical search criteria>: When this is checked, the system shall apply the criteria on the geographical search criteria form, together with the other search criteria. This shall automatically be checked if the user has defined search criteria in the geographical search criteria form.

<Start search>: This button will start the search for pollution sources and the related discharge facilities. Is soon as the search is started, the button shall switch to "Stop search". The button shall be renamed compared to ENSIS 2.05. The search shall only be done for the tab which is in focus, if search for all pollution types are time consuming. If so, search for sources in the next tab that is activated must automatically be started when the user activates the tab.

3.1.3 Source composition (New and Edit), tab WWTP



Specifics for Tab Domestic WWTP

Additional search criteria:

There shall be search criteria for WWTP method and sludge treatment method (these are tree-views meaning that all WWTP which have a WWTP method sludge sludge treatment method equal to the selected parent or children of the parent will be found) . When the check is checked, defined items from these look up tables shall be listed in the list controls. The user shall be able to select one or several items from these lists. The additional search criteria shall operate together with the global search criteria.

Search for PE:
It shall be a search for the information entered about PE for the domestic WWTP. It shall be possible to relate to any component. A combo box listing the Boolean operators >, <, =, >=, <= and between shall be implemented in the combo box. It shall be possible to do a general PE search independent of component or link the search to a specific component.

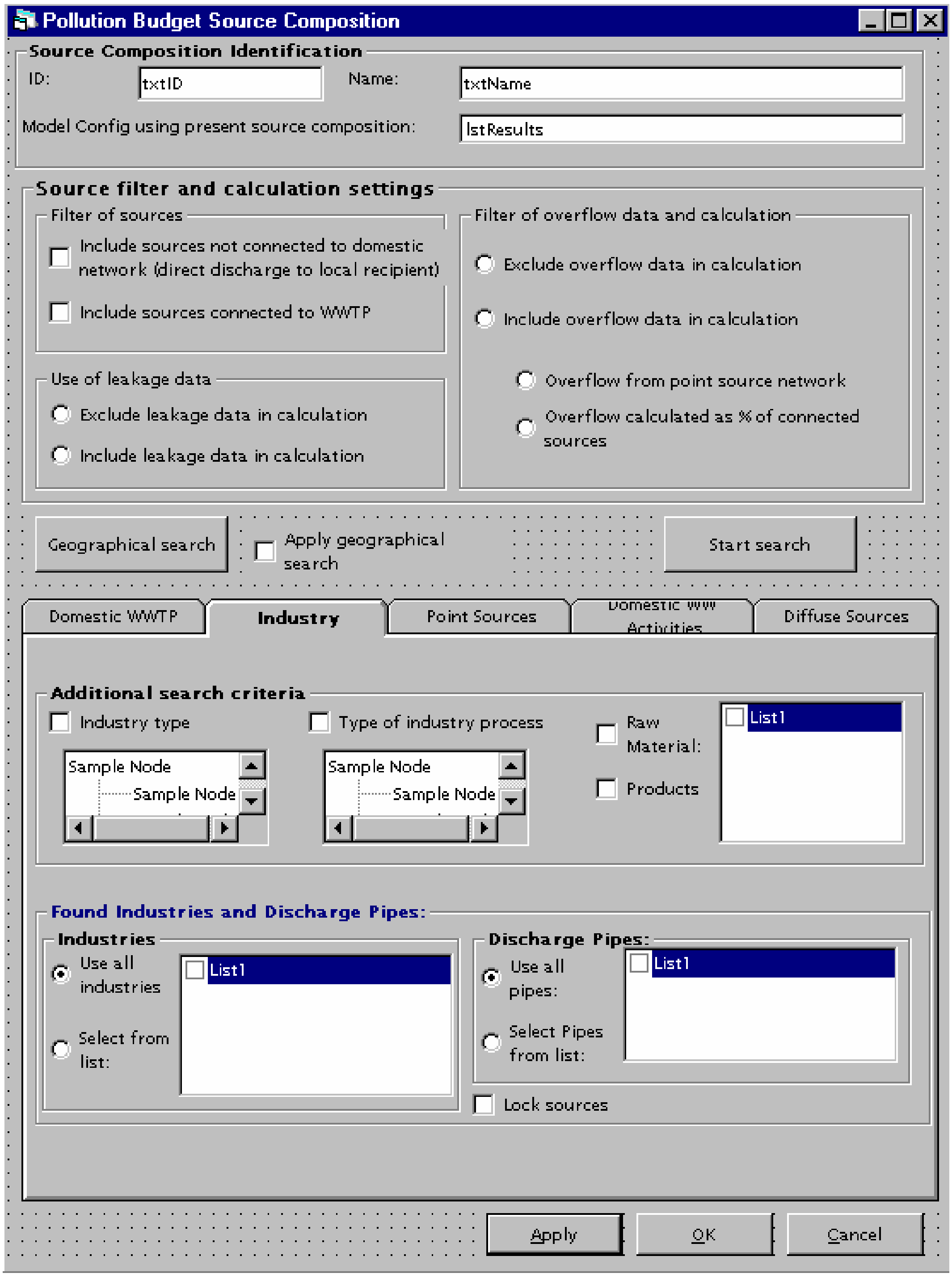
The system shall search for only the data available in the form WWTP - Tab treatment processes, and in the frame labelled Last registered PE connection.

WWTPs with data within:
The user searches for WWTP which have measurements (time series or aggregated data) within the selected period.

Lock sources: See specification above.

Since there is only possible to link one discharge pipe to each WWTP, it is not relevant to have a separate control for discharge pipes like on the industry.

3.1.4 Source composition (New and Edit), tab Industry



If include source connected to WWTP is checked the industries that are linked to (connected to) the checked WWTPs in the first tab shall automatically the selected in this tab.

Tab Industry

The upper part and buttons are identical to the Domestic WWTP tab.

<u>Additional search criteria:</u>

<Industry type>: This is what was earlier called Lines of Business. The user shall be able to narrow the search for industries by selecting only industries defined as belonging to a specific industry type. It shall be possible to select one or more types from a tree view. The search is carried out when pressing the "Start search". Implement with a check box.

<Type of industry process>: This is a new look up table (from earlier activity type). The user shall be able to narrow the search for industries by selecting from this tree view. It shall be possible to select one or more processes from the tree view. The search is carried out when pressing the "Start search". Implement with a check box.

<Raw Material>: The user shall be able to narrow the search for industries by selecting only industries defined as consuming one or more specific raw materials. Raw materials and products can be listed in the same control as today.

<Product>: The user shall be able to narrow the search for industries by selecting only industries defined as producing one or more specific raw products.

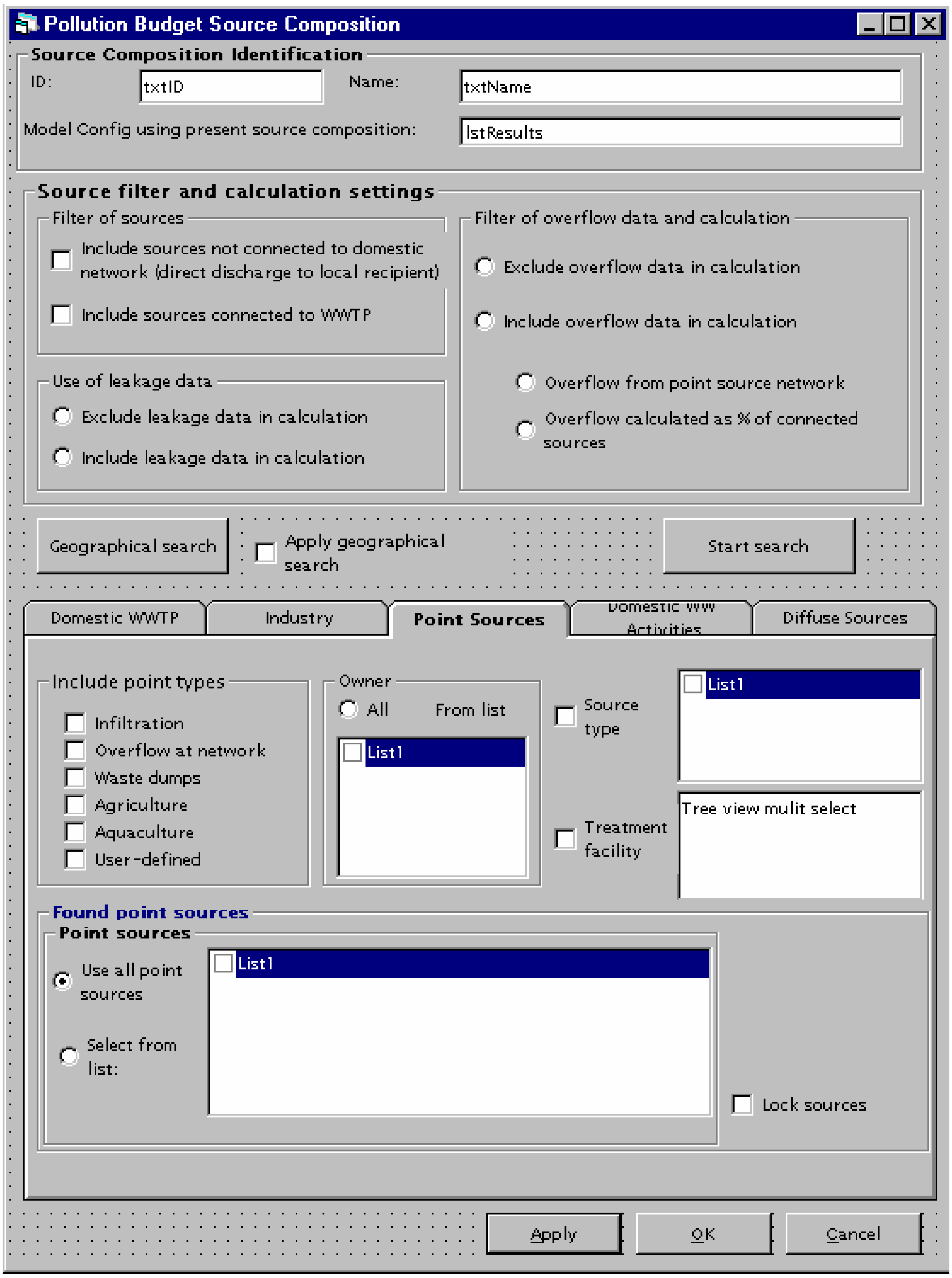
<u>Found items:</u>

<Industries>: The user shall be able to check all or only selected industries from a list industries fulfilling the search criteria. The industries shall be listed with ID and name.

<Discharge pipes>: The user shall be able to check all or only selected discharge pipes among the pipes linked to the checked industries. The discharge pipes shall be listed with ID and name. The discharge pipes shall be independent if they are in operation or not.

Lock sources: See explanation in the beginning of the chapter.

3.1.5 Source composition (New and Edit), tab Point sources



The upper part of the form (identification and global search criteria): See description above.

If include source connected to WWTP is checked the point sources that are linked to (connected to) the checked WWTPs in the first tab shall automatically the selected in this tab.

Tab Point sources

Additional search criteria:

Include points of type: It shall be possible to search only specific point sources (the new point sources defined in this specification), like only infiltration, overflow at network, etc. By default, all point source types shall be checked. Exceptions: when the user has selected General overflow from connected sources, it shall not be possible to select the point source type "overflow at network". The selection of point source type will also affect the listed items in the Source type search criteria, since only source type linked to the selected point types shall be listed.

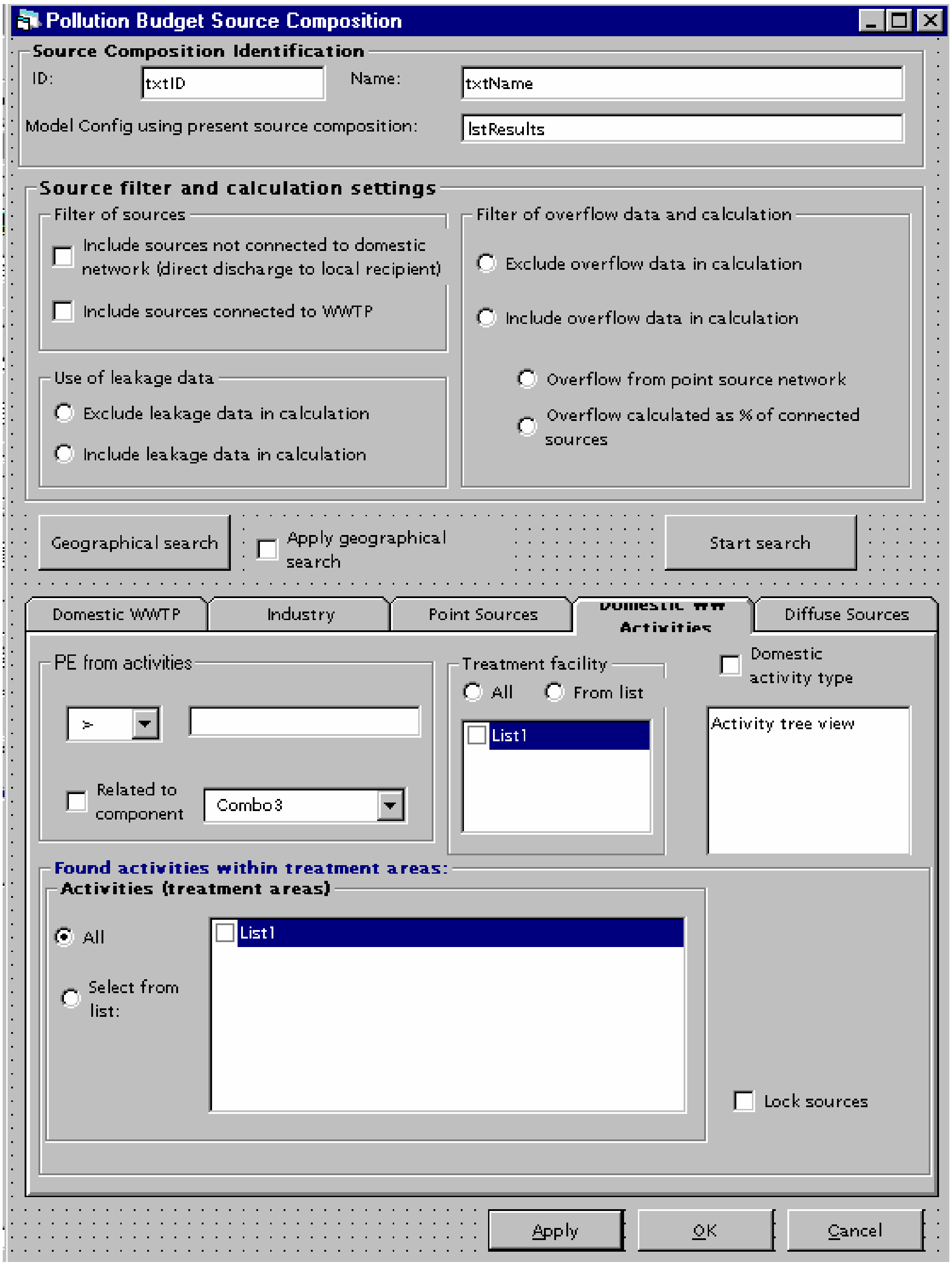
Owner: The user shall be able to search only point sources where one or more specific owners are defined. By default, the all radio button shall be checked.

Source type: This is a new look up table. When the user checks this control, all the source types linked to the selected point types shall be listed and made available for checking.

Treatment facility: This is a new tree view look up table. The user shall be able to use this as search criteria for point sources. It shall have multi-select functionality.

Lock sources: See the beginning of this chapter.

3.1.6 Source composition (New and Edit), tab Domestic ww activities



The upper part of the form (identification and global search criteria): See the description above.

If include source connected to WWTP is checked the domestic ww activities that are linked to (connected to) the checked WWTPs in the first tab shall automatically the selected in this tab.

This tab shall list activities defined within a treatment area that fulfils the search criteria. Since many activities can be defined within the same treatment area, the treatment area might be listed many times (in parenthesis) in the list of found activities. NB, the list shall show activities (ID and name) with the ID and name of the treatment area in parenthesis in the list of found items.

Tab Domestic ww activities

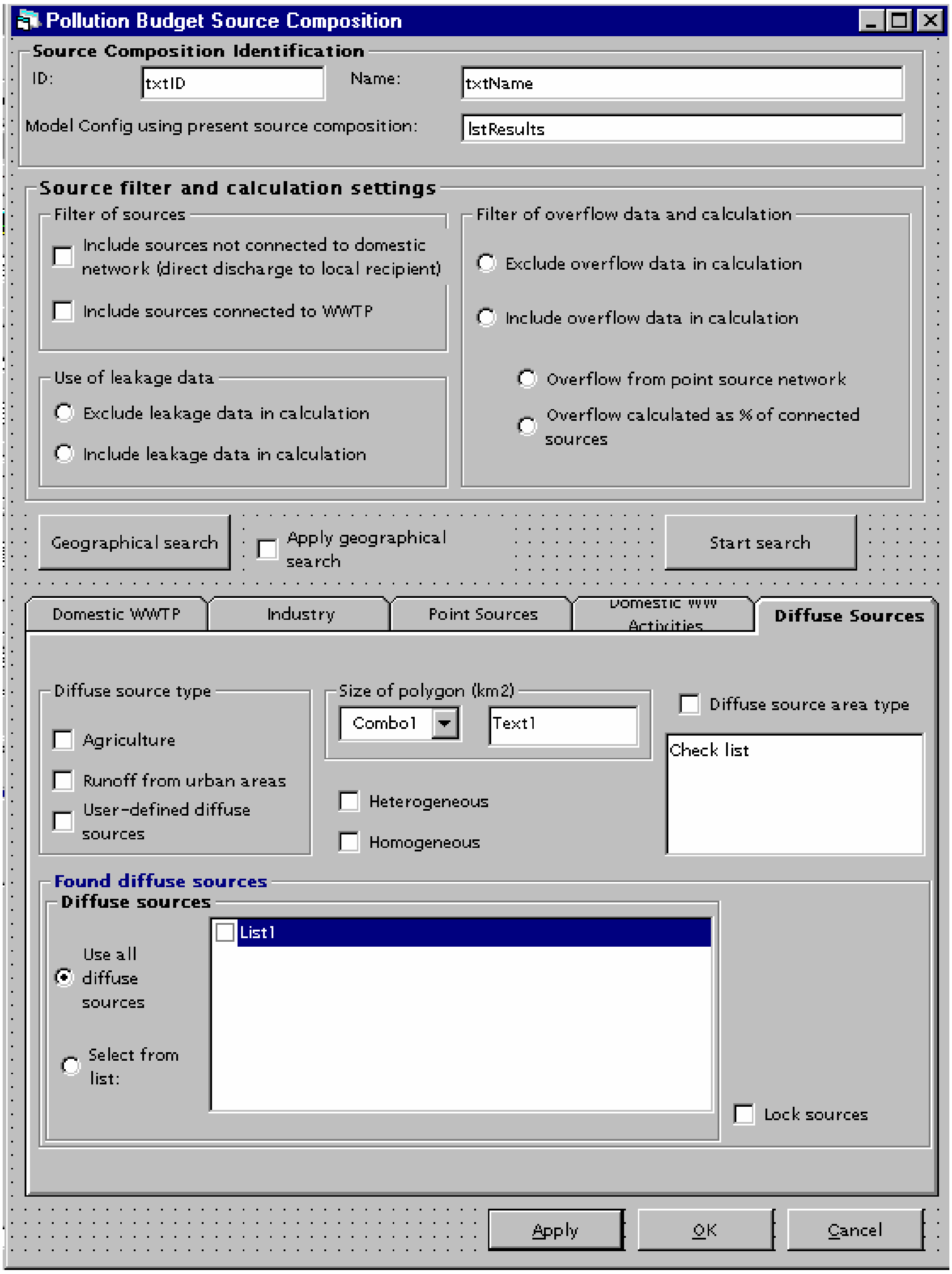
<u>Additional search criteria:</u>
PE from activities: It shall be a search for the information entered about PE for the individual activities. It shall be possible to relate to any component (as on domestic WWTP). A combo box listing the Boolean operators >, <, =, >=, <= and between shall be implemented in the combo box. It shall be possible to do a general PE search independent of component or link the search to a component.

Treatment facility: The user shall be able to search only point sources where one or more specific treatment facilities are registered. By default, the all radio button shall be checked.

Domestic activity type: It shall be possible to search for domestic activities (tree view). This search criterion shall only check if the selected domestic activity types are registered or not (independent of data). It shall be implemented with multi-selection functionality.

Lock sources: See explanation at the beginning of this chapter.

3.1.7 Source composition (New and Edit), tab Diffuse source



The upper part of the form (identification and global search criteria): See the description of the previous tabs.

Tab Diffuse source

Diffuse source types: It shall be possible to search only specific diffuse source types (agriculture, runoff from urban areas and user-defined diffuse sources). By default, all types shall be checked.
Size of polygon: It shall be possible to search for diffuse areas as a function of size of the polygon. A combo box listing the boolean operators >, <, =, >=, <= and between shall be implemented in the combo box. The user must define the size in km2. If the size of any polygons is entered in area units different from km2, the system shall automatically convert into km2 during the search.

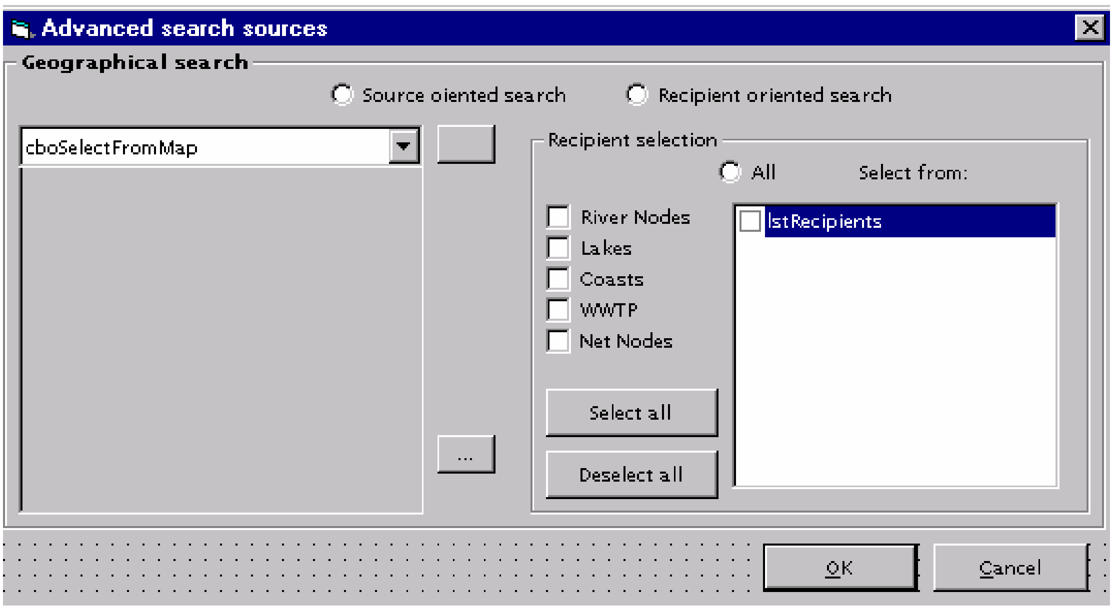
Heterogeneous: The user shall be able to exclude diffuse sources that are defined as heterogeneous. This shall by default be checked, meaning that it is included unless the user unchecks it.

Homogenous: The user shall be able to exclude diffuse sources that are defined as homogeneous. This shall by default be checked, meaning that it is included unless the user unchecks it.

Area type: The user shall be able to search diffuse sources that only specific area types are defined (for instance only forest, mountain areas, marshes, etc). All diffuse sources with one or several of the checked areas defined shall be found in the search. The content of this check list shall be taken from the (diffuse source) area type look up table.

Lock sources: See the beginning of this chapter.

3.1.8 Source composition (New and Edit), Geographical search



Geographical search criteria

Sometimes the user wants to find the sources located within a specific region (adm region, catchment, etc). This is typically a source-oriented search. Other times the user wants to find those sources that discharge to (linked to) any of the recipients located within a specific region. This means that pollution sources that are geographically defined outside the selected geographically region might be found. This is the general difference between the source oriented and the recipient oriented approach.

<u>Source oriented:</u>
If the user selects the option button source oriented, secondly a geographic region, and presses OK, the system shall find all sources geographically defined within the area (when Start search is pressed from the main search form). If the user presses a geographical region, and then presses the "select from" option button only recipients within the selected region shall be listed in the control of recipients, when the water elements type (RN, lake, coast, wwtp, net node) is checked. If the user checks some water elements, presses OK, and the Start search, the system shall find those sources within the selected region AND is linked to any of the selected water elements. In other words, sources geographically located inside the selected region AND linked to any of the selected recipients shall be listed. This shall be the default choice when the form is opened.

<u>Recipient oriented:</u>
If the user selects this option, secondly a geographical region and then "Select from" recipient option button, the list of water elements shall still be a function of selected geographically region. When the user checks one or several water elements, OK, and finally Start search, the system shall find all pollution sources linked to any of the selected water elements, independent of if they are inside or outside of the geographical region. This means that the geographical region is used ONLY to limit water elements, not pollution sources.

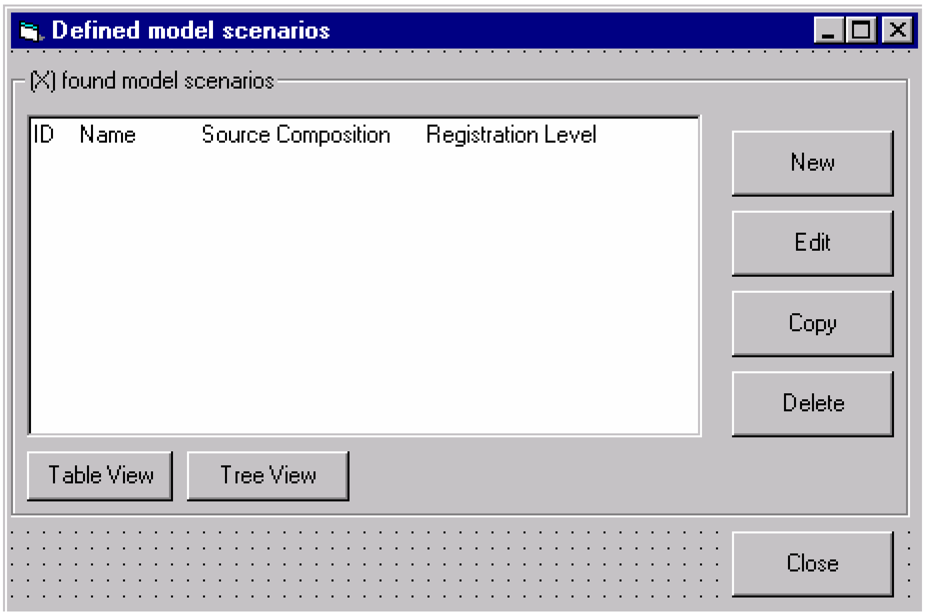
<List open map>: This is a standard way of searching for geographical objects. The user can select among open maps, make a rectangle on the map which the objects shall be within, and by this limit the pollution sources to be read into the source composition form. Similar to the selection of a geographic region defined in the database, the use of freely defined regions will work a bit different if it is a source oriented or recipient oriented search.

<Geographical tree view>: The selection in the pre-defined regions shall in a similar way limit the pollution source to be listed. If an already defined source composition is selected, the geographical boundary of the source composition shall be shown. The new button shall allow the user to define a new region. This is standard feature in ENSIS. As implemented in ENSIS 2.05. In addition to existing functionality, it must be possible to do a multi-selection in the tree view.

Recipient selection: This is similar to elsewhere in ENSIS. Listed recipient shall be a function of selected geographical region(s). By default, the All option shall be checked, and no water elements.

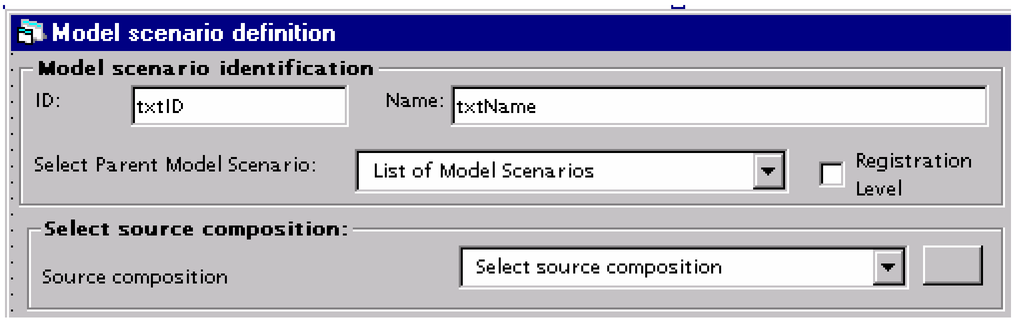
Regarding the WWTP and net node: These two water element types shall only be available (enabled) for selection when the option Include sources connected to WWTP is selected from the main form.

3.2 Model scenario



This is the list of defined model scenarios for the pollution budget model. Be aware of the fact that there shall be a copy button on this form, coping everything, except for ID, name, Source composition and registration level to from the selected model scenario into a new definition form. Table View should be the default view. If tree view is selected the table view should be changed to tree view with only ID and Name shown.
The alternative hierarchy can be organised different according the problem of concern. In chapter 5 there are given 2 different ways/examples of organising the alternative tree views.

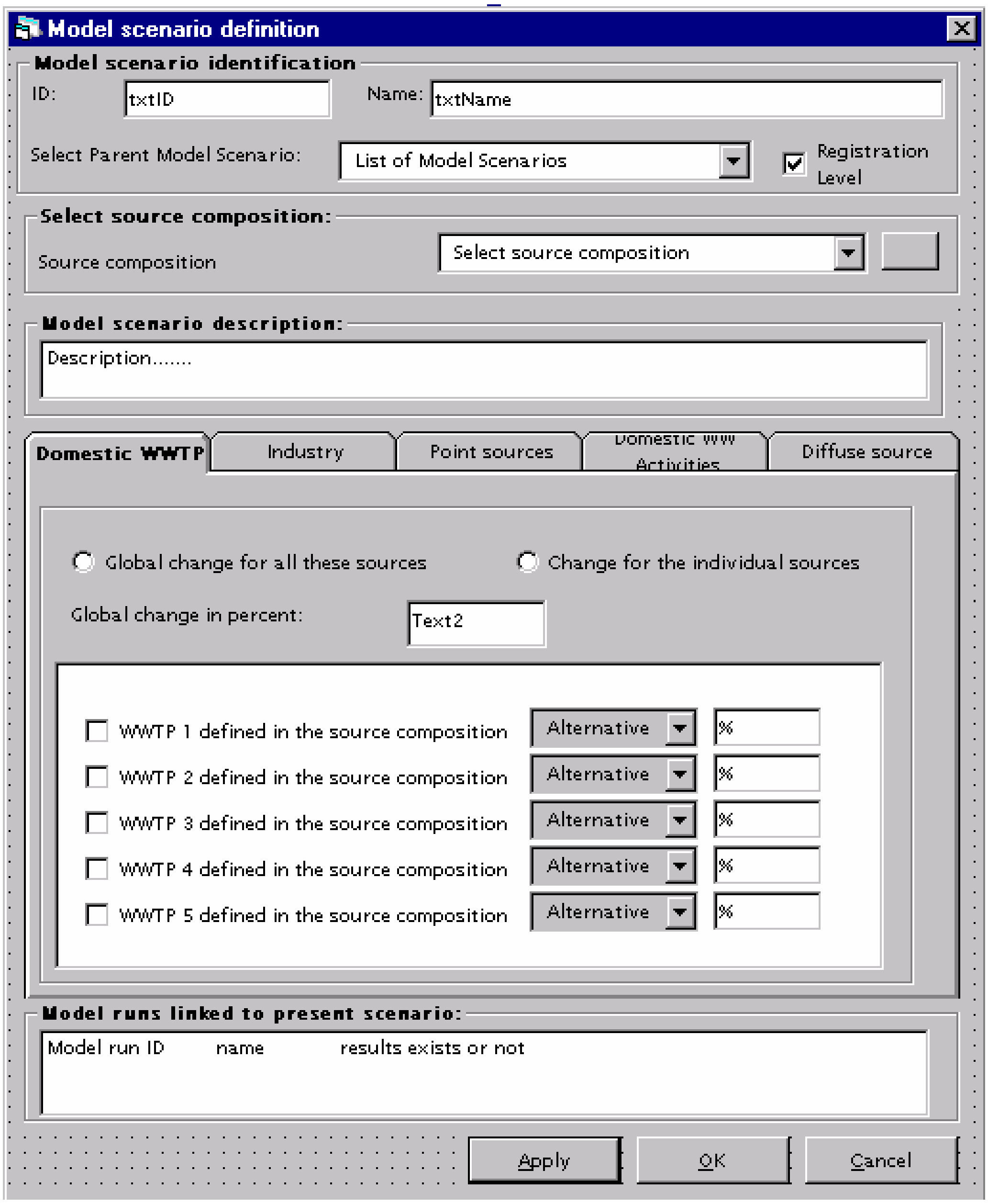
3.2.1 Model scenario - definition forms



Model scenario definition is given above. The Model scenario is in a hierarcic structure and parent model scenario must be given. The level of scenario could either be a ”empty” scenario or a scenario where registrations have been made.

If the Registration level has been checked, the form below should be shown. This is the form where the user can manipulate the source composition (adjust discharges, etc) for analytical purpose. The tabs are analogue to the tabs of the source composition. The following tabs to adjust data must be implemented, in the given order (from left to right):

- Domestic WWTP
- Industry
- Point sources
- Domestic ww activities
- Diffuse source



The changes the user can do, are to adjust the sources defined in the selected source composition by a certain percentage. 0 % means no change, -100% means no discharge, and 100 % means doubled discharge. Number smaller than -100% are not relevant and shall not be allowed to enter. The sources can be adjusted globally for the whole tab, or individual for the defined pollution sources.

Model scenario ID and name: Standard ENSIS functionality.

Select source composition: The user must select which source composition to be adjusted the discharge for. As soon as this is selected, the five tabs will be automatically filled out with the sources defined to be included in the calculation.

Description: This shall be a standard text field (256 characters) where the user can enter information about the Model Scenario.

Model runs linked to Model scenario: Information that should be given in the table are listed below.

For the water pollution budget model:

- Name of the model (water pollution budget model)
- Source composition ID and name (only relevant if base alternatives or sub of base alternative)
- Model scenario ID name (only relevant if alternative different from base alternatives or sub of base alternative)
- Model configuration ID and name
- If results exist (Yes/No)

For the water quality model

- Name of the model (water quality model)
- If results exist (Yes/No)

Be aware that yellow tool tip or scrolling must be implemented in a way that the user can see all the information.

Tab Domestic WWTP:

Global change for all these sources: The user shall be able to change all the sources displayed in the list of sources globally. The user can enter a number in percent. When this choice is selected, the list of pollution sources shall be disabled (the sources shall all be checked). This option shall be present for all the 5 tabs.

The field "Global change in percent" shall only be enabled when the global option button is selected.

Change for the individual sources: This is the second radio button. When the user selects this one, all the sources shall be available for defining individual reduction/increase in pollution discharge. By default, all sources shall be checked (meaning included), and all shall have the change in percentage = 0 % (no change). This option shall be present for all the 5 tabs.

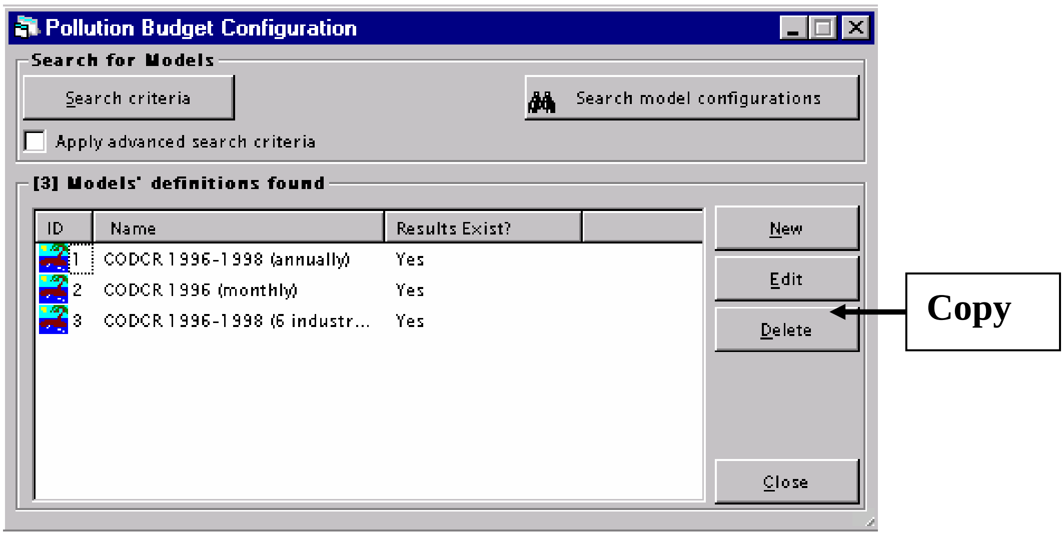
Either if the user selects to have a global change or a individual change, the user must select which alternative of the source that should be used in the model scenario. By default the base alternative is selected. Only defined alternatives should be available.

There shall be 4 other tabs, working similar to the domestic WWTP tab. These four tabs are not explained further.

3.3 Model configuration

Both the list of model configuration and the Model configuration definition shall almost be kept unchanged, except for the difference to be able to handle scenarios. The search for advanced model configurations shall neither be changed.

List of model configurations

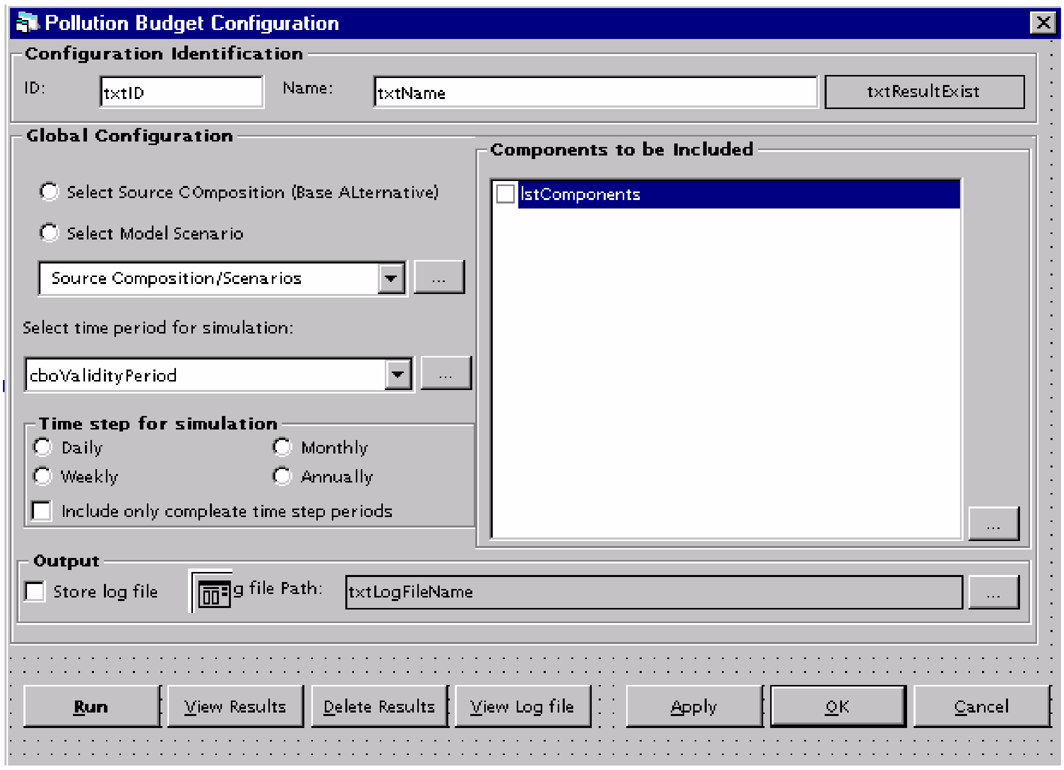


The list of model configurations must be extended with an extra property saying which scenario it is linked to. There shall also be a copy button, allowing the user to copy one model configuration into a new. All the information from the selected model configuration shall be loaded into a new form, except for the ID, name and if results exist (shall be NO).

3.3.1 Model configuration - definition form

A change that shall be implemented is when the user presses the OK button in the model configuration definition form, after **changing a model configuration**. The following options shall be prompted to the user as soon as he has clicked OK (before final storage to the database):

- Keep the related results even though there is a mismatch between the input and the results.
- Delete the related results to avoid mismatch between the input and the results.
- Cancel the operation.



This form and its functionality shall be kept unchanged, except the introduction of scenario.

This shall be kept unchanged, except for a few minor changes. The select source composition combo box shall list all source compositions (ID and name) with base scenario in parenthesis, and also model scenarios with model scenario ID and name, and which alternative these are linked to in parenthesis.

There shall be introduced 2 option buttons:

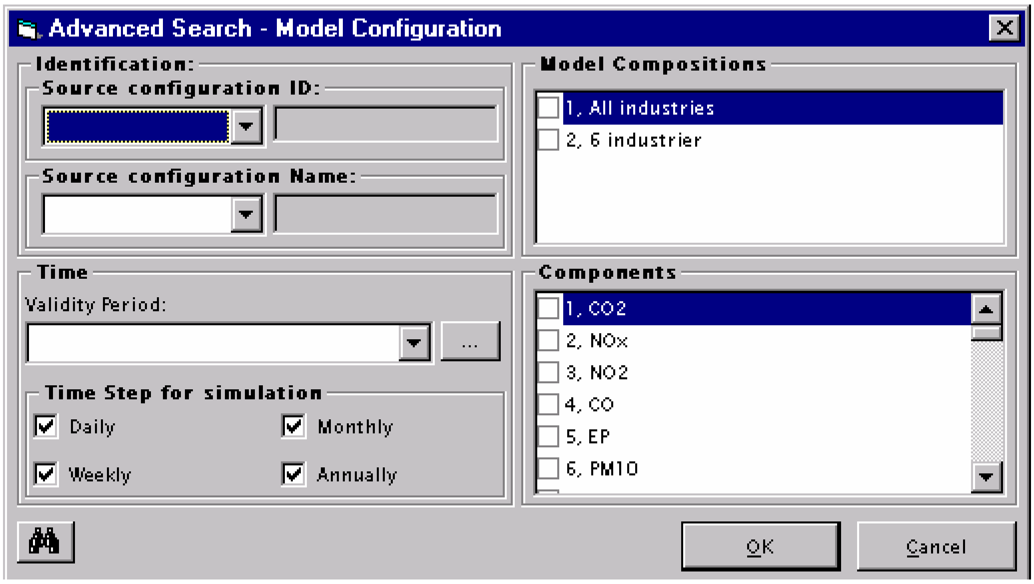
- Select source composition (base alternative), and
- Select model scenario

If the user selects source composition – all source compositions will be listed in the combo box. If the user selects model scenario, the user can be able to select another alternativ for the source if this is defined in the model scenario or if there have been some manipulation of the sources– which is is defined in each model scenario definition.

1. Results for the selected source composition the model scenario refers to is available, then "scale" these results according what is set in the model scenario definition. New results are stored to the database.

2. Results form the selected source composition the model scenario refers to is NOT available. First the model must find which source composition the model scenario is based on (a model scenario refers backwards to a source composition), and temporarily calculate the results from this (maybe the results already exist). The results are then adjust (by the percentage defined), to what is specified in the model scenario definition form. The adjusted results are then stored to the database.

3.3.2 Advanced search for model configurations



This form must be extended with a tree view where the user also can search as a function of which alternative (scenario) it is linked to.

3.4 Pollution budget model - presentation of results

3.4.1 Major adjustments and extensions

- Since the extended/complete water pollution budget model covers more sources, the options for filtering results in the presentation form must be extended.
- Model results from the water pollution budget model are in ENSIS 2.05 stored as water point dataset. Results from the extended (complete) water pollution budget model shall also be stored as water point dataset. This means that results from the area sources (agriculture, runoff from urban areas, user-defined diffuse sources, and domestic ww activities) also must be stored as part of the water point dataset. The point representing the area source shall be located in the centre (centre of gravity) of the polygon when presented on the map.
- There shall be added functionality for filtering and sorting results in the model result table.

3.4.2 Calculation routine

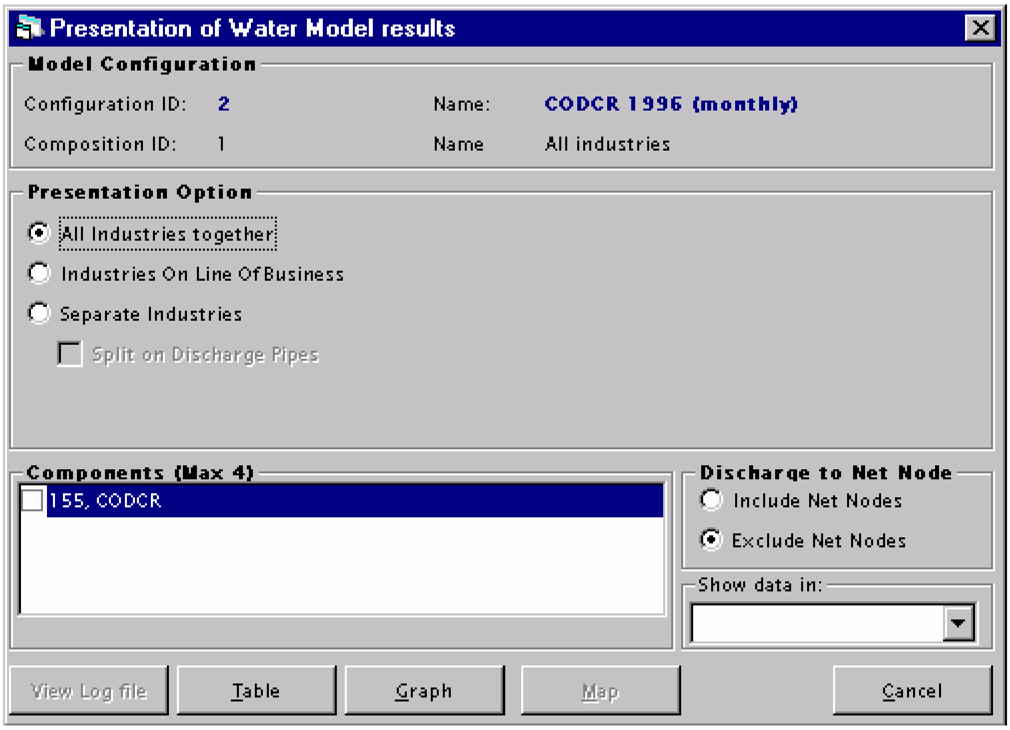
This chapter sums up some general functionality of the model. It is referred to how it already is implemented in ENSIS 2.05 where this is more convenient than explaining from scratch.

Interpolation/extrapolation
This shall follow the same strategy as implemented in present version of ENSIS. The user documentation covering this issue is enclosed in annex 1. (see new calculation specification (Measurement specification))

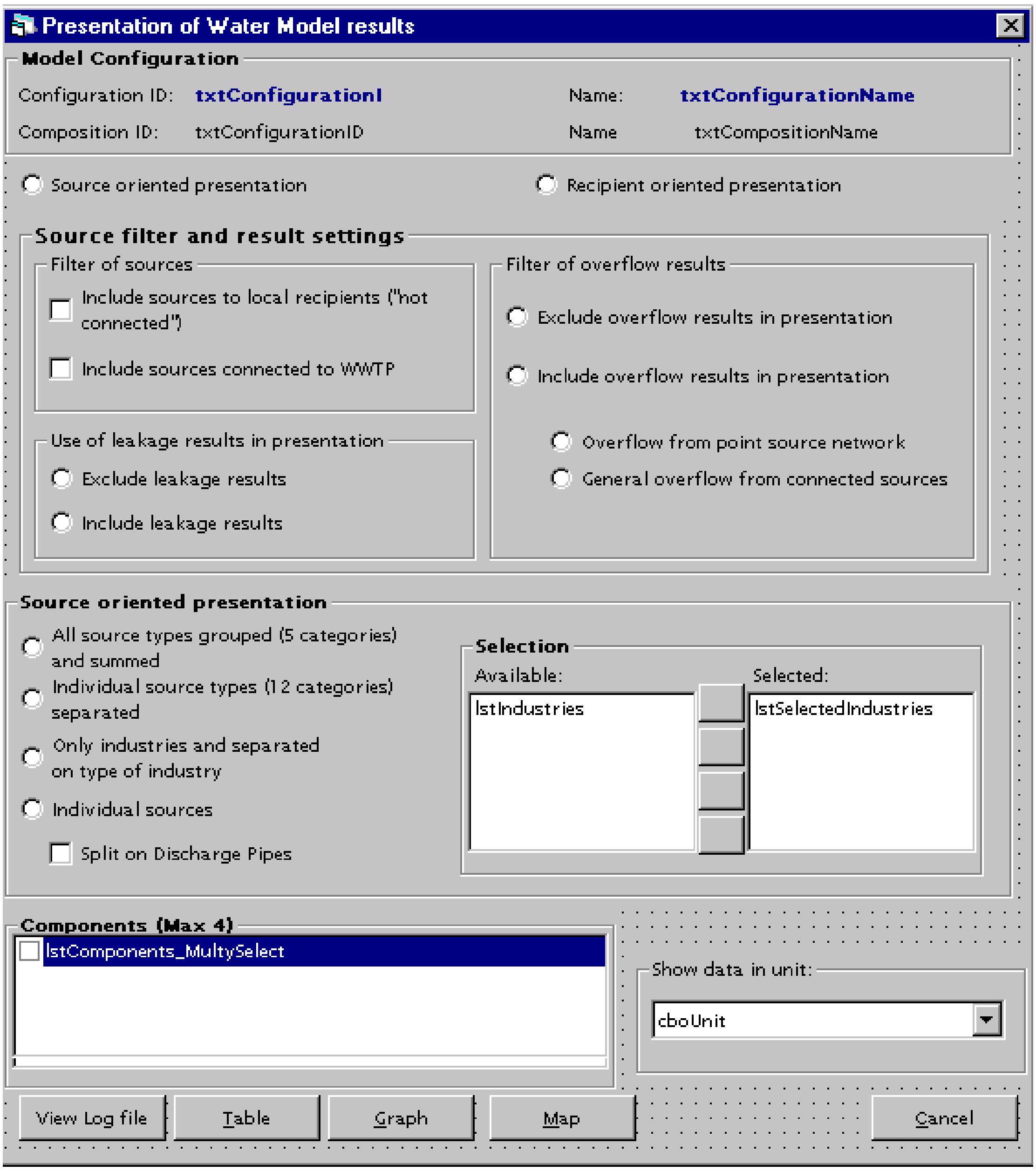
Aggregation methods
This shall follow the same strategy as implemented in present version of ENSIS. The user documentation covering this issue is enclosed in annex 1. (see new calculation specification (Measurement specification))

Remember that the priority of input data to be used in the calculation is defined on the individual sources that are included.

3.4.3 Presentation of water model results form

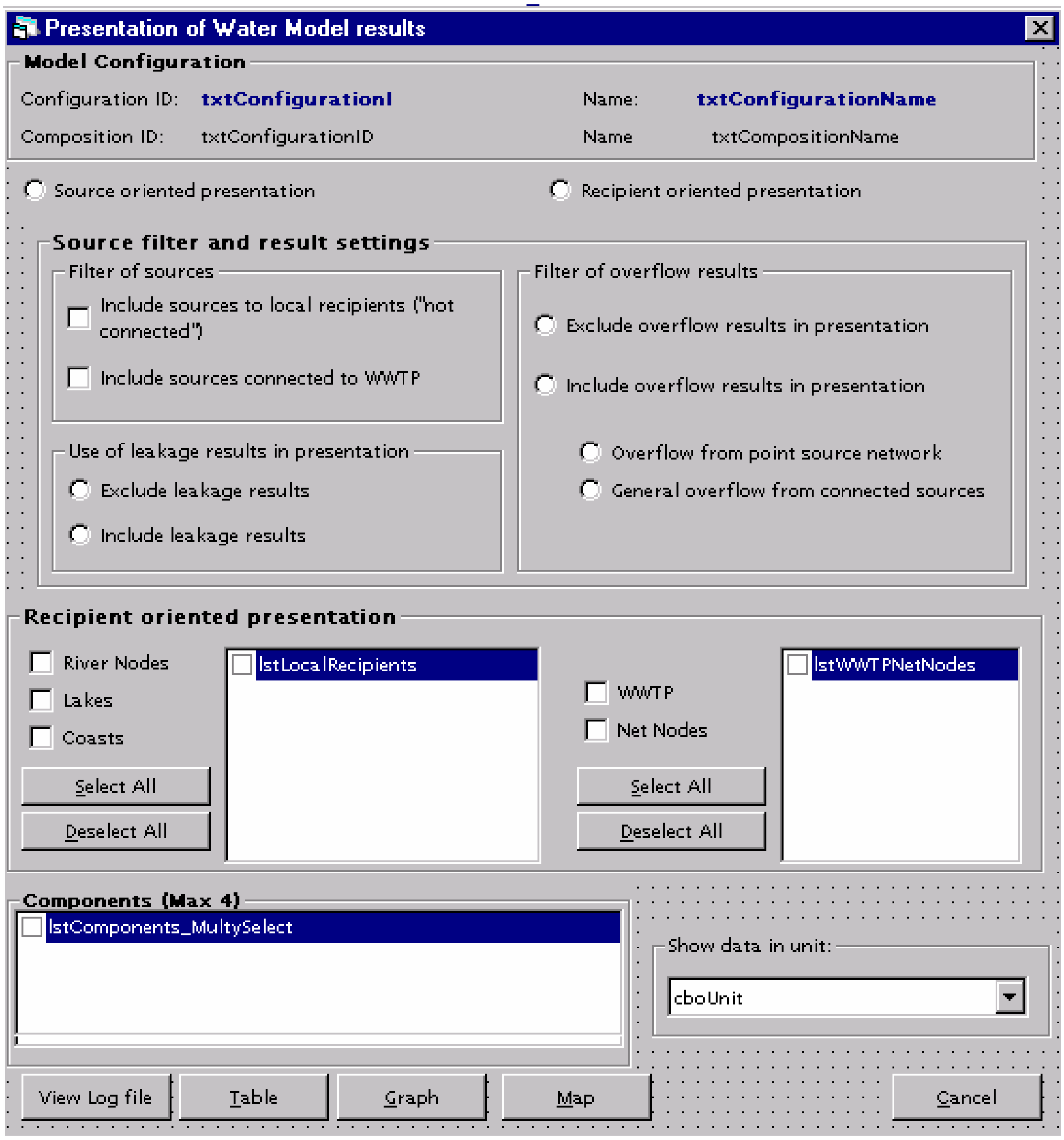


This is the existing form for selecting presentation option. This shall be adjusted to cover more sources (types) and other ways of presentation.



The new form where the presentation of results from complete water pollution budget model is determined. Source oriented is selected on the top of the form.

Lots of the functionality from the existing presentation form is kept unchanged from ENSIS 2.05, but there are also added new functionality to handle new sources and new presentation requirements.



The new form where the presentation of results from complete water pollution budget model is determined. Recipient oriented is selected on the top of the form.

There are two different strategies to present model results. The first is like in present version, the source oriented. It is focused on the pollution sources (industry, diffuse, etc), and compares the different sources at the source. The second strategy is to look at the recipients (lakes, rivers, and coastal areas) and compare the load to the different recipients called recipient oriented presentation. The option buttons on the top of the form determines if the user selects to present data source oriented or recipient oriented. Selection of the source oriented presentation disables everything inside the frame "Recipient oriented presentation". When the option button Recipient oriented presentation is selected, everything within the frame labelled Source oriented presentation is (previous page) is disabled.

Regarding the map presentation, if source oriented presentation is selected, the results shall be shown at the location of the source, but if recipient oriented presentation is selected, the results shall be fetched to the recipient they discharge to.

Source filter and result settings
This frame is very similar to the one used when the source composition is defined. In general, the term "data" is changed with "results". The default setting within this is frame is the setting that is identical to the one used in the source composition.

If exclude leakage is selected in the calculation, the user cannot change the option button to include leakage in the presentation. Similar for overflow, if the user has excluded the overflow in the calculation, it is not possible to include it in the presentation. In these cases, the include buttons shall be disabled.

Both "Include sources to local recipients ("not connected")" and "Include sources connected to WWTP" must be checked in the model composition to be able to uncheck any of them.

In other words, the user can only limit data for presentation, not include more than those calculated.

Source oriented presentation
This is similar to how it is in present (2.05) version of ENSIS. The following options shall be available:

- All source types grouped (5 categories) and summed
  The 5 categories are similar to the 5 tabs in the source composition forms (domestic wwtp, industry, point sources, domestic ww activities and diffuse source).

  When this option is selected, an additional control shall appear, with all options checked by default. The user shall be able to uncheck specific categories and/or the sum.

The system shall (if default is selected) sum up all sources within each of these 5 categories for each time step of the simulation (defined in the model configuration). The system shall also be able sum up all sources independent of category for each time step. It shall be possible to include several components in the result presentation.

- All individual source types (12 categories) separated
  This option is very similar to the previous one. The only difference is that the division of categories is even finer. The group point sources shall also be spilt up. The 12 categories are:
  Domestic wwtp, industry, infiltration, overflow at network (if applied in the source composition), waste dumps, agriculture (point), aquaculture, user-defined (point), domestic ww activities, agriculture (area source), runoff from urban areas and user-defined diffuse source.

  The control shown on the source oriented screen dump above (labelled selection) shall be filled with these 12 items on the left side. The user shall be able to move them to the right control for presentation.

  The system shall sum up all sources within each of these 12 categories for each time step of the simulation (defined in the model configuration), if all are selected. The system shall also sum up all sources independent of category for each time step.

- Only industries and separated on type of industry.
  This shall be kept identical to present version of ENSIS, just change the name from line of business to industry type.

- Individual sources and split on discharge pipes.
  This is similar to present version of ENSIS, but shall include all sources defined in the source composition, not only industry sources. There should be a parenthesis in front of the source name and ID to show what type of source it is. We suggest:
  - [WWTP] for domestic wwpt
  - [IND] for industry
  - [INF] for infiltration
  - [OF_N] for overflow at network
  - [WD] for waste dumps
  - [AGR_P] for agricultural point sources
  - [AQUA] for aquaculture
  - [UD_P] for user-defined point source
  - [DOM_WW] for domestic ww activities
  - [AGR_D] agriculture diffuse source
  - [URB] for runoff from urban areas
  - [UD_D] for user-defined diffuse sources

  Discharge pipe is only relevant for industries, and shall only be enabled if one or more industries are among the sources for presentation.

Recipient oriented presentation
The user shall be able to select which recipients (lakes, rivers, and coastal areas, and also to net node and WWTP) he wants to look upon the discharge to. The user can select one or several recipients, and then the system shall analyse which sources that go to the selected recipient/wwtp/net node, and calculate the load to the selected objects for each time step. One or several components can be selected when recipient oriented presentation is selected.

If only one component is selected, the user shall be able to see contribution from the 5 different categories. This shall be shown as 5 bars beside each other for each of the recipients included in the presentation.

The options net node and wwtp are only relevant when the choice "Include sources connected to WWTP" is selected both in the source composition and in the presentation form.

Details for presentation of these results are specified in the following sections (graph, table and map).

Components
Shall be kept as in present version of ENSIS.

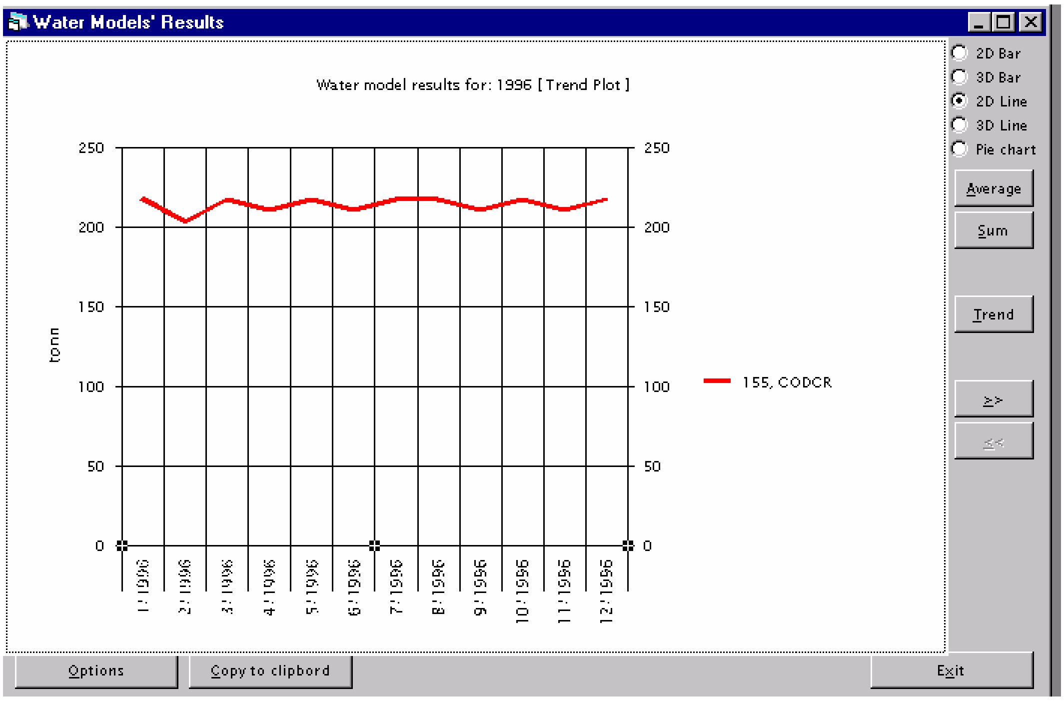
Discharge to WWTP (via net node), implemented in ENSIS 2.05.
This is removed since the functionality to decide if discharge to net node/wwtp is now defined in the option choice "Include sources connected to WWTP".

Show data in unit
Shall be kept as in present version of ENSIS.

Buttons
Shall be kept as in present version of ENSIS (but includes new sources, of course, and specified in more detail in the following sections). The map button is only enabled when the user has selected "Individual sources" in the Source oriented presentation, and Recipient oriented presentation.

3.4.4 Presentation of water model results form, Graph

Pressing this button shall start up a graphical presentation of the desired results. The specification is based on present graph tool, and not the new one that is supposed to be part of the modularised version. The graphical presentation should be harmonised with the new graph package.



Present graph implemented in ENSIS.

If source oriented presentation is selected
This shall be similar to how it is implemented today, and there has to be a limitation in number of sources, or source types, to be presented (maybe 6?).

If recipient oriented presentation is selected
This shall be similar to how it is implemented for the source-oriented approach. The difference is that the name of the recipient/wwtp/net node shall be along the x-axis (when each time step is presented) instead of the name of the source. When "trend" is selected, the name of the recipient/wwtp/net node shall be put in the heading of the graph and the time along the x-axis. There has to be a limitation in number of recipient/wwtp/net node sources to be presented (maybe 6?).

3.4.5 Presentation of water model results form, Table

Pressing this button shall the results from the desired extraction into a table, like in present version of ENSIS. The present version of the table is in general good. To be able to handle the new sources and to handle the analysing part of the results better, additional functionality is required.

We think it is maybe better if it can programmed in a way that Report Generator starts up when the Table button is pressed instead of the VB form. The further manipulation of the results are probably better handled there, and the possibility to add properties not predefined in the results table as well.

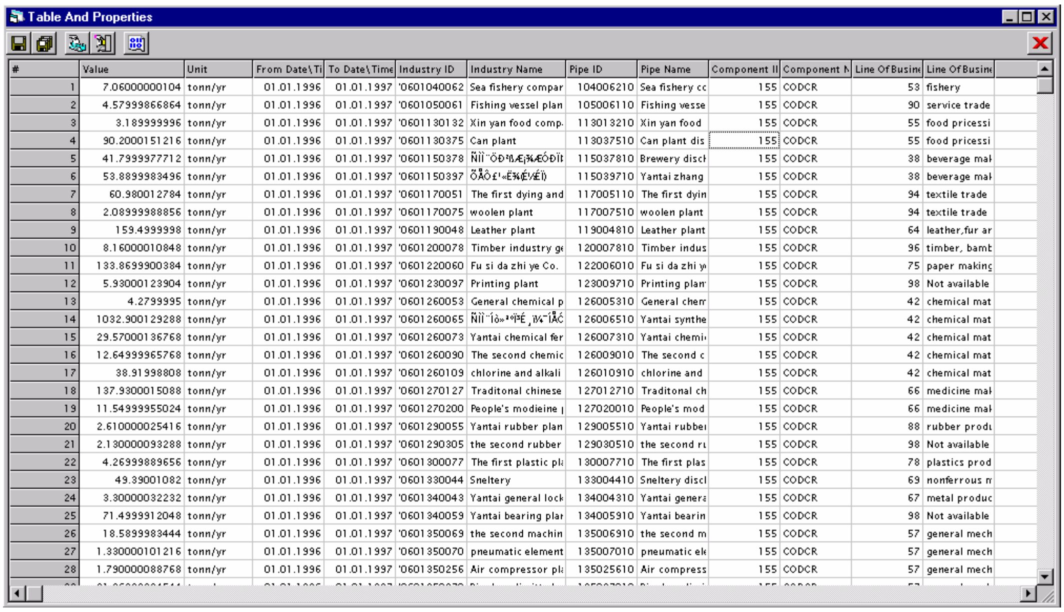


Table And Properties

#	Value	Unit	From Date\Ti	To Date\Time	Industry ID	Industry Name	Pipe ID	Pipe Name	Component II	Component N	Line Of Busine	Line Of Busine
1	7.06000000104	tonn/yr	01.01.1996	01.01.1997	'0601040062	Sea fishery compar	104006210	Sea fishery cc	155	CODCR	53	fishery
2	4.57999866864	tonn/yr	01.01.1996	01.01.1997	'0601050061	Fishing vessel plan	105006110	Fishing vesse	155	CODCR	90	service trade
3	3.189999996	tonn/yr	01.01.1996	01.01.1997	'0601130132	Xin yan food comp.	113013210	Xin yan food	155	CODCR	55	food pricessi
4	90.2000151216	tonn/yr	01.01.1996	01.01.1997	'0601130375	Can plant	113037510	Can plant dis	155	CODCR	55	food pricessi
5	41.7999977712	tonn/yr	01.01.1996	01.01.1997	'0601150378	ÑÌÌ¨ÖÐ³ßÆ¡¾ÆÓÐÏÞ	115037810	Brewery disch	155	CODCR	38	beverage mak
6	53.8899983496	tonn/yr	01.01.1996	01.01.1997	'0601150397	ÕÅÔ£¹«Ë¾(É½ÆÌ)	115039710	Yantai zhang	155	CODCR	38	beverage mak
7	60.980012784	tonn/yr	01.01.1996	01.01.1997	'0601170051	The first dying and	117005110	The first dyin	155	CODCR	94	textile trade
8	2.08999988856	tonn/yr	01.01.1996	01.01.1997	'0601170075	woolen plant	117007510	woolen plant	155	CODCR	94	textile trade
9	159.4999998	tonn/yr	01.01.1996	01.01.1997	'0601190048	Leather plant	119004810	Leather plant	155	CODCR	64	leather,fur ar
10	8.16000010848	tonn/yr	01.01.1996	01.01.1997	'0601200078	Timber industry ge	120007810	Timber indus	155	CODCR	96	timber, bamb
11	133.8699900384	tonn/yr	01.01.1996	01.01.1997	'0601220060	Fu si da zhi ye Co.	122006010	Fu si da zhi y	155	CODCR	75	paper making
12	5.93000123904	tonn/yr	01.01.1996	01.01.1997	'0601230097	Printing plant	123009710	Printing plan	155	CODCR	98	Not available
13	4.2799995	tonn/yr	01.01.1996	01.01.1997	'0601260053	General chemical p	126005310	General chem	155	CODCR	42	chemical mat
14	1032.900129288	tonn/yr	01.01.1996	01.01.1997	'0601260065	ÑÌÌ¨Íò»ª¾ÛÌÉ¸¡ÏÍÅÖ	126006510	Yantai synthe	155	CODCR	42	chemical mat
15	29.57000136768	tonn/yr	01.01.1996	01.01.1997	'0601260073	Yantai chemical fer	126007310	Yantai chemi	155	CODCR	42	chemical mat
16	12.64999965768	tonn/yr	01.01.1996	01.01.1997	'0601260090	The second chemic	126009010	The second c	155	CODCR	42	chemical mat
17	38.91998808	tonn/yr	01.01.1996	01.01.1997	'0601260109	chlorine and alkali	126010910	chlorine and	155	CODCR	42	chemical mat
18	137.9300015088	tonn/yr	01.01.1996	01.01.1997	'0601270127	Traditonal chinese	127012710	Traditonal ch	155	CODCR	66	medicine mak
19	11.54999955024	tonn/yr	01.01.1996	01.01.1997	'0601270200	People's modieine	127020010	People's mod	155	CODCR	66	medicine mak
20	2.61000025416	tonn/yr	01.01.1996	01.01.1997	'0601290055	Yantai rubber plan	129005510	Yantai rubber	155	CODCR	88	rubber produ
21	2.13000093288	tonn/yr	01.01.1996	01.01.1997	'0601290305	the second rubber	129030510	the second ru	155	CODCR	98	Not available
22	4.26999889656	tonn/yr	01.01.1996	01.01.1997	'0601300077	The first plastic pla	130007710	The first plas	155	CODCR	78	plastics prod
23	49.39001082	tonn/yr	01.01.1996	01.01.1997	'0601330044	Sneltery	133004410	Sneltery discl	155	CODCR	69	nonferrous m
24	3.30000032232	tonn/yr	01.01.1996	01.01.1997	'0601340043	Yantai general lock	134004310	Yantai genera	155	CODCR	67	metal produc
25	71.4999912048	tonn/yr	01.01.1996	01.01.1997	'0601340059	Yantai bearing plar	134005910	Yantai bearin	155	CODCR	98	Not available
26	18.5899983444	tonn/yr	01.01.1996	01.01.1997	'0601350069	the second machin	135006910	the second m	155	CODCR	57	general mech
27	1.330000101216	tonn/yr	01.01.1996	01.01.1997	'0601350070	pneumatic element	135007010	pneumatic ele	155	CODCR	57	general mech
28	1.790000088768	tonn/yr	01.01.1996	01.01.1997	'0601350256	Air compressor pla	135025610	Air compress	155	CODCR	57	general mech

Present version of the result table, when "Show all data" is pressed.

All the columns in present version shall be kept, but new ones have to be added. The following table shows which properties that shall be listed (with examples). "Show selected data" is a subset/aggregation of this data, like in present version of ENSIS. All properties shall be shown when "Show all data" is pressed. The table is inverted in this specification compared to the table in ENSIS due to the page orientation in the document.

If leakage and/or overflow from the individual sources are included in the presentation (overflow not as separate point source) this shall be stated in column 5.

If source oriented presentation is selected

Column no	Property	Examples	Comment
1	ID of source	5567843	Key of the source
2	Name of source	Kensington industry, Greaker WWTP	Text of the source
3	Alternative of source	More pollution	Text of the source
4	ID of pipe/collection point	55678432	
5	Name of pipe/collection point	Greaker wwtp pipe 2	
6	Source type	Domestic wwtp, industry, domestic ww activity, agriculture, etc	One of 14 types/categories (12 standard + overflow and leakage)
7	From date	01.01.1996	
8	To data	01.01.1997	

9	Value	78.4	
10	Value unit	Tonn/year	
11	Component ID	56	
12	Component name	CODMN	
13	Recipient ID	3456	If linked to net node, display the net node ID
14	Recipient name	Lake Malawi	If linked to net node, display the net node name
15	WWTP ID		If connected source
16	WWTP name		If connected source
17	WWTP alternative	Rebuild WWTP	If connected source
18	Secondary recipient ID		If connected source
19	Secondary recipient name		If connected source
20	Source size (km2)	45.9	Only relevant for diffuse source and treatment area if domestic ww activity, leave blank for the rest
21	Type of industry ID	456	Only relevant for industry, leave blank for the rest
22	Type of industry name	Paper and pulp	Only relevant for industry, leave blank for the rest

If recipient oriented presentation is selected

Column no	Property	Examples	Comment
1	Recipient ID	3456	If net node or WWTP selected, display this.
2	Recipient name	Lake Malawi	If net node or WWTP selected, display this.
3	Source size (km2)	45.9	Only relevant for diffuse source and treatment area if domestic ww activity, leave blank

			for the rest
4	From date	01.01.1996	
5	To data	01.01.1997	
6	Component ID	56	
7	Component name	CODMN	
8	Value	78.4	
9	Value unit	Tonn/year	
10	Source ID	456732	There might be several sources discharging to one recipients (one to many). Column 1-7 might be repeated several times (=number of sources discharging to the recipient, or more if several discharge pipes). The sum to the recipient will be part of the "Show selected data".
11	Source name	Greaker WWTP	See comment to column 10.
12	Source alternative	More pollution	See comment to column 10.
13	Pipe ID	456732	See comment to column 10
14		Greaker WWTP pipe	See comment to column 10
15	Source type	wwtp	See comment to column 10. The source type will be one of 11 types.

Common functionality for the table
The functionality described under shall be implemented, either as a VB form like today, or better if possible with the use of Report Generator. This will probably support the possibility to add user specific properties (i.e. add more columns in the output table, treatment method, area types, etc).

Sort button: It shall be able for the user to sort the columns of the table. This is in a way it is implemented other places in the application when the user presses the heading of the columns (in for instance lists). It is important that all columns containing numeric values are sorted as numeric and not alphanumeric (like it is several places in the application for IDs).

There is one main addition to the functionality. The user must be able to sort several columns (like it is in for instance Excel and Access). Example: The user first wants to sort as a function of the source type, secondly as a function of start date, third as function of value.

Multi-selection (and multi-removal) must be implemented in the table. The user must be able to highlight one or several columns and remove (multi-select). In a similar manner the user must be able to highlight one several rows and remove (multi-select). The multi-removal of columns might be convenient to avoid slow response time when updating a huge table. Removal of column is implemented in ENSIS 2.05, but there seems like there might be some bugs there. It seems like the columns disappear a bit randomly.

Be aware of that the results in the database shall not be changed, only on the table form.

Copy to clipboard: There shall be implemented a "copy to clipboard button" on the table that copied the table exactly how it looks like after manipulation by the user.

Map: A map button must be implemented in the table to provide a direct access to the map. If the user has done any manipulation of the table, only the remaining items in the table shall be shown on the map. Is this possible if the report generator is used?

Statistics: Keep the functionality as today, but add the possibility to set the number of decimals (this is especially relevant for the column containing the values).

3.4.6 Presentation of water model results form, Map

This part shall be kept like today, but extended to cover more sources, and new alternative ways of presenting data.

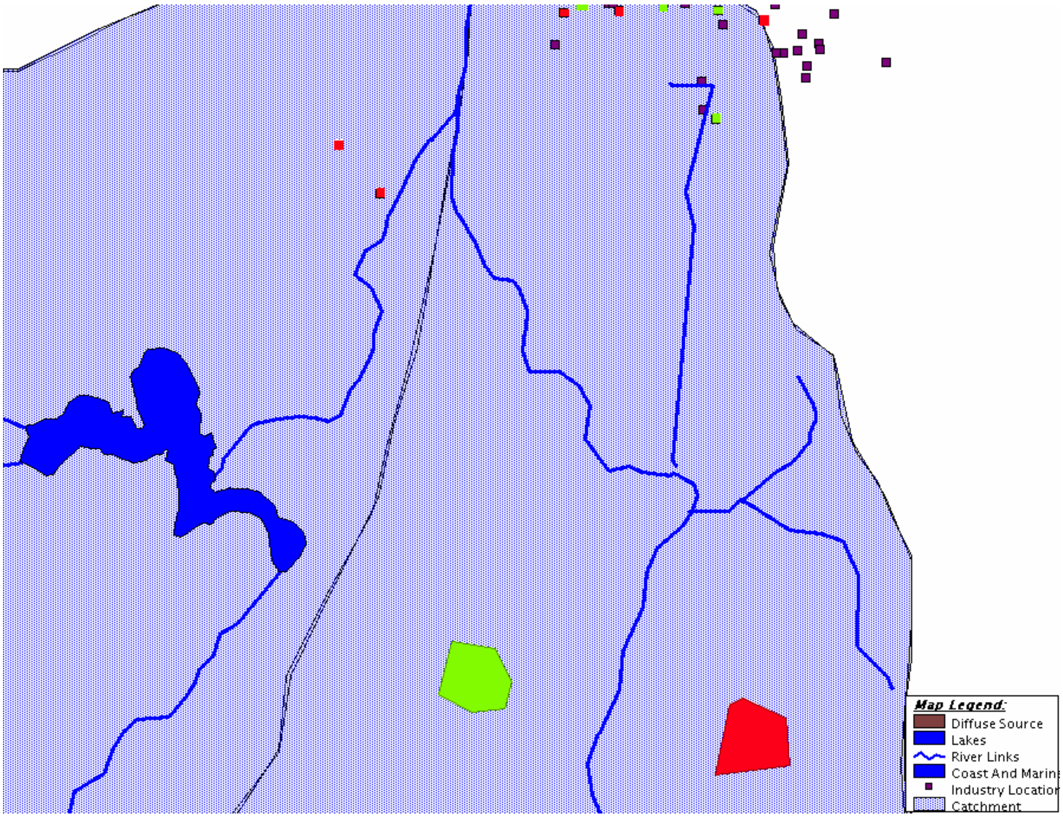
If source oriented presentation is selected

This is the present situation in ENSIS. The user shall be able to present the results as:

- Bars (like in present version)
- pies (the size is a function of the value)
- standard point dataset with different colour (this shall be the new default way of presenting the results instead of bars)

If the user opens up the map after manipulating the results in the table, the map presentation shall be updated according to the changes in the table.

There are 4 area sources (agriculture, runoff from urban areas, user-defined diffuse source and treatment areas via activity types) that by default is represented as a point (centre of the polygon, collection point for the domestic ww activities). The user shall be able to present these sources with colour (the same as the point dataset colour), covering the entire source. This function can be called "Representative for area (fetch to entire area source)". An example is shown below.



Example how dataset values are fetched to two area sources. The light green and the red in the lower part of the image are discharge values for diffuse sources. If the option "Representative for area (fetch to entire area source)" were not selected, the values would appear as points in the centre of the sources. Diffuse area sources should be possible to be split into different types of diffuse sources, if this is configured in the map setting.

If recipient oriented presentation is selected

This is different from the present version of ENSIS, and will require calculation by the system when extracting data from the database. In the database, the values are linked to the source, but we want the values for the presentation to be linked to the recipient/net node/wwtp instead of the sources. For this reason, the system must sum up all the sources discharging to the selected recipient/net node/wwtp for each time step. Be aware of that this includes also the overflow figures (from the sources and not the point source at the network) and leakage if these are included in the calculation, by being assigned to a specific recipient.

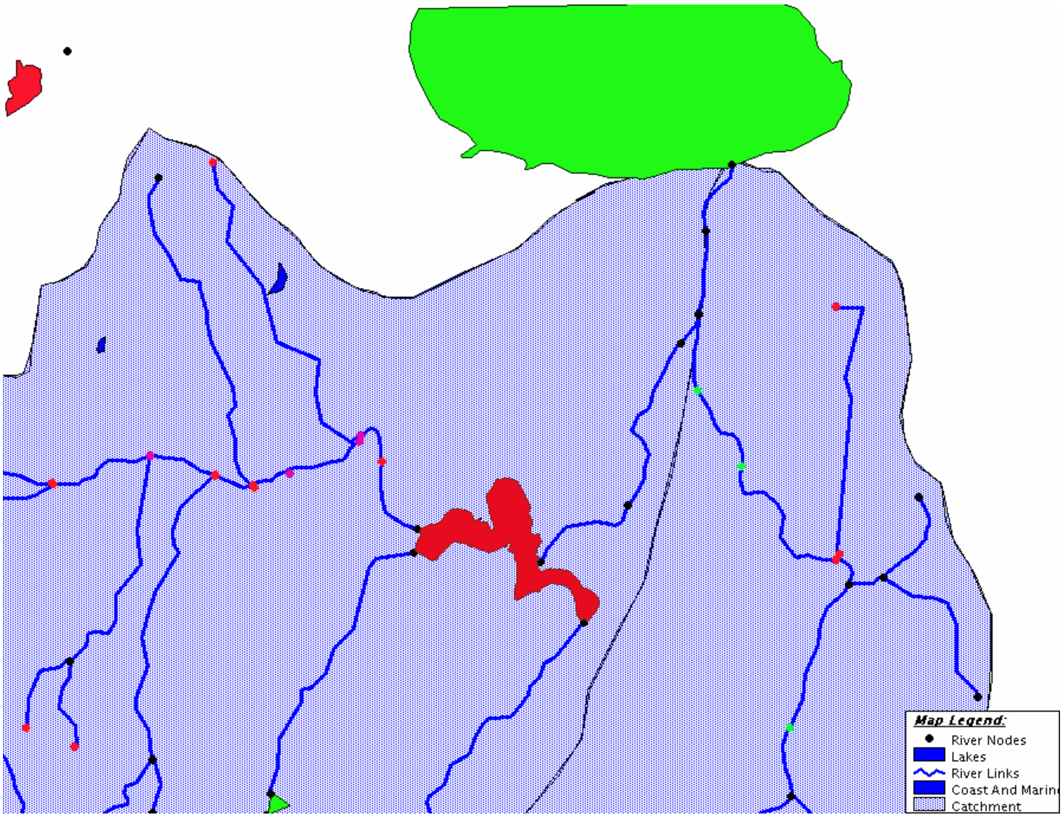
The user shall be able to present the results as:

- Bars
- Pies (the size is a function of the value)

- Standard point dataset with different colour (this shall be the new default way of presenting the results). It shall be able to change representation levels as implemented in present version of ENSIS.

If the user opens up the map after manipulating the results in the table (i.e. exclusion of some recipients), the map presentation shall be updated according to the changes in the table.

If a lake or coastal area are among the recipients to be presented, they shall by default is represented as a point (centre of the polygon). The user shall be able to present these recipients with colour (the same as the point dataset colour), covering the entire polygon. This function can be called "Representative for area (fetch to entire recipient)". An example is shown below.



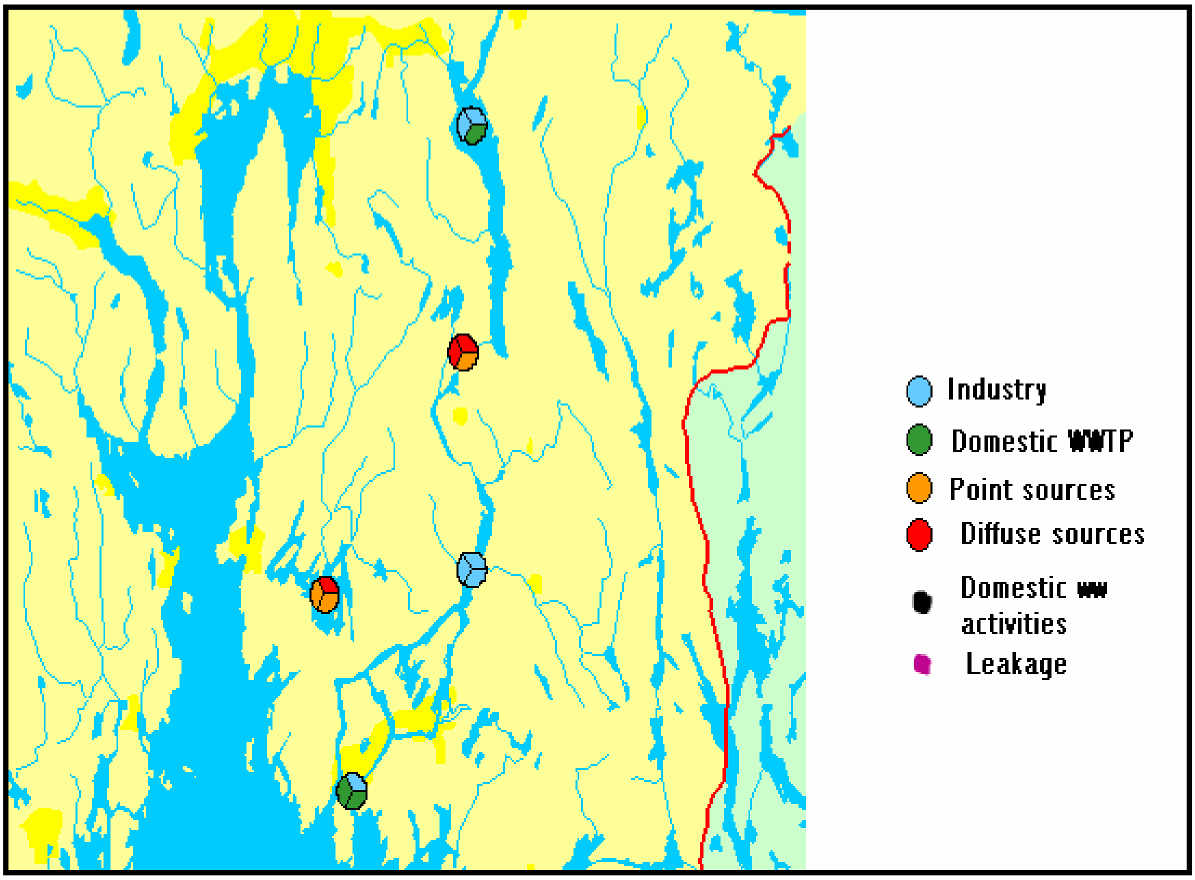
This example shows how recipient oriented presentation with "Representative for area (fetch to entire area source)" can look like. River nodes are given colour according to the value, and the lakes and coastal area in a similar way, but the values are made representative for the entire polygon.

<u>Presenting the discharge from different sources:</u>
This type of presentation will only be relevant for the types pie and bars. The idea is to view on the map what is the origin of the discharge to the recipient/net node/wwtp. This possibility shall be avilable with the use of the right mouse button (Discharge from source categories). The discharge shall be grouped in 7

categories, which reflect the 5 tabs from the source composition, and overflow at the source and leakage if included. The groups/categories are:

- [WWTP] for domestic wwpt
- [IND] for industry
- [POINT] for point sources
- [DOM_WW] for domestic ww activities
- [DIFF] for diffuse sources
- [OF_S] for overflow at source
- [LEAK] for leakage at source

It shall be possible to view the amount of discharge both as the real number, and as a percentage shall be possible to switch on directly on the map. The user can switch between percentage and real values by use of the right mouse button. The division between the categories of sources will, of course, be the same. Example of presentation is given below.



This example shows the principle how the pie presentation shall look like. But, each pie shall be composed by 5 (+ maybe 2 more) sectors, one for each source category (+ maybe leakage and overflow). The size of the sector shall reflect the *amount of discharge for each sector. In a similar way, it shall be possible to present results from each of the categories as bars.*

It shall be possible to export the prepared maps (bmp, wmf and shape) to other programs.

4 Water quality model

The list of water quality model setup is identical to pollution budget model source composition list, and the functionality is given on the next page. Remember to include a "Copy" button on the list of water quality model setups, to allow the user to copy one setup into a new one. Include also a property saying which scenario (previously called alternative) the water quality model setup is linked to. Everything shall be copied except for ID and name.

Graphic presentation of the results should be harmonised with the Graphics specification.

Simulation type: All three options shall by default be selected. If the user selects:

◊ Pollution load calculation, the system shall calculate only the mass/time step for the individual links and lakes.

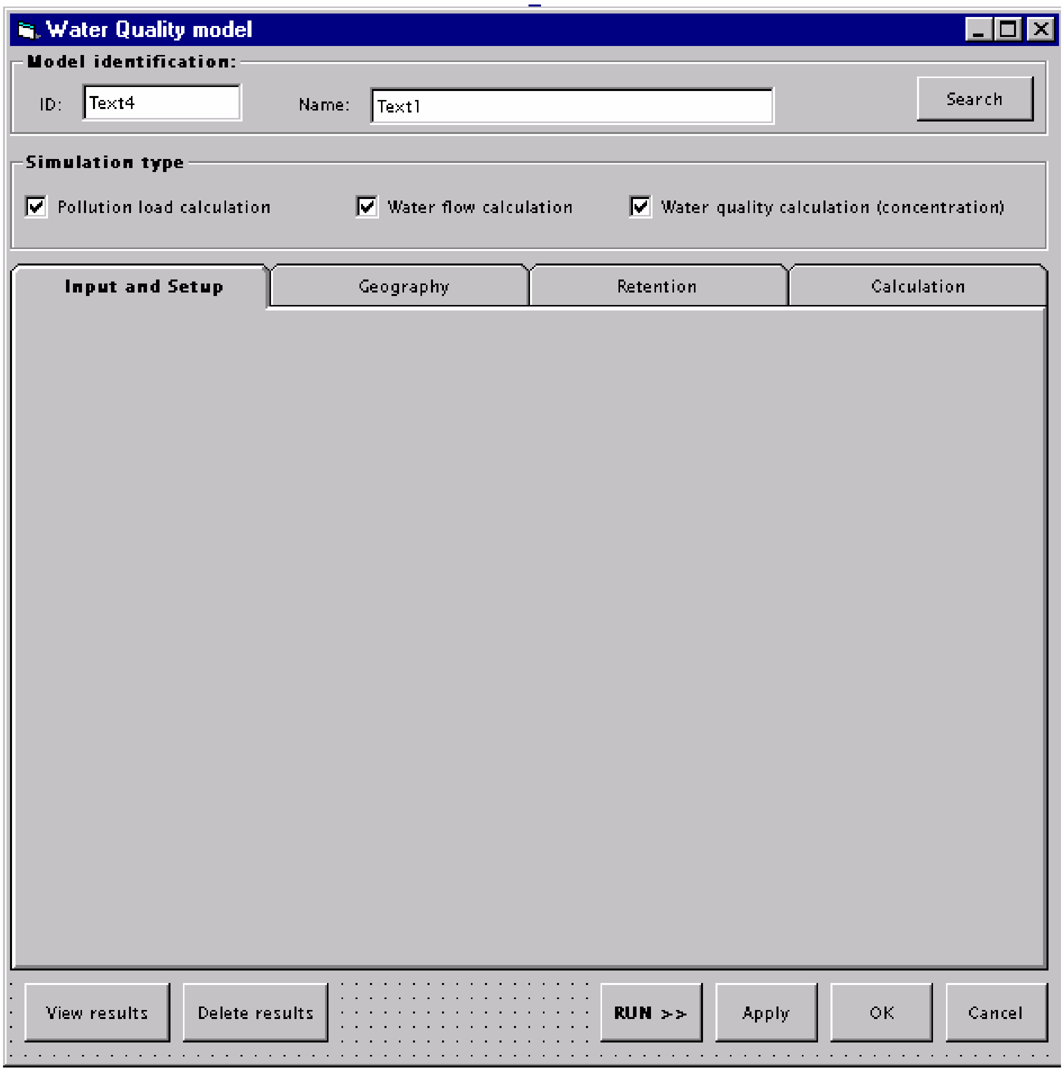
◊ Water Flow calculation, the system shall calculate volume/time (typically l/sec or m^3/sec).

◊ Water quality calculation the system shall calculate the concentration in mass/volume (i.e. mg/l) of the selected component for the individual links and lakes. If the water quality calculation is selected, the water flow in the river links must be available. For this reason, if the user selects water quality calculation, the water flow calculation must be automatically switched on. The user can check water flow calculation without checking the water quality calculation. One or several options are required.

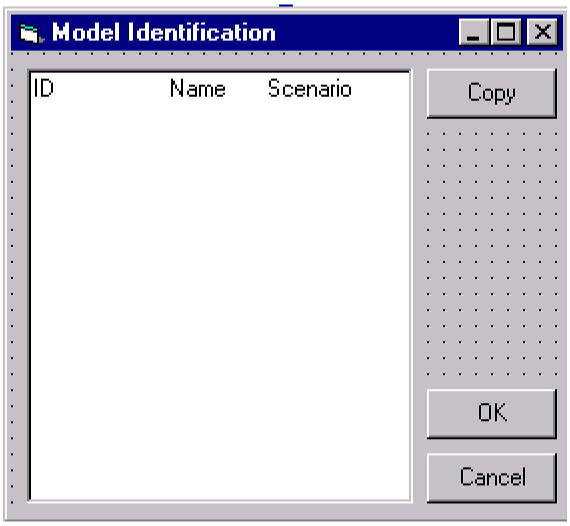
During the calculation: The calculation of the pollution (mass/time) will be the basic calculation. To be able to go from mass/time to concentration (mass/volume) the system will need water flow in the river (volume/time, typically l/sec or m^3/sec) and inflow to the lake over the time step (typically m^3/sec). It is assumed completely mixed water bodies. The concentration will then be:

Concentration (river links) = pollution load / water flow [mass/volume]
Concentration (lakes) = pollution load/ inflow to the lake [mass/volume]

The inflow must be taken from the river links linked to the lake. Only the river links with their downstream node/lake = the lake in question shall be used in the sum (not the river links located downstream of the lake).



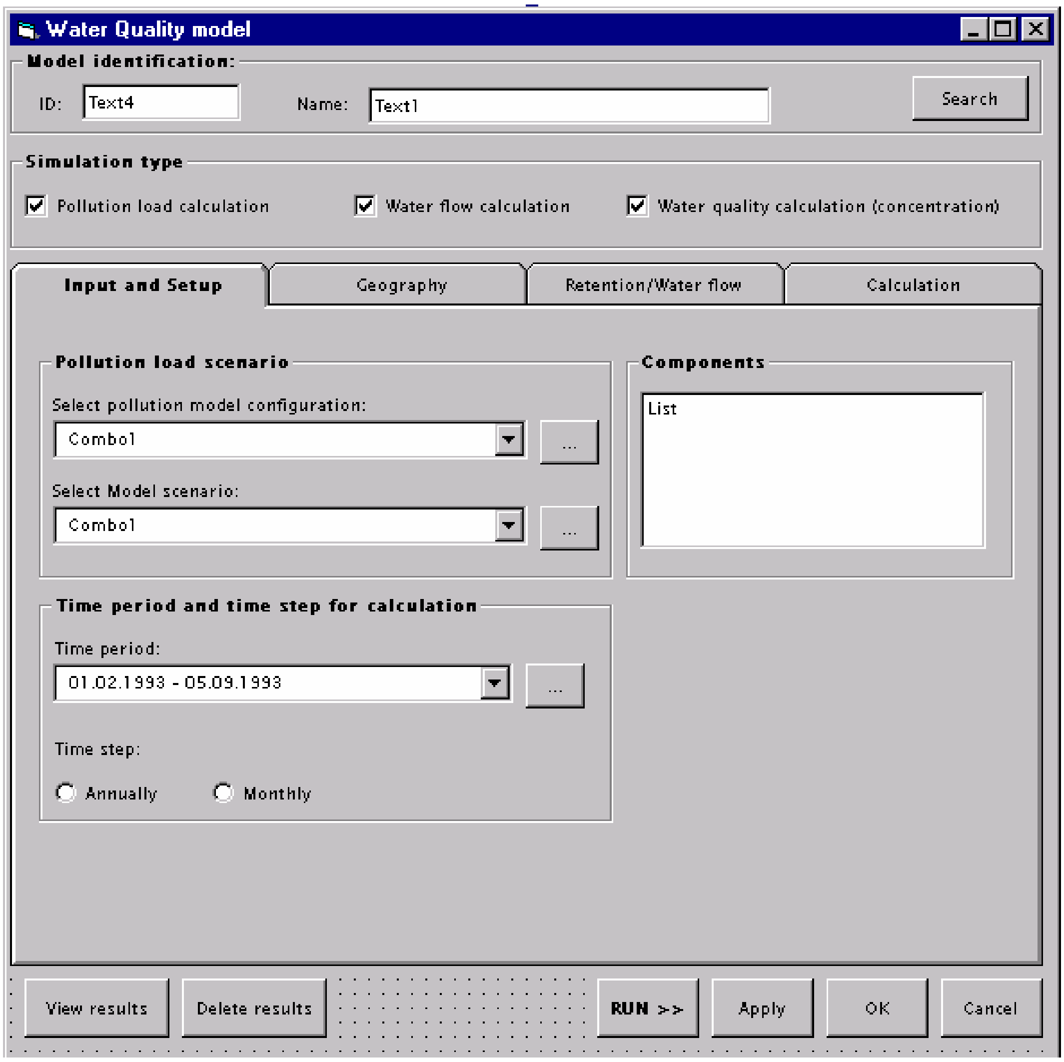
Water Quality Model is opened from Models|Water Quality|Water Quality Model. ID and name are standard ENSIS controls. ID shall be numeric. Both are required. It should be possible to open a previously defined model setup by pressing Search. Defined setups should be listed by ID and Name. The user can open a defined Model setup, edit the setup and save it again either by a new name and ID or with the same ID and name. There should be a warning if the user is overwriting a setup.



This form consists of 4 tabs:

Input and Setup	Select pollution load through pollution load scenario. Select time period and time step.
Geography	Define geographical area (meaning river links and lakes)
Retention	Define pollution load through dataseries or manual entering of data. Define water flow input to the model. Calculates retention for all river links and lakes.
Calculations	Define log-file and run the model.

4.1 Tab 1: Input and setup



Pollution load scenario: The user shall be able to select one of the available water pollution budget simulations (model configurations). The ID and the name of the model configurations shall be shown in the combo box. This shall be <u>optional</u> information. If the user wants to calculate the water quality without any sources discharging to the river system, but only based on boundary condition, this should be possible. These boundary conditions are defined in tab 3. If a pollution scenario is selected the geographical objects that was included in the scenario should be listed automatically in tab 2.

Select Model Scenarios: The user must select which scenario the simulation shall be linked to if a model configuration has been selected. The default shall be the same scenario as the selected pollution model configuration.

The introduction of linking to water quality scenarios will not be any major consequences for the water quality model. A model scenario will be defined in exactly the same way as an ordinary water quality model run, except for the fact that the user should select to link a scenario to another scenario than what is considered holding "real, true" data.

Components: This control shall list the included components from the selected model configuration, in other words, the components that there exist results for. The user shall be able to select only one component from this list. This is required information. If no pollution load scenario is selected, all components should be listed. The user can select one component and this component will be predefined search criteria in tab 3.

Time period (validity period): Default choice in this combo box shall be the same period as there exist results for in the selected pollution load model configuration. The user shall be able to make the period shorter, but not longer. This is required information.
If no pollution load scenario is selected, the user can define a time period. When searching for dataseries later – only dataseries with validity period covering the time period will be searched for.

Time step: The user shall be able to define the time step of the simulation (the time resolution of the results). Only annual and monthly shall be available. The default choice shall be identical to the same time step as there exist results for in the selected model configuration. If the time step of the model configuration is different from annually/monthly, no default choice shall be provided. This is required information.

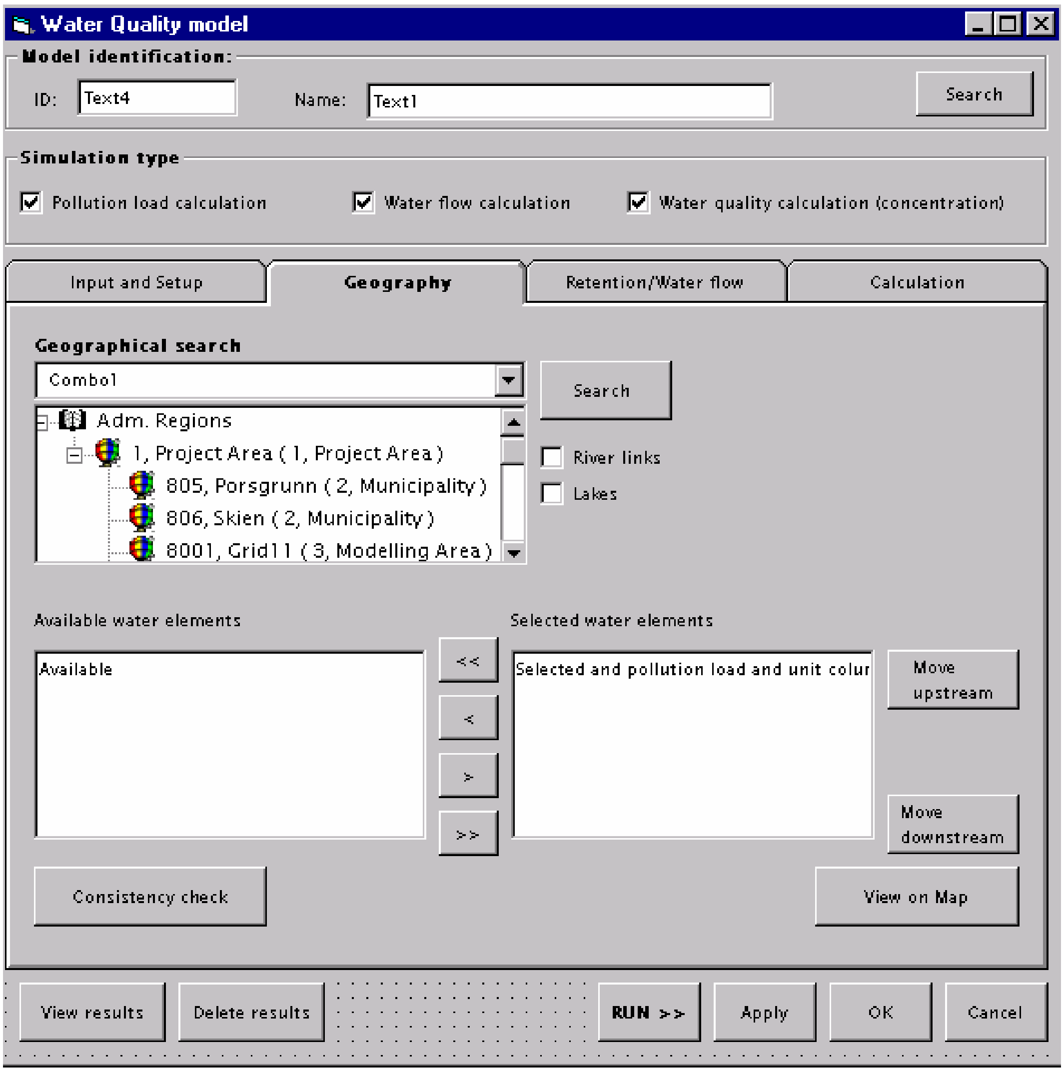
If the time step of the water quality model is different from the results they are based on (from pollution load model), the system must automatically "convert" the results into the desired time step of the water quality model.

Apply: Stores the setup to the database without closing down the form. If the setup already exist in the database, a warning about overwriting shall appear.

OK: Stores the setup to the database and closes down the form. If the setup already exist in the database, a warning about overwriting shall appear.

Cancel: Closes down the form without saving changes. If changes have been made, a warning that changes will not be stored shall appear.

4.2 Tab 2: Geography



This is the second tab and the tab where the river system to be calculated is defined.

Geographical search: This is a standard geography tree view (adm region, catchment, treatment area and user-defined area) for search for other geographical objects.

River links and lakes: These shall be checked indicating which objects the geographical search criteria shall be applied to. The system shall find river links and lakes fully or partly within the selected geographical region. By default, both shall be checked. Since the calculation method is based on river links and lakes (and not river nodes), the relevant water elements are river links and lakes.

Search: The search shall be performed when this button is pressed.

Available water elements: All found items shall be listed in this control. The water elements shall be listed with what type of element (river link = [Link] and lake = [Lake]), ID of the water element and name and alternative of the water element. (alternative should be included in the geography modules). If there are more alternatives for one lake (for example) the ID and Name will be the same in more rows. In addition, the river chain ID and river chain name shall be shown for those river links and lakes that are part of a chain. The user shall be able to sort the elements by clicking on the top of the column. IDs shall be sorted as numeric.

Arrows: Standard ENSIS buttons to move all/one item(s) between lists.

Selected water elements: The user can manually select which elements to be included in the simulation by moving from the available water elements control to this control. The properties shown shall be identical to the available water element control. The user shall be able to select many items in the list and move these simultaneously up or down as the user presses the "Move" buttons. In this way, the user can move a group of elements at the same time.

Move upstream/downstream: The water elements can be moved up and down in the list, to indicate the river system structure. The most downstream element shall be on the bottom of the list, while the most upstream (different elements can actually be defined as the most upstream) shall be on the top of the list. The order defined in this list is used to check the consistency of the river system. See description below. This control shall have drag-and-drop functionality in addition to the arrows (section 3.1). The user must select at least one element.

View on map: The user shall be able to view the river links and lakes in the control "Selected water elements" on the map. The display is done when the user presses this button.

Consistency check: See detailed description about calculation routine below. The consistency check (with a returned value = OK) must be run before the calculation starts.
If the consistency check return NOT OK, the river elements should be edited in the tab shown above.

4.2.1 Explanation of the consistency check

The idea of the consistency check is that the system shall check whether the selected water elements (one or many river links, and one or many lakes) form a complete entity. **The consistency check shall always start from the downstream end.**

This consistency check must be performed before the calculation of the model. The RUN button will not be enabled before this has been performed.

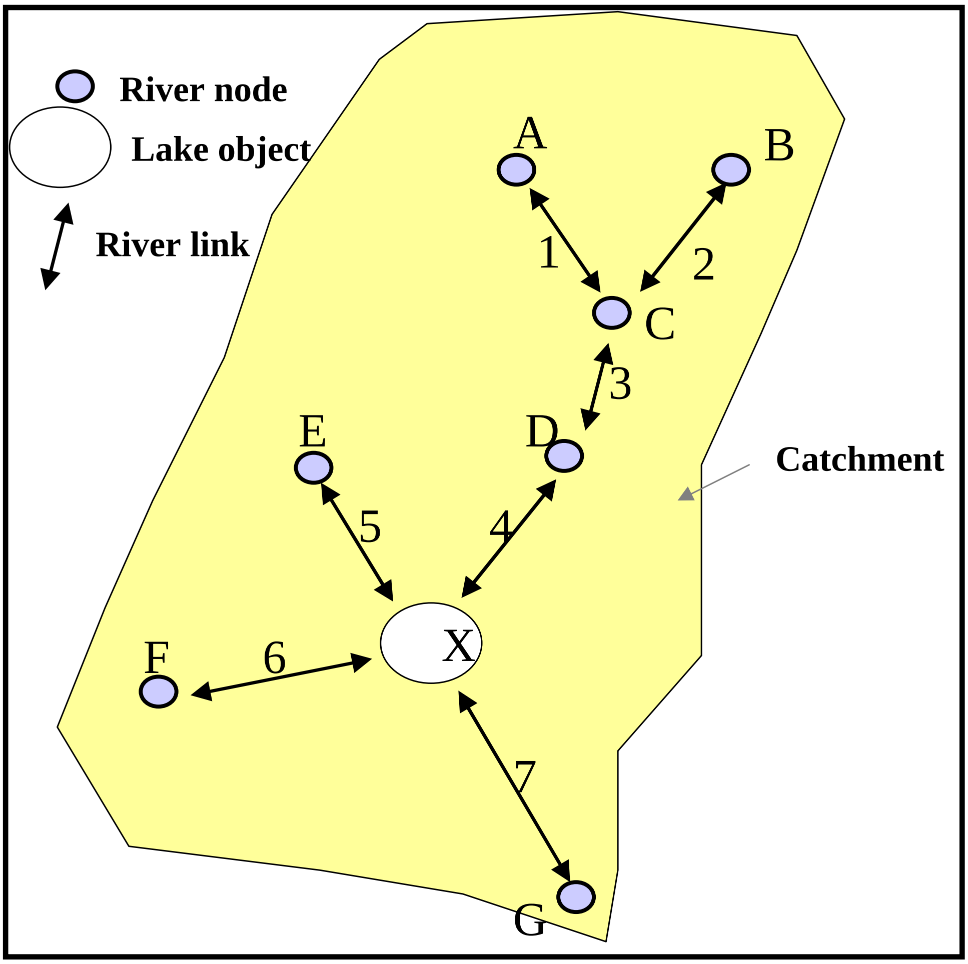


Figure 1. The figure shows a schematically view of the river system. Arrows represent river links, small circles river nodes and larger circle lake.

The consistency check shall return a report. If the check is OK, then OK and which elements that are checked are the only needed answers. If the answer is Not OK, then the system must tell the user what is wrong with the selected river system.

The output list/report shall contain only river links and lakes. The list is identical to the control called "Selected water elements …." in tab 2. The algorithm for checking the list should start with the most downstream elements and calculate in the upstream direction.

The system must use the information available on the definition of the river links to perform the check. The routine should start with the most downstream element.

<u>If most downstream element is a lake:</u>

- Go to the second most downstream element and check if the most downstream element (the lake) is a downstream node/lake
- If OK, the first two elements are OK
- The second element from the bottom must be a river link if the first one is a lake
- If the third element is a river link, check if the downstream element (river node) of the third element is the same as the upstream element of the previous element (river link). If OK, the first three elements are OK
- If element number four from the bottom of the list is a lake, check that this lake is the same as the upstream element/node of the previous river link. If element OK, the element number 4 from the list is OK.
- Keep on like this.
- The system must end up with a temporarily not OK answer (for instance on the top of a river branch). Before returning an error value (not OK), the system must check if the element that fails is an upstream element of one of the items more down on the list. A lake or a river node might be connected (as downstream element) to several river links. If temporarily fail on the first check, the system shall:
    - If the item is lake, the consistency check permanently failed
    - If the temporarily failed item is a river link, the system shall:
        - Find the downstream element of the river link in the database (river node or lake. If coastal object, the check should return an error), and check if this is the upstream element of any of the previous items in the list. If OK, the check should go on with the next item in the list. If not OK, return an intelligent error message.

<u>If most downstream element is a river link:</u>

- Go to the second item in the list. If this is a lake, check if this is the upstream element of the first river link. If the second item is a river, check if the downstream element of this river link is identical to the upstream element of the first item of the list (river node or lake).
- See the above "algorithm" for further consistency checking.

Examples:

Table 1. Content of list with water elements. Should return OK.

Name of water element	Order
[Link] 1	Most upstream
[Link] 2	
[Link] 3	

[Link] 4	
[Link] 5	
[Link] 6	
[Lake] X	
[Link] 7	Most downstream

Table 2. Content of list with water elements. The order is changed from table 1, but the check should still return OK.

Name of water element	**Order**
[Link] 6	Most upstream
[Link] 5	
[Link] 2	
[Link] 1	
[Link] 3	
[Link] 4	
[Lake] X	
[Link] 7	Most downstream

Table 3. Content of list with water elements. Two water elements are taken out of the list from table 1 and 2. The system shall return Not OK and an explanation what is wrong when the user runs the consistency check.

Name of water element	**Order**
[Link] 6	Most upstream
[Link] 5	
[Link] 2	
[Link] 1	
[Link] 4	
[Link] 7	Most downstream

4.3 Tab 3: Retention

Another result of the consistency check should be that all water elements that are located as the most upstream element of one river branch (river link 1, 2, 5 and 6 in the example of the consistency check in the document) shall be **marked blue** (tab 3). Beside these elements, there shall be 2 additional columns where the user shall be able to enter a discharge entering the system from upstream areas. The second extra column will be the unit of the pollution load (in mass per time). By default the boundary condition shall be zero if no pollution load scenario has been selected, but the user shall be able to enter a number and a unit in these two columns. Be aware that in the calculation, the boundary input will be constant over time, meaning that the entered pollution load shall be added for all time step of the simulation. If a pollution load scenario has been selected, the pollution load values from the scenario should be filled in. The user should be able to edit all cells except for columns 1-5 and the last column Retention.

The columns should be as the following:

Given and edited in tab 2

Element	Element ID	Element Name	Element Alternative	Order	Length [km]	Comp (PTOT)	Unit	Comp (SO4)	Unit	Q	Unit	Retention
Link	Numeric	String	String	TAB 2	10	Value	Mg/l	Value	Mg/l	Value	m3/s	Value
Link	Numeric	String	String	TAB 2	5	Value	Mg/l	Value	Mg/l	Value	m3/s	Value
Lake	Numeric	String	String	TAB 2		Value	Mg/l	Value	Mg/l			Value
Link	Numeric	String	String	TAB 2	12	Value	Mg/l	Value	Mg/l			Value
Lake	Numeric	String	String	TAB 2		Value	Mg/l	Value	Mg/l			Value
Link	Numeric	String	String	TAB 2	17	Value	Mg/l	Value	Mg/l			Value

Columns element, element ID, element Name, element alternative and Order can not be edited in this table, but in the table in tab 2. Retention equation can be edited through “Calculate Retention” and edit retention equation. All columns can be sorted. If column 1 is sorted lakes and links are separated.

Water flow can be added in two ways:

1) Manual entering of data in the table
2) Mark the cell, press search criteria water flow and the standard search form will open. All stations that are representative for the selected river link (river links if more cells are selected) and with component water flow will be

searched for. This should be predefined search criteria. The user can edit the criteria.

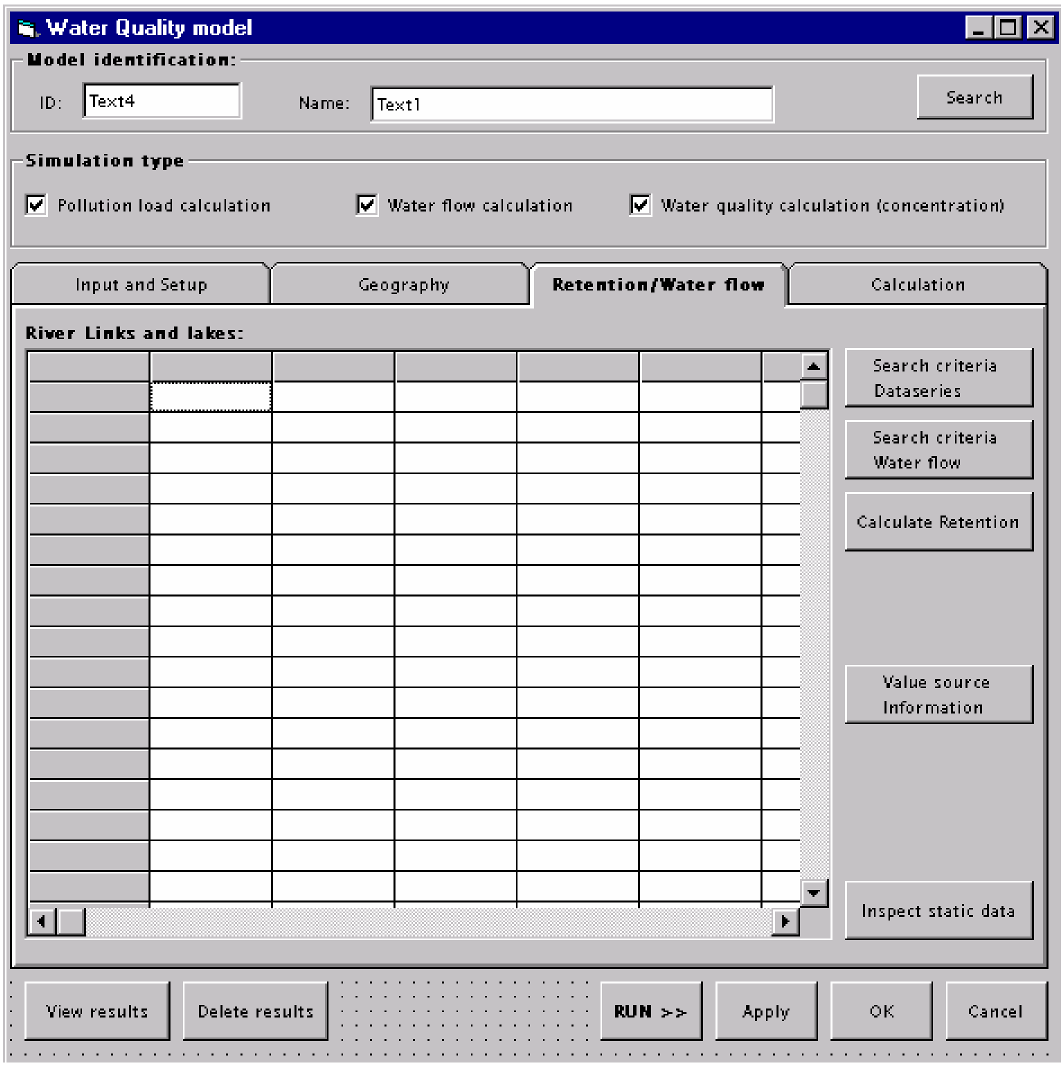
If static is selected in the previous column, the value shall be shown together with the unit m^3/sec. This value shall be taken from the static data part of the river links (average flow). It can be several Q-values within the selected simulation period, because the validity period of the static data of the river link might be shorter, change in the middle of the simulation period, etc. If many different Q-values are available, this shall be shown by displaying the values separated by / (i.e. 30/32/25). If the water flow is a data series, this shall be indicated with <<series>>. Shall be disabled.

Water flow priority. (shown later in this chapter, on the form Value source) The user should be able to give Q-priority meaning if the static value of the dataseries should be used in the calculation. This shall be a combo box with the item static data (indicating that data from the river link object is used), and the definition of all the data series in the list above are present. The user shall be able to manually pick one series from here. This column can also be automatically (partly) filled from functionality described above. Regarding the input to the model, if static data is selected as the highest priority, dataseries shall never be used as input. If a dataseries is selected as the highest input priority, and this dataseries does not cover the whole period, the system shall go to the static data and take data from here. If still not enough data to fill in relevant data for the simulation period, the system shall extrapolate the data with the highest priority. Shall be enabled.

Use of water flow in the calculation:
If time series is to be used as input to the model, the series must be aggregated "on the fly" to fit the time step of the model. It shall be used time weighted interpolated average. The priority must be done the following way, which is similar to priority of model input on the pollution budget model. The system shall take data with highest priority first. If the simulation period is longer than the period the data covers, the system shall take data from the next (and lowest) level of priority if data exist for the remaining period. If still input data is missing, the system shall extrapolate the data with the highest priority. If static data is selected to have the highest priority, the system shall never go to the second highest priority. If the static data do not cover the whole period, extrapolation must be performed.

Pollution load data – there are three ways of entering data:

1) Manual entering of data in the table
2) Mark the cell/cells, press search criteria dataseries and the standard search form will open. All stations that are representative for the selected river link (river links if more cells are selected) and with component as selected in tab 1 will be searched for. This should be predefined search criteria. The user can edit the criteria. To calculate a pollution load with the correct timestep and timeperiod, the time series calculator will open automatically.
3) Select pollution load scenario if this is relevant and not done before. This should be done in tab 1.



Search criteria dataseries: The idea with this functionality is to provide a short cut to the dataseries to make the user enter reliable boundary condition for pollution input in the most upstream elements (marked blue).

By default, all the stations that have some of the most upstream water elements (blue river links and/or lakes) linked to them (via geographical representation) shall be checked. All stations shall be listed, to make the user able to check more stations than the default ones. The selected components (as defined to be included in the model calculation) shall also by default be checked in the data series search form. In a similar way, the user shall be able to add more components.

If some of the elements have been selected before the user press “search criteria dataseries”, only stations linked to the selected elements should be shown.

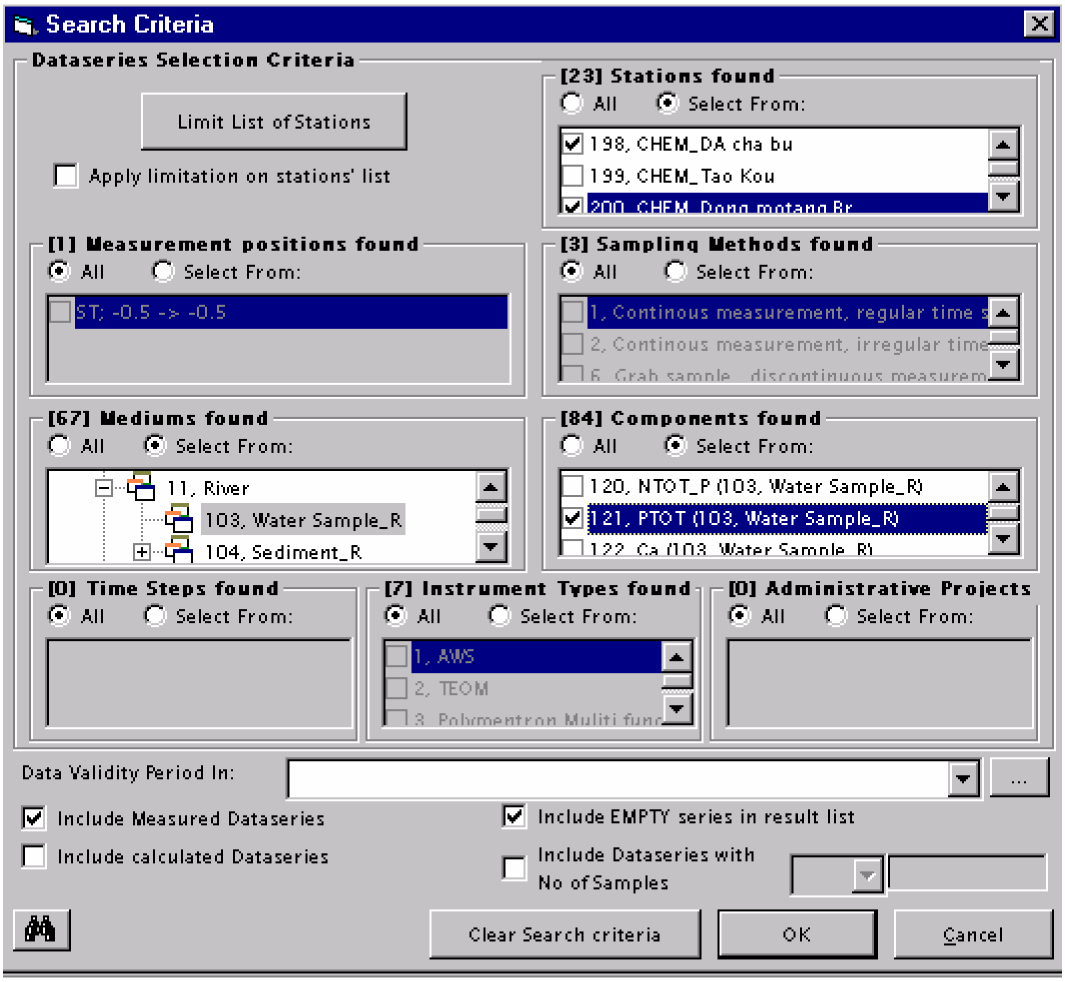
Search criteria Water flow:
The idea of this part is to be able to identify which water flow data series (from the predefined component Q) that are relevant to be used as input water flow to the model run instead of using the static data stored directly on the river links.

Search criteria button: Pressing this button shall open up the standard data series search criteria form. All the stations that have one of the river links included in the simulation linked to them (via the Station form and geographical representation) shall automatically be checked. It shall be possible to check additional station. The user shall be able to add additional components/parameters.

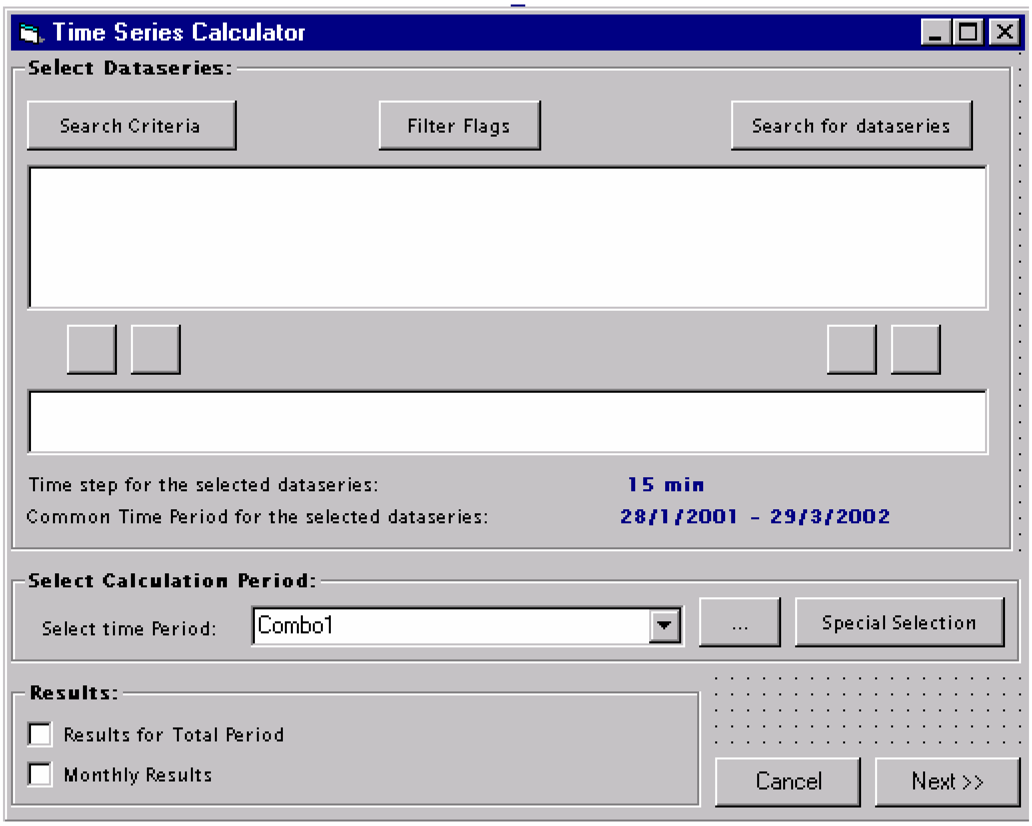
If some of the elements have been selected before the user press "search criteria dataseries", only stations linked to the selected elements should be shown.

The selected values can be edited.

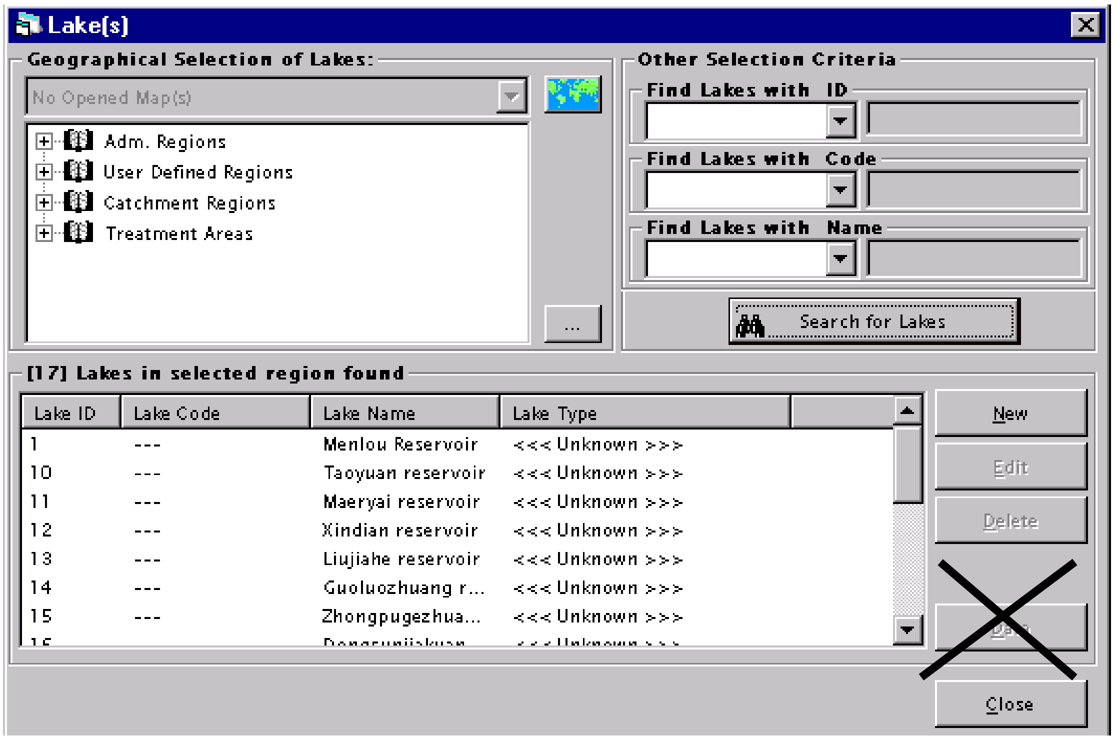
This form is opened with default checks when the user presses the "Search criteria dataseries" button.



When the user presses OK from the search criteria form, he is taken into the time series calculator form, where he can perform the calculation of monitoring values (concentration and flow) and find a value for the boundary condition.



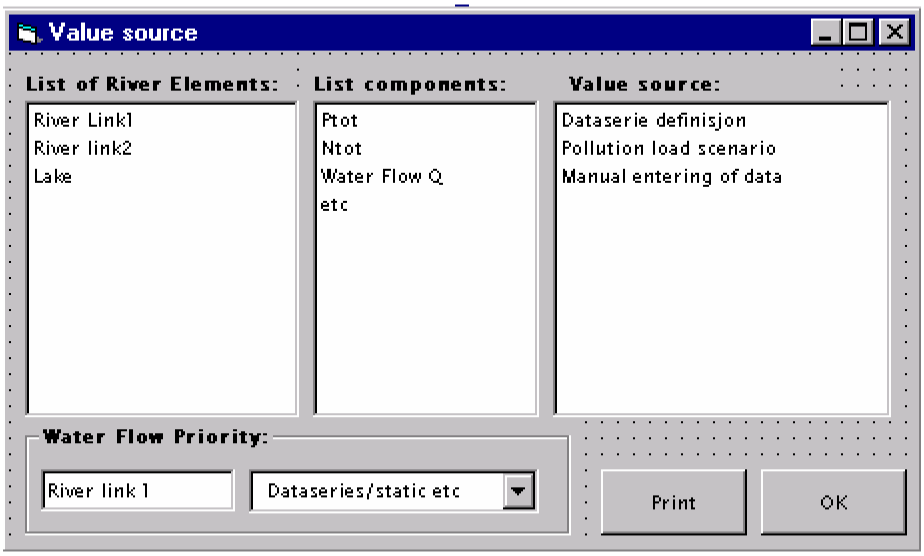
Inspect static data: When the user presses this button the main search form for river links (or lakes) are opened (similar to shown below), with the highlighted river links (lakes) read into the control with the list of river links (lakes). From there, the user can inspect the data, by pressing the "Edit" button (we assume that everything behind the "Data" button is moved to a separate tab invoked by the "Edit" button. The forms should be as defined in the geography chapter in measurement specification.).


Lake(s)
Geographical Selection of Lakes:
No Opened Map(s)
Adm. Regions
User Defined Regions
Catchment Regions
Treatment Areas
...
Other Selection Criteria
Find Lakes with ID
Find Lakes with Code
Find Lakes with Name
Search for Lakes
[17] Lakes in selected region found
Lake ID
Lake Code
Lake Name
Lake Type
1 --- Menlou Reservoir <<< Unknown >>>
10 --- Taoyuan reservoir <<< Unknown >>>
11 --- Maeryai reservoir <<< Unknown >>>
12 --- Xindian reservoir <<< Unknown >>>
13 --- Liujiahe reservoir <<< Unknown >>>
14 --- Guoluozhuang r... <<< Unknown >>>
15 --- Zhongpugezhua... <<< Unknown >>>
New
Edit
Delete
Close

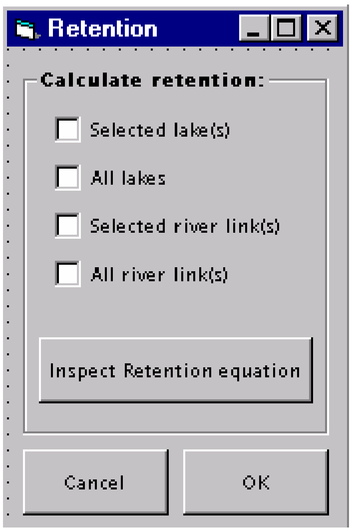
Information about the value source and water flow priority will be like this:
The first list will give all the river elements that are part of the river system. The second list is list of components. If the user selects river link 1, all components and water flow that are given for river link 1 should be shown. When one component is selected for river link 1, the source of that component value should be given in list 3. Value source means from where the value has been derived.

Ex: River link 1, component: PTOT and water flow (Q), Pollution load scenario for the component and dataseries definition for water flow.

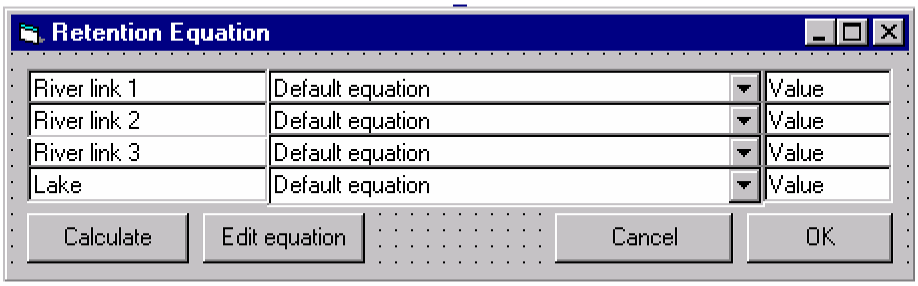
Water flow Priority is given in the combo box – and has been described above.



4.3.1.1 Retention



River Element	Retention Equation	Retention Value
River Link 1	List of all equations. The default equation should be selected by default. In the end of the list there should be an option : new equation	After calculating, the value should be given here. When the user press OK, the values should be updated in tab 3.
River Link 2		
Lake		



Retention on river links and lakes:

Column 1: This shall be the ID and the name of the river links. Shall be disabled.
Column 2: This shall be where the user defines which retention equation to be used for the different river links. The default retention equation of river links and the retention equation of lakes shall be filled in automatically, but the user shall be able to select another from a combo box of the grid control. This equation goes into the calculation to reduce the load on the river links (due to retention) or lakes. There shall be fill in column functionality (right mouse button) on top of the column. Shall be enabled. To edit the equation or create a new equation press "edit equation" and the user will come to the form given in chapter 1.7.
Column 3: This shall be the calculated retention value.

The calculation of the river link retention in the model simulation

The default calculation of the retention on the river links is pointed out below. Other equations can, as specified in a later section, be used. The equation to reduce the load and/or concentration gives a number in the range [0, 1] as output to be used on the incoming load at upstream end of the present river link for calculating the reduction in pollution load. The default equation for retention in river links is:

$$\text{Retention} = 1 - (1 - \text{retention coefficient})^{\text{river link length [km]}}$$

Retention coefficient = 0.03 per km river link. (meaning 3 % of the load “disappears” every km of river):

$$\text{Retention} = 1 - (1 - 0.03)^{\text{river link length [km]}}$$

Example:
River link length = 2.3 km

$$\text{Retention} = 1 - (0.97)^{2.3} = 0.56$$

Remaining load in the river link = 1 – 0.068 = 0.932 (meaning 93.2 % of incoming load)

Expressed in terms of load (L) in mass/time, remaining in the river link, and providing input to the next element:

$$\text{Remaining matter} = 1 - (1 - 0.03)^{\text{river link length [km]}} * L_{\text{incoming load}}$$

The calculation of the lake retention in the model simulation

The default calculation (to be shipped with an empty ENSIS project) of the retention in the lakes is pointed out below. The equation to reduce the load and/or concentration gives a number ranging between [0, 1]. The remaining load ratio is 1 minus the retention, to be used on the incoming load. The default equation is:

$$\text{Lake retention} = \left({}^{k1}\!\Big/\!{}_{\left(1 + \sqrt{\tfrac{1}{Tw}}\right)} + k2 \right)$$

k1 = retention coefficient 1 (dimensionless)
k2 = retention coefficient 2 (dimensionless)
Tw = theoretical retention time (entered in years, but considered dimensionless)

As default, the following numbers shall substitute k1 and k2:
k1 = 0.2
k2 = 0.1

For your information, for mesotrophic and N the coefficients are typically:
k1 = 1
k2 = 0

If the user wants to use these coefficients instead, he has to define this in the retention equation form.

Example:
Theoretical retention time = 1 year

$$\text{Lake retention} = \left(0.2 \Big/ \left(1+\sqrt{\tfrac{1}{1}}\right) + 0.1\right) = 0.1 + 0.1 = 0.2$$

Remaining load in lake = 1 – 0.2 = 0.8 (meaning 80 % of incoming load is still in the lake water)

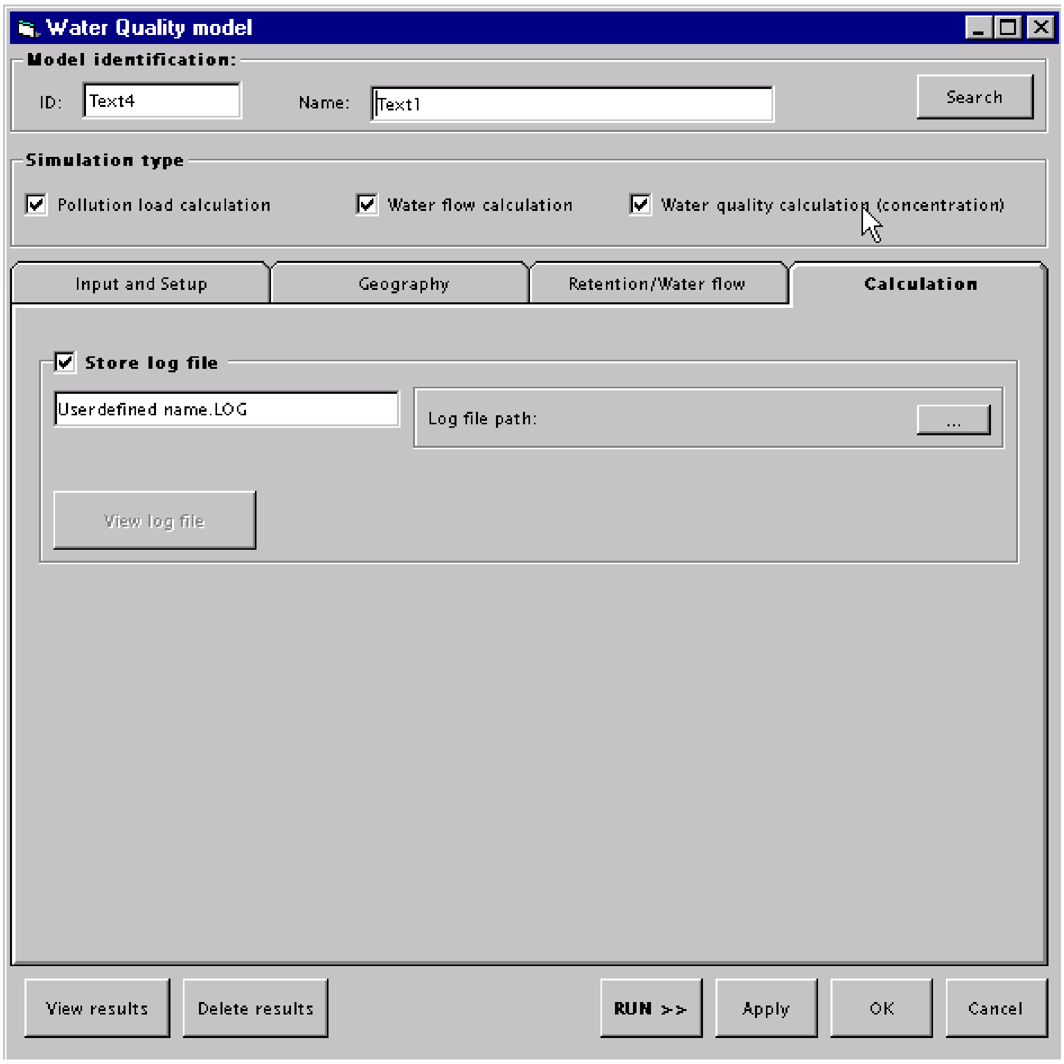
Expressed in terms of load (L) in mass/time, remaining in the lake, and providing input to the next element:

Remaining matter = (1 – retention) * $L_{fincoming}$ = $\left[1 - \left(\left(0.2 \Big/ \left(1+\sqrt{\tfrac{1}{1}}\right) + 0.1\right)\right]^*$ $L_{fincoming}$

An example covering a river system is included at the end of the document (section 6).

Be aware of that retention works identical (mathematically) on load and concentration, but to get the concentration, the load must be multiplied with the water flow into the lake (Q) (the river links with water directly flowing into the lake).

4.4 Tab 4: Calculations



This is the forth tab, and the user can select to store log file: This is similar to the water pollution budget model (model configuration).

In addition there should be a text field where the user can give a description of the model simulation. This description should be included in the log-file.

RUN: This button is only enabled from this tab. This starts the simulation with the defined input. A warning shall appear if the user has not stored the model setup to the database (pressed OK or Apply), and/or sufficient data/information is not present.

View results: Starts up the presentation of the model results. Details specified later.
View restults button will be enabled when the calculation has been performed.

Delete results: Deletes the results if results and sufficient user rights are present. A warning shall be presented before removal.

View log file: An editor starts up with the log file (if present) read into it.

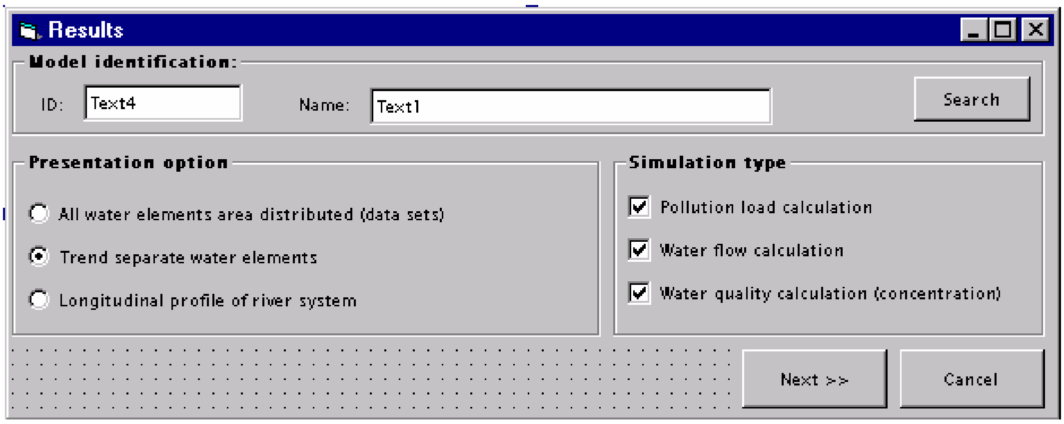
4.5 Presentation of results

The presentation system is started by the "View results" button.

It is assumed that ICB has found a smart way to combine river link datasets and lake datasets into one and the same datasets. The following part of the specification is based on this assumption.

There are three main presentation options:

1. All water elements area distributed (data sets)
2. Trend separate water elements
3. Longitudinal profile of river system



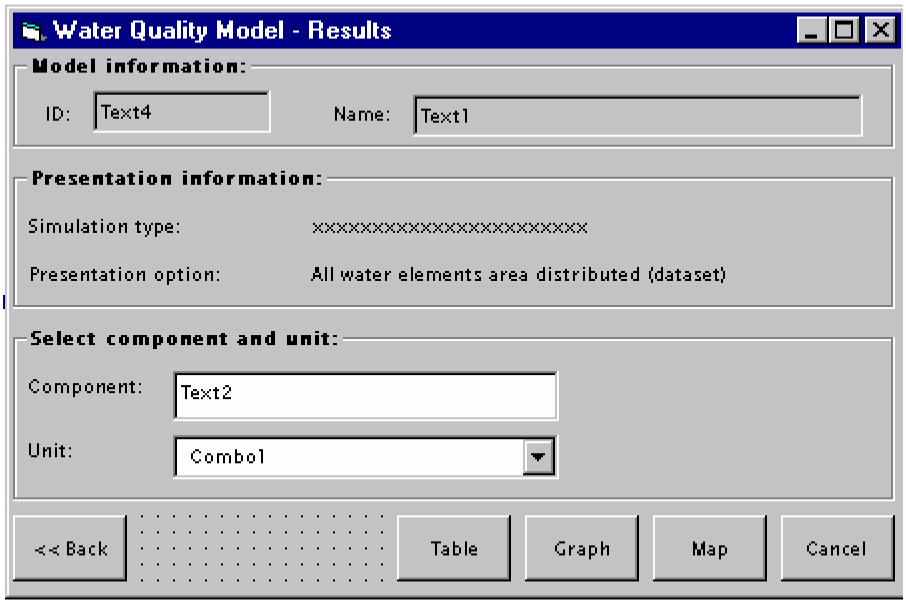
The layout of the form will be a bit changed as a function of presentation option selection.

This is the main form that pops up when the user presses the View results button, and then the All water elements area distributed (data sets). The upper part keeps information about the model run the form is opened from. This information shall be disabled.

Simulation type: The second step is to select type of simulation to present data from. Only simulation types included in the actual simulation (defined in the Input and setup tab) shall be disabled.

Presentation option	**Simulation type available**
All water elements area distributed	Use able to select only one simulation type
Trend separate water elements	User able to select more than one simulation type
Longitudinal profile of river system	User able to select more than one simulation type

4.5.1.1 Presentation option 1: All water elements area distributed (data sets)



After pressing next in the previous form after selecting presentation option “All water elements area distributed”, the form above should be shown.

Component: The component will automatically be a function of selected simulation type. For this reason, the component control shall be disabled and just showing the information. If the pollution load simulation is run, the component will be the same as defined in the Input and setup tab, with the unit type mass/time and mass (i.e. tonnes/year and tonnes). If the water quality calculation is selected, the component will be the same as defined in the Input and setup tab, but the unit will be mass/volume (i.e. mg/l). If water flow calculation is selected, the component will be Q (predefined water flow component), with the unit type volume/time and volume (i.e. m^3/sec).

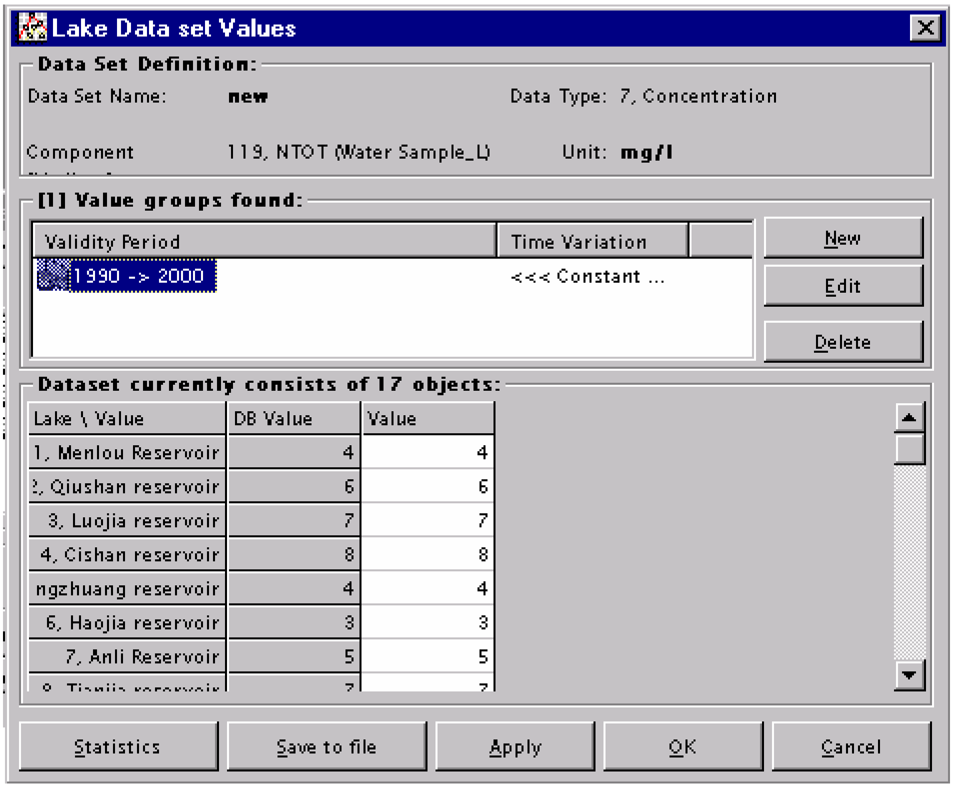
Unit: This shall be a combo box listing relevant data types as a function of selected simulation type/component:

- Pollution load calculation: mass/time and mass
- Water quality calculation: mass/volume
- Water flow calculation: volume/time and volume

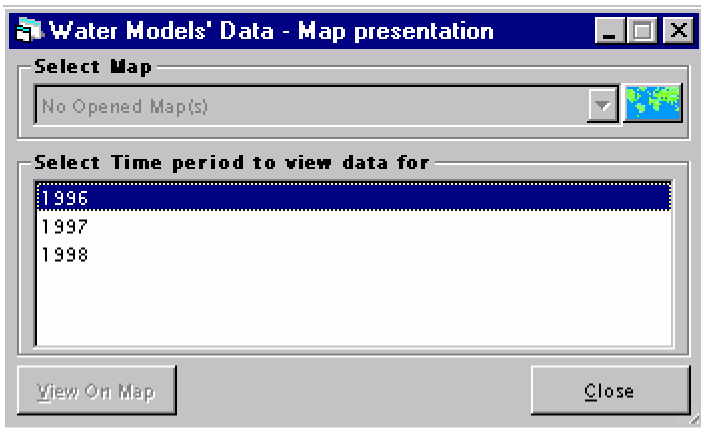
Explanation of mass/time and mass + volume/time and volume. If the user selects mass or volume per time, the amount of matter (mass) or water (volume) shall be divided on the time period defined in the denominator (for instance second or year). If the user selects the unit to be a unit derived from only mass or volume, the system shall divide the amount of matter or water on the time step of the simulation (i.e. month).

Graph button: The button graph shall be disabled.

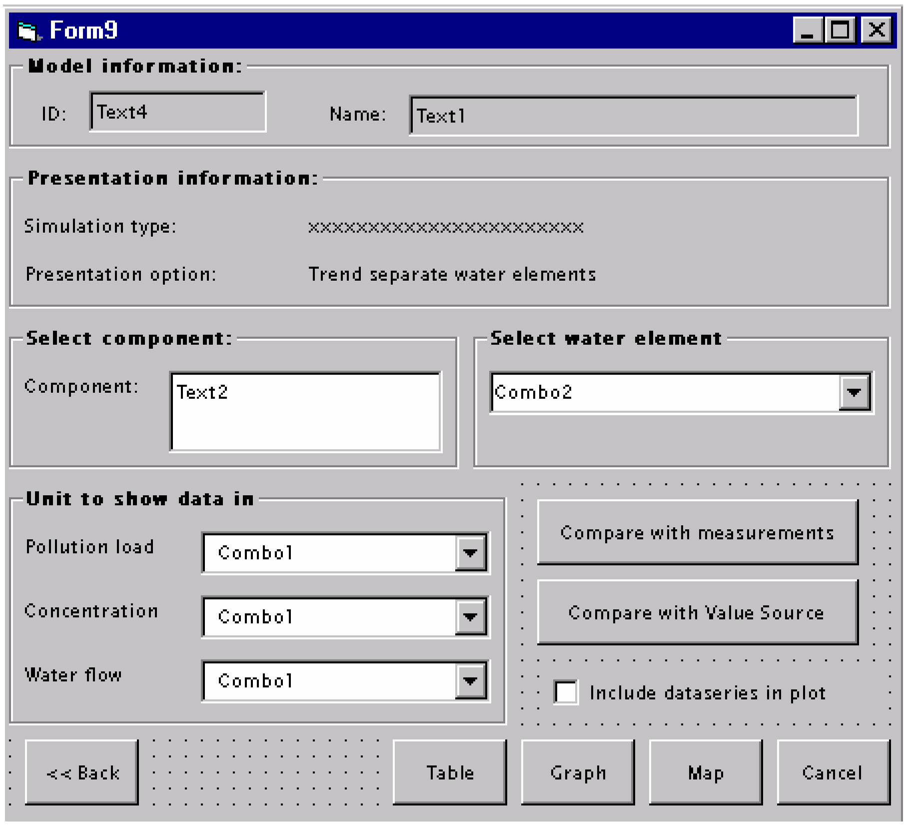
Table button: The form below shall be used. All time periods in the simulation shall be available, and the data/ results shall be shown when the user highlights the different time periods.



Map button: An intermediate form must be opened to be able to define time period/step to show. The form below shall be included for this purpose. From this, a standard dataset presentation shall be shown. It is important that the user can select colour representation of the dataset from defined colours from the water quality classification system (already implemented in ENSIS 2.05).



4.5.1.2 Presentation option 2 - Trend separate water elements



When the user selects "Trend separate water elements", the option buttons for simulation types are replaced by check buttons, allowing the user to select all types of simulations, if they are all simulated in the selected model run.

This is the layout when the second option "Trend separate water elements" is selected. The upper part is identical to the previous selection.

Component: If all three simulation type options are selected, two components shall be shown in the text/list control. Pollution load and concentration components are identical, and water flow is Q. Component control shall be disabled – and only give information to the user.

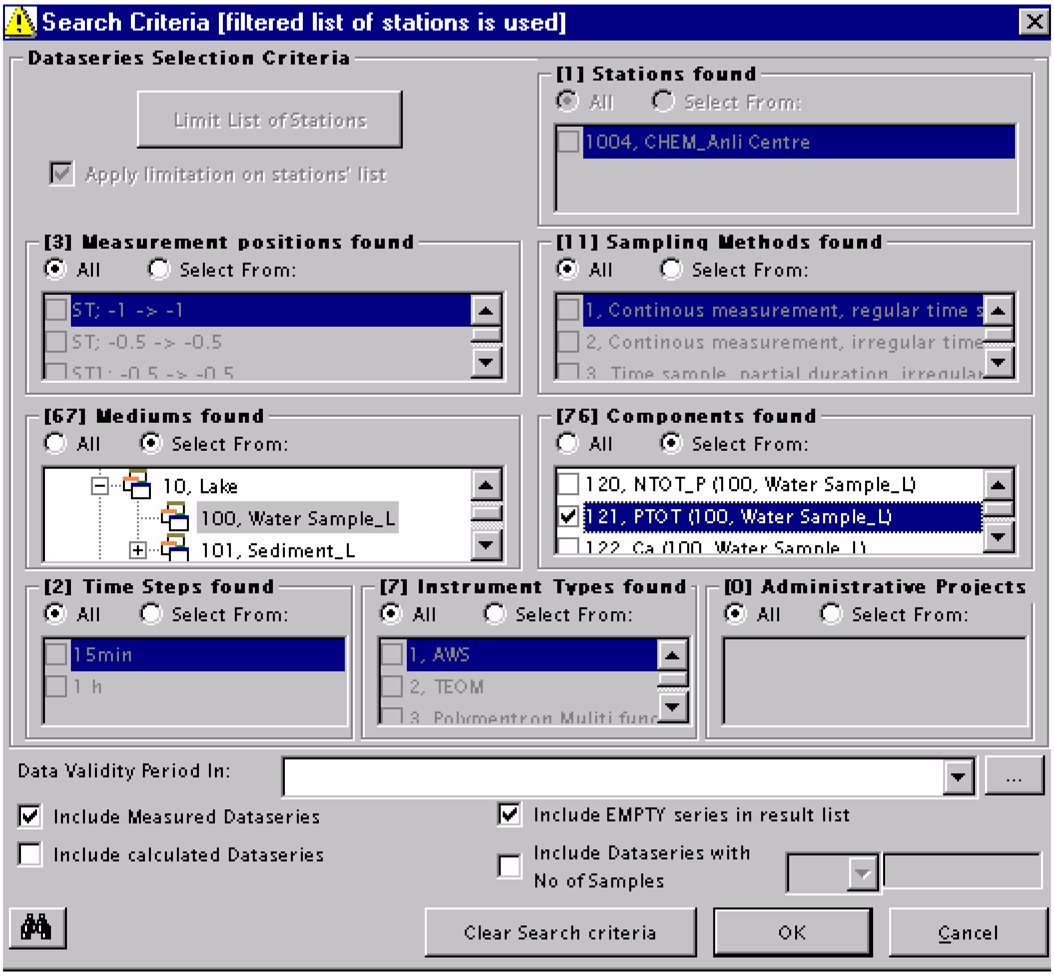
Units to show data in: Combo boxes shall be disabled/enabled as a function of the selected simulation types. If two simulation types are checked, only to unit boxes shall be enabled. Only relevant units shall be selected simulation type/component:

- Pollution load calculation: mass/time and mass
- Water quality calculation: mass/volume
- Water flow calculation: volume/time and volume

Select water element: This is a combo box that shall list all water elements (river links and lakes) included in the simulation. The user shall be able to select only one from this one.

Compare with measurements: It is important that the calculated results and the measured data series can be plotted in the shown simultaneously, and shown in the same graph. By default, the only one station that is made representative for the selected water element (river links or lakes, which is done on the station form), shall be checked. One river link/lake can only be linked to one station. The selected components shall also by default be checked in the data series search form. The user shall be able to uncheck these components and check additional ones.

This form below shall be opened when the user presses the comparison button. As soon as this is closed the check box "Include data series in plot" shall be checked. It is important that the user shall be able to include calculated data series (check in the lower left), because the user will this way be able to compare aggregated data series with calculated values with for instance annual time step.



Compare with value source: The user shall also be able to select a dataseries from the form Value source. When pressing this button the Value source form should be shown, and the user should be able to select the source.

Table button: This shall be presented with the following columns:

- Water element type/ID/name
- Time period
- Pollution load
- Pollution load value
- Pollution load unit
- Concentration
- Concentration value
- Concentration unit
- Water flow
- Water flow value
- Water flow unit

Table 4. Example (limited number of columns):

Water element	**Time period**	**Component**	**Value**	**Unit**	**Component**	**Value**	**Unit**	**Component**
[RN], 33, Glomma river segment 1	1998	PTOT	40	Tonnes/year	PTOT	7	ug/l	Q
[RN], 33, Glomma river segment 2	1998	PTOT	34	Tonnes/year	PTOT	7.3	ug/l	Q

When the user clicks with the right mouse button on top of the column with numeric values, the following menu shall pop up (similar to the result table for the water pollution budget model):

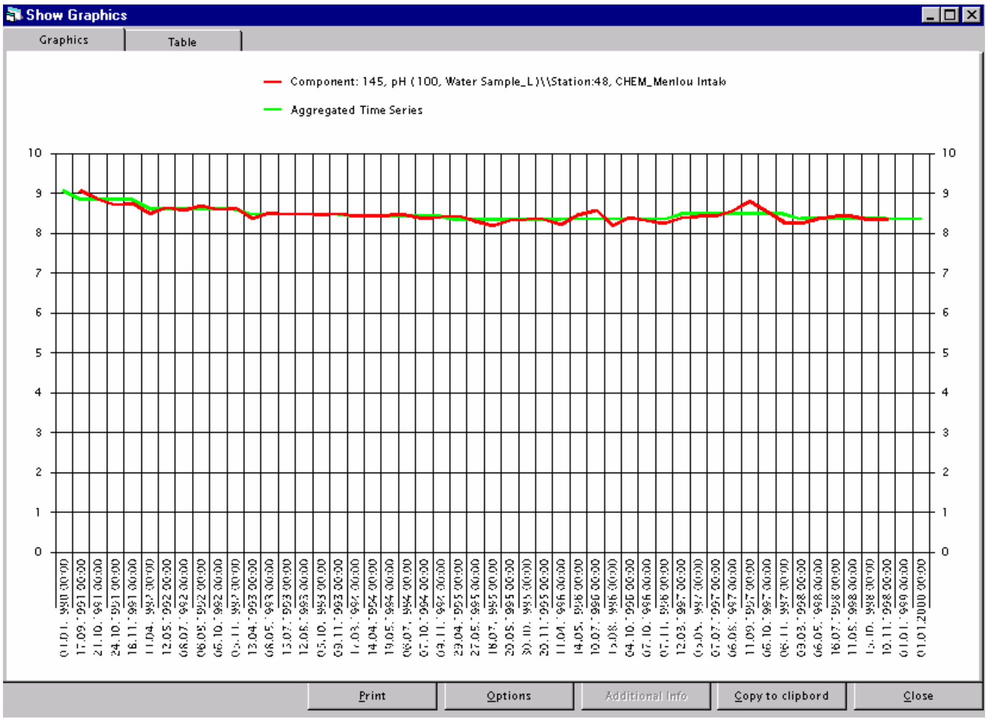
- Minimum
- Maximum
- Arithmetic average
- Sum
- Multiply all by
- Divide all by
- Remove column

If the user has selected to include measured data series in the table, these series must be shown to the very right, in a similar way the model results are presented. Since the time for the samples and the time for the samples are not necessarily synchronised, the table must be adjusted according to the time. For instance, if 3 measured samples are available for 1998, then the model value for 1998 must be shown in 3 rows. This is already handled in the presentation of aggregated data series together with the measured ones.

There must be "copy to clipboard" functionality from this table.

Graph button: The table above shall be shown in a graph, meaning also the measured data series. This is solved for aggregated data series.

Example:

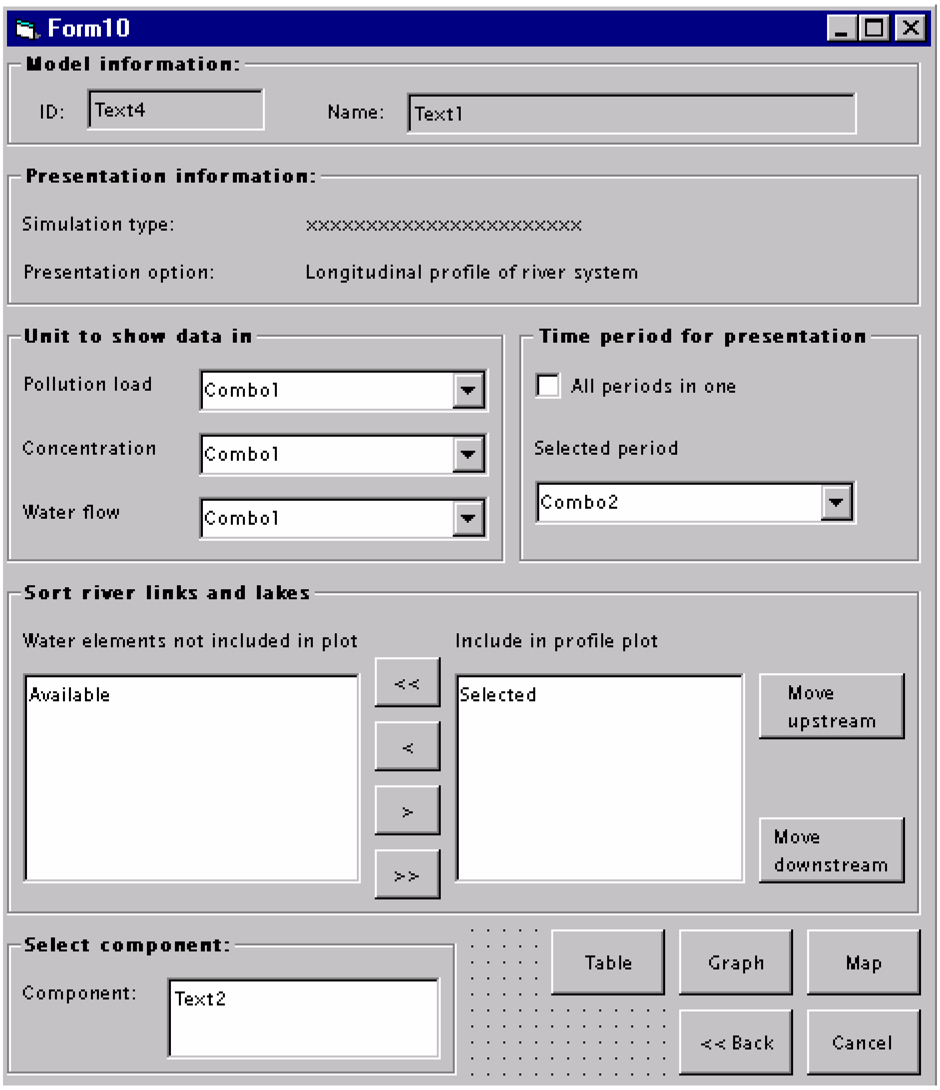


Hopefully the new graph control can make the plot look nicer. It must be possible to include the water quality classification borderlines, in proper colours, in this graph. There must be secondary axis if several components are plotted simultaneously.

Map button: Shall be disabled.

4.5.1.3 *Presentation option 3: Longitudinal profile of river system*

The idea of this type of presentation is to see how the pollution load, concentration and water flow vary along the river system.



This is the third button. The controls are already specified earlier in the section.

Time period for presentation: The user shall be able to present all modelled time steps in the same plot, or profile plots of each time steps separately. The combo box shall list the individual time steps in the simulation (as when presenting data sets on the map). The "All periods in one" shall by default not be checked, asking the user to select on of the time step simulation results exist for.

Sort river links and lakes
The idea with this part is to be able take away some elements for presentation. In this way the user can for instance present only one branch separately. The left control (Water elements not included in the plot) shall by default be empty, while

the right hand control shall contain the same list of elements (with the same order) as in the Geography tab. The user shall able to deselect elements from the right control to the left. The water elements shall be listed with what type of element (river link = [Link] and lake = [Lake]), ID of the water element and name of the water element. In addition, the river chain ID and river chain name (only relevant for river links) shall be shown for those river links that are part of a chain. The user shall be able to sort the elements by clicking on the top of the column. IDs shall be sorted as numeric.

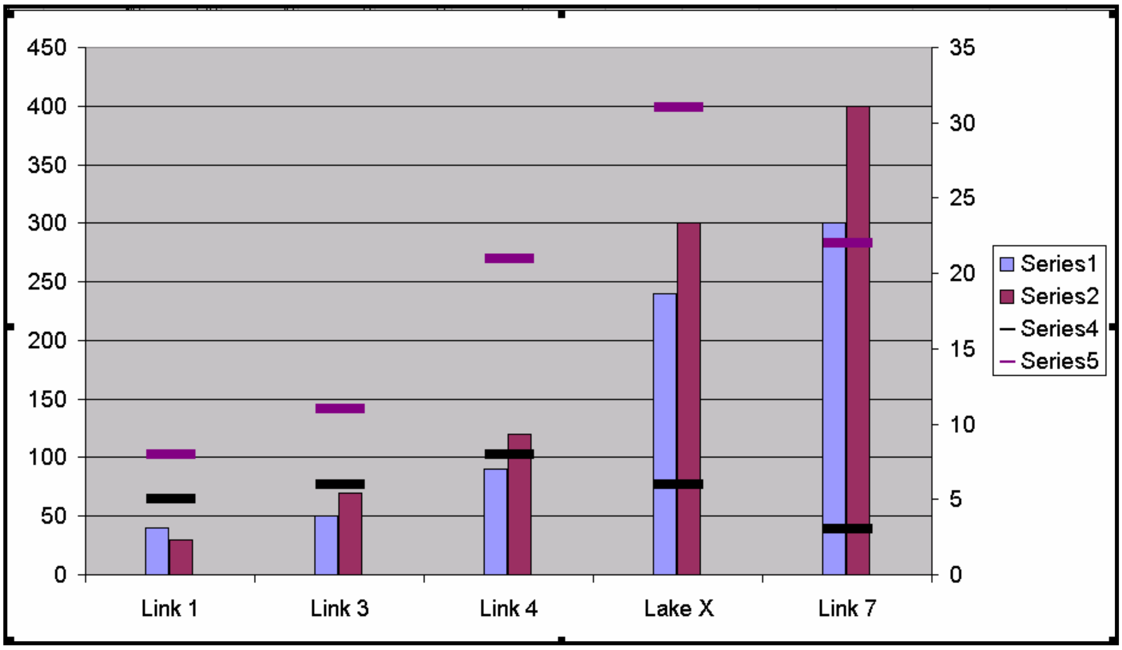
Move upstream/downstream: The water elements can be moved up and down in the list, to indicate the river system structure. The most downstream element shall be on the bottom of the list, while the most upstream shall be on the top of the list. The order defined in this list shall indicate the order the river links/lakes are plotted on the graph. The most upstream shall be plotted to the very left on the graph, while the downstream to the right. See example below. This control shall have drag-and-drop functionality in addition to the arrows. The user must select at least one element.

Table button: The table shall be identical to the one shown under presentation option 2 (Trend separate water elements). The only difference is that the table under this presentation option consists of all selected water elements and that it can be limited in time periods. The order shall be the most downstream on the top of the table. All the other functionality (statistics, copy, etc) shall be the same.

Graph button: This graph is not a graph that is a function of time, but a function of location. The Y-axis still shows the value of the component (there must be secondary axis if several components are plotted simultaneously). The X-axis shows the water elements include in the presentation. The locations (river links, lakes) shall be distributed evenly along the axis.

For instance: 5 elements are selected for presentation, with 2 components/graphs each (load and concentration for PTOT). The user selects to show all years (in this case 1998 and 1999). This gives in total 4 longitudinal profiles.

Example:



Hopefully the new graph control can make the plot look nicer. It must be possible to include the water quality classification borderlines, in proper colours, in this graph.

The axis must be properly labelled with units, the legends with component name (plus load/concentration if same component) and time period.

Map button: Shall be disabled.

4.6 Storage of results

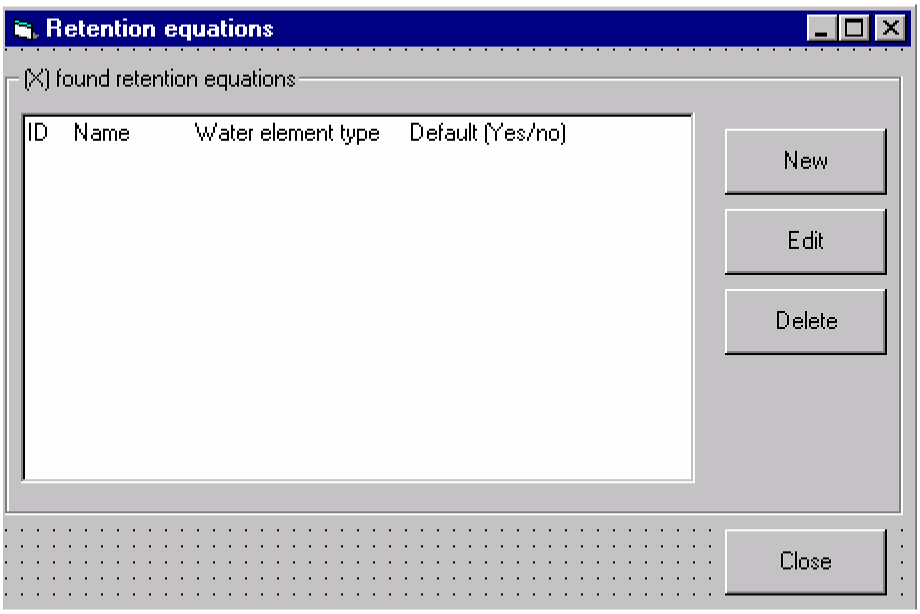
Since the calculation method is based on river links and lakes (and not river nodes), the results must be produced for river liver links and lakes. The system shall calculate the desired results for all included elements (river links and lakes) in this list for all time steps. This means probably that the results must be stored as a hybrid of river link and lake dataset. **It is up to ICB to decide how river link datasets and lake datasets can be combined.**

4.7 Water quality model - Retention equation

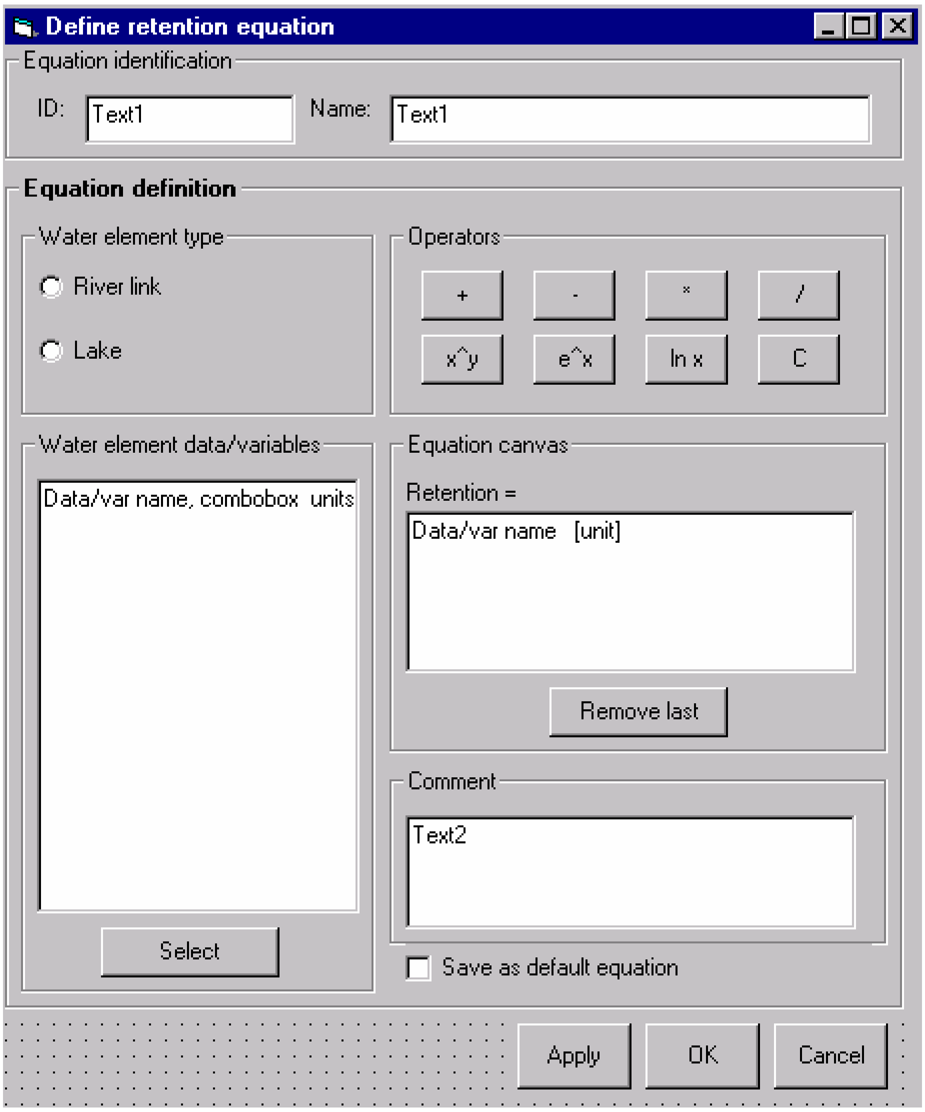
The idea of retention equation editor is to make the user able to define his own equations calculating the retention is rivers and lakes. The user defines in the model setup which of the equations to be used for the different river links and lakes. One river link retention equation and one lake retention equation shall be shipped with an empty project. They shall be flagged as default. Which equation to be automatically defined by the system is described where the retention calculation is explained.

The form below gives the list of the available equations. The following properties shall be shown:

- ID
- Name
- Which water element type the equation is linked to (river link or lake)
- If the equation is default or not for river link or lake



This form lists defined equations.



This is the form where a new retention equation is defined, or an exiting edited. The retention shall always be given as a fraction, not as a percentage (multiplication with 100). The value coming out of the equation will hence always be in the range [0, 1]. The retention equations used in the water management are in most cases derived from statistics (empirical), and not necessarily dimensional correct (meaning the units of the right hand side of the equation not identical to the units on the left-hand side). The water element data/variables to be used in the equation are not always given in the base units. For instance, in some retention equations the user is supposed to use theoretical retention time, but the value should be given in years and not is seconds. But, the retention equation itself shall be dimensionless. To be able to define retention equations, the user must then select which unit the number to used in the equation shall be have. The control called water elements data/variables must have a column where the user defines the units of the value to be used in the calculation. The selected unit shall also the shown in the retention control.

Equation identification: Standard functionality with ID and name.

Equation definition

Water element type: The user must select if the entered equation shall be applied to river links or to lakes.

Operators: Standard mathematical operators the user shall be able to apply in the equation. Number, parentheses, etc shall be entered in the equation by pressing the keyboard. The ones given are:

+ plus
- minus
* multiplication
/ division
x^y potential function
e^x exponential function
lnx logarithic
C: clear

Water element data/variables: This shall be a list of the static and the variable (numeric) data types that are present for river links and lakes. The river link data types shall be shown when the river links option button is selected, while the lake static data and variables shall be listed when the lake option button is selected.

For instance, if river link is selected, the list shall contain the following items:

- Average width
- Average depth
- Average flow
- Min. flow
- Max flow
- Catchment area
- Variable 1 (if present)
- Variable 2 (if present)
- Etc

Be aware of that the value of these data shall not be shown, just the data type/variable name. The user must be able to select data type/variable from the list to be used in the equation. In addition, the units defined for the different data/variables shall be available in a combobox beside the name of the data/variable. The name of the data/variable shall be moved to the equation canvas when the user presses the "Select" button.

Equation canvas: This control shall show the construction of the equation. The name of the data/variable shall be shown with the defined unit for the data/variable in parenthesis. If the user wants to remove something from the canvas, the last part of the equation is removed when the user presses the "remove last" button.

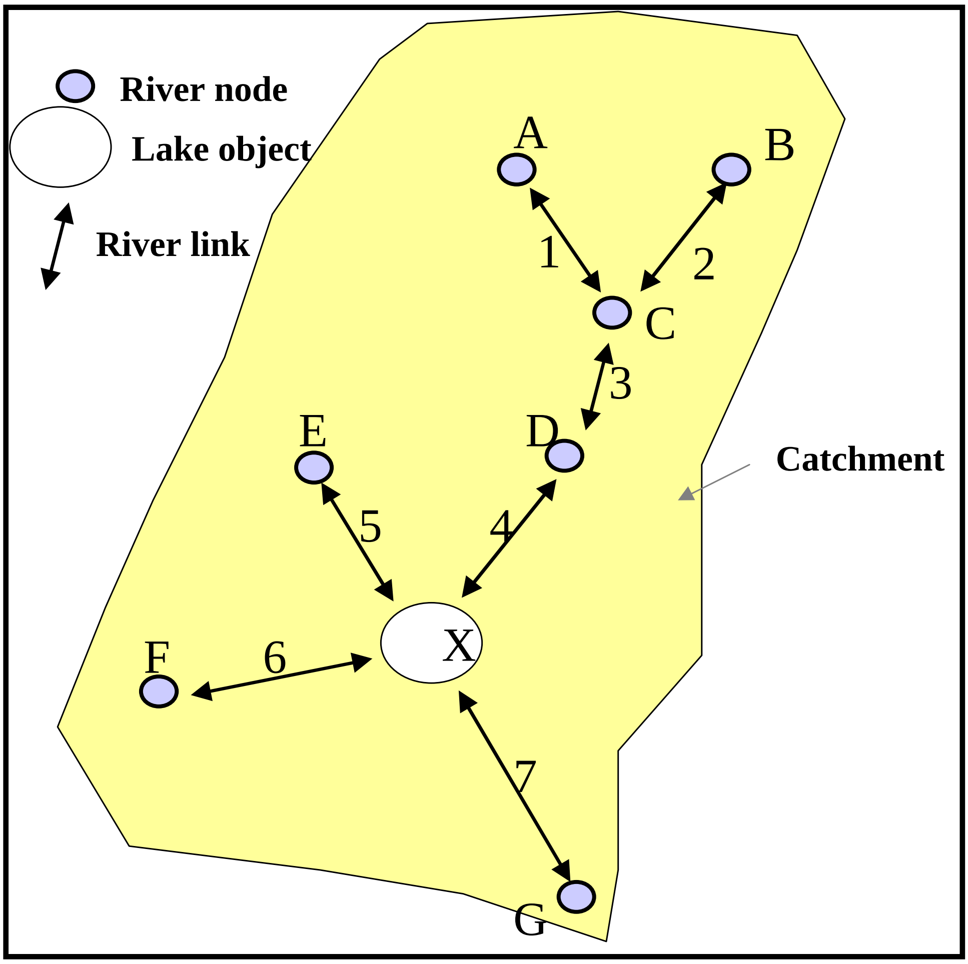
Comment: Standard comment field.

Save as default: One lake equation and one river link equation shall come up as default selection when the user do the setup of the model. The user can select to save one lake and one river link retention equation as default. The equation defined earlier in the specification must come as default with an empty ENSIS project.

The "Save as default" control shall by default not be checked.

4.8 Example of calculation of a river system

This river system shall be calculated. For the simplification, the example calculates only one time step. It is assumed that the consistency check of the river system returns OK.



The calculation is based on the following pollution budget scenario. The pollution budget model calculates initially the discharge load for each pollution source. This must be summed up for each recipient included in the water quality simulation (load is summed up for each river node and lake included).

The pollution budget simulation ends up with the following load for the time step (= one year, not leap year) to be calculated:

Table 5. The table is a result of a pollution budget simulation giving input to the water quality model. The river link 5 is given an additional discharge load of 50 tonnes/year as a boundary condition. RN = river node.

Water element	**Discharge load [tonnes/year]**
RN B	10
RN A	0
RN C	50
RN D	0
RN E	200 + *50*
RN F	100
Lake X	1000
RN G	500

The numbers in the table are load from the pollution sources to the recipients, not pollution received from the upstream part of the river system. Be also aware of that this calculation starts from the upstream end, in contrast to the consistency check that starts from the downstream end.

Table 6. The table gives necessary input about the recipients to the model. The flow data are simply based on static data.

Water element	**Length in km and Tw in years**	**Flow data in m3/sec. For the lake: sum of Q from river links into the lake**
River link 1	2 km	10
River link 2	2 km	10
River link 3	1 km	10
River link 4	2 km	10
River link 5	3 km	5
River link 6	3 km	5
Lake X	2 years	20
River link 7	3 km	20

Equations used (defined as default above):

$$\text{Retention} = 1 - (1 - 0.03)^{\text{river link length [km]}}$$

$$\text{Lake retention} = \left(0.2 \big/ \left(1 + \sqrt{\tfrac{1}{1}}\right) + 0.1\right)$$

Table 7. Intermediate result table

Water element	Input load to element (from pollution budget model + upstream element + boundary cond) tonnes/year	Retention	Remaining (1 – retention)
River link 1	0	0.06	0.94
River link 2	10	0.06	0.94
River link 3	59.4	0.03	0.97
River link 4	57.6	0.06	0.94
River link 5	250	0.09	0.91
River link 6	100	0.09	0.91
Lake X	1000+91+227.5+54.1	0.217	0.783
River link 7	1090.4	0.09	0.91

Table 8. Final result table

Water element	Load in element in tonnes/year	Flow data in m3/sec. For the lake: sum of Q from river links into the lake	Concentration in mg/l
River link 1	0	10	0
River link 2	9.4	10	0.02981
River link 3	57.6	10	0.18265
River link 4	54.1	10	0.17155
River link 5	227.5	5	1.44280
River link 6	91	5	0.57712
Lake X	1090.4	20	1.72882
River link 7	992.2	20	1.57312

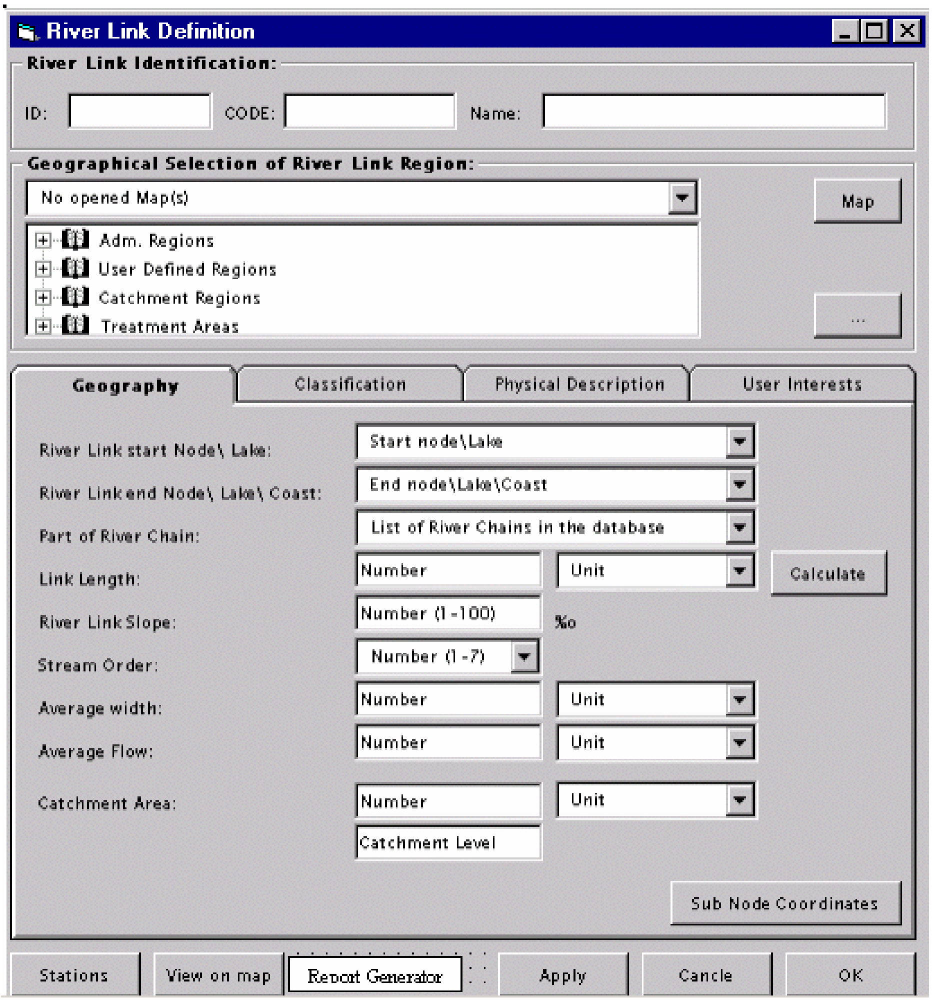
(*) multiplied with 31536000 to get year

1 tonnes = 1 000 000 000 mg
m3 = 1 000 litre

4.9 Extension of river link, lake and coastal object form

The new River link definition form is given in the geography chapter in the measurement specification.

Include alternative as elsewhere in the application and a copy button



Stations are made representative for a river link through the station form. The same is done for lakes and coastal area.

The station ID, code and name must be shown (disabled). The linking of the river link/lake/coastal area to a station is done in the station form (geographical representation). The information about the station is used when the water flow data series that might be used is accessed in the model input.

5 Scenarios and alternatives

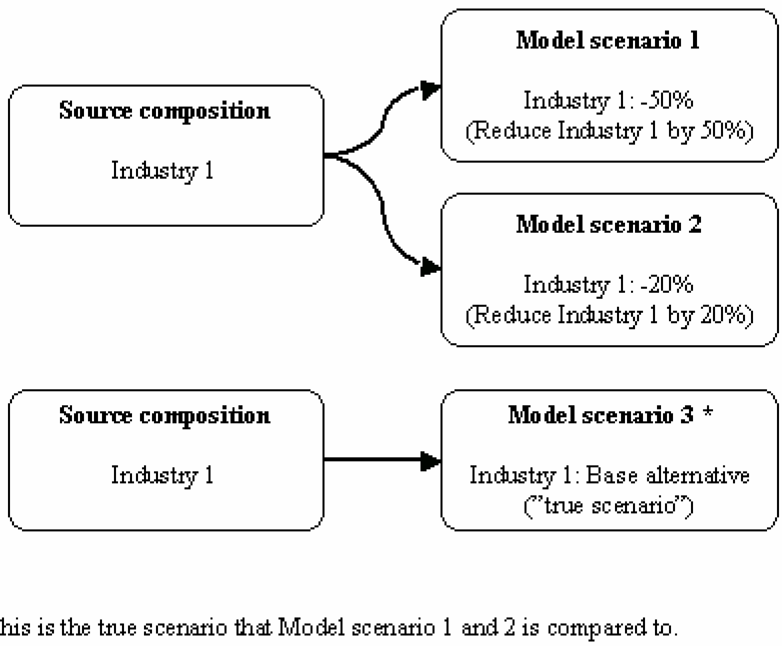
5.1 Introduction and definition of terms

The alternative-handling concept in ENSIS is in general not very good. The use of alternative is in this document the same as explained in previous versions of ENSIS. Alternative is used for geographic objects and pollution sources.

Scenario consept is in this document referred to Model scenarios which means different ways of manipulationg data.

<u>The main changes and principles for alternative handling are:</u>

- The user shall link all pollution sources and geographical objects (river links and lakes) to a specific alternative of the source. This is done for the pollution in the the Model scenario definition and for the geographical objects in the Model configuration.
- The user shall be able to easy change the alternative of sources for a new scenario analysis.
- Objects available and created via the standards forms/modules within the application shall all automatically be flagged with the alternative "base alternative" when creating a new source. When copying a source the user shall be able to copy directly in to a defined alternative (ex: a new not bouild industy area).



The figure above shows the relation between alternative and scenario.

Definition of terms:

Alternative: Shall be a tree view the sources shall be linked to. Objects within the application (in the pollution sources inventory, water objects, etc) that are available through the ordinary forms, shall be flagged with user defined alternatives.

Base alternative: **The base alternative is one specific item in the alternative treeview**. The base alternative item shall be a predefined part of the alternative tree view. "Measured and true data" shall be linked to this alternative. It shall be possible to create sub levels of the base alternative, but also parallel trees in the alternative tree view. Data created within the standard forms of ENSIS (pollution inventory, water elements, etc) shall all be automatically be flagged with base alternative if nothing else is specified. Examples are provided in the section (section 4) where the alternative tree view is specified to explain typical situation where sub-alternatives are relevant.

Model scenario: A model scenario is a definition of a specific source composition and the alternativ for sources where "true data" (meaning data that are flagged with base alternative), is manipulated to reflect a specific and possible change (reduced discharge, improvement of treatment technology, future scenario, etc). The model scenario definition is unique for the individual model. It must be specified which types of scenarios that are relevant for the different models (pollution reduction, etc). For the water quality model, it can be relevant to run different calculations with different flow data, boundary conditions, etc. The term model scenario is only visible in the menu as an entrance under the water pollution budget model.

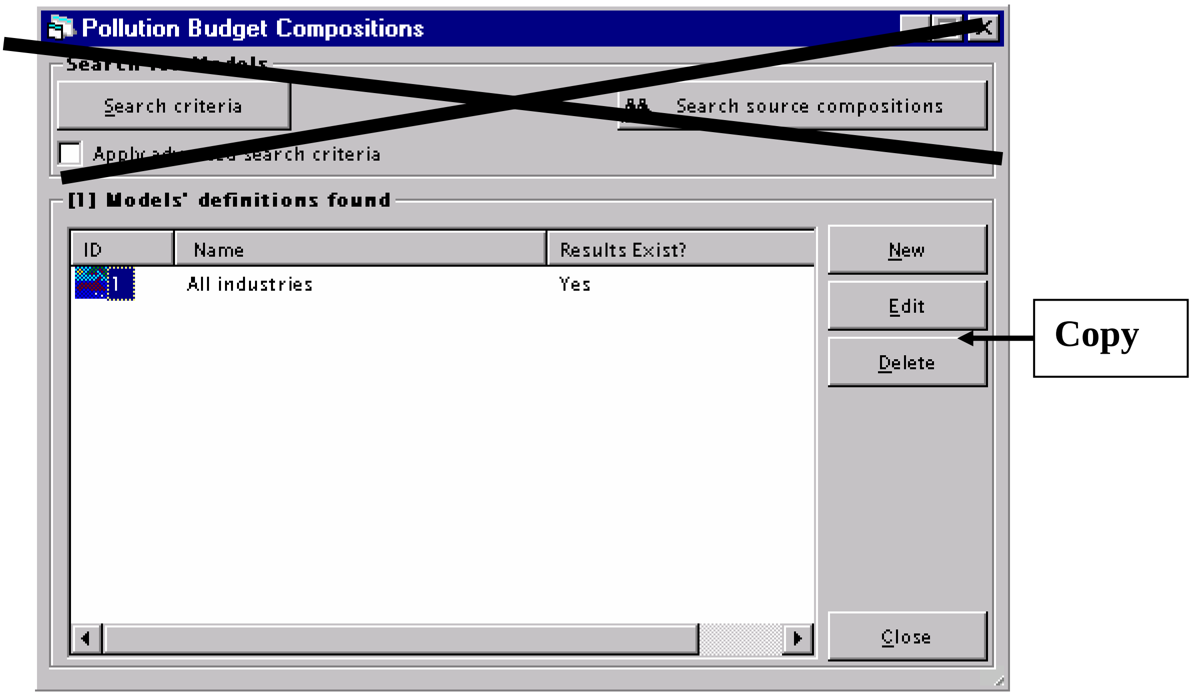
5.2 Consequences for the pollution budget model

The menu bar must be extended with an extra entry for the model scenario.

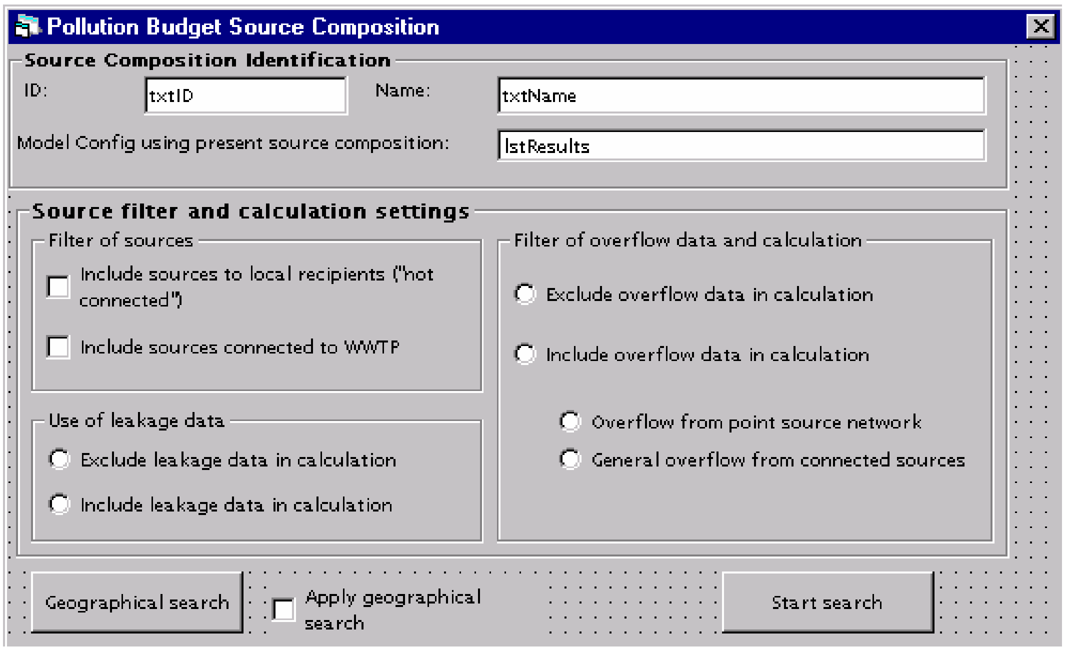
Water pollution budget model >>	Source composition
	Model scenario
	Model configuration (*)

(*) We might want to change the configuration term to setup instead. This is however specified for the menu and the individual forms.

5.2.1 Source composition



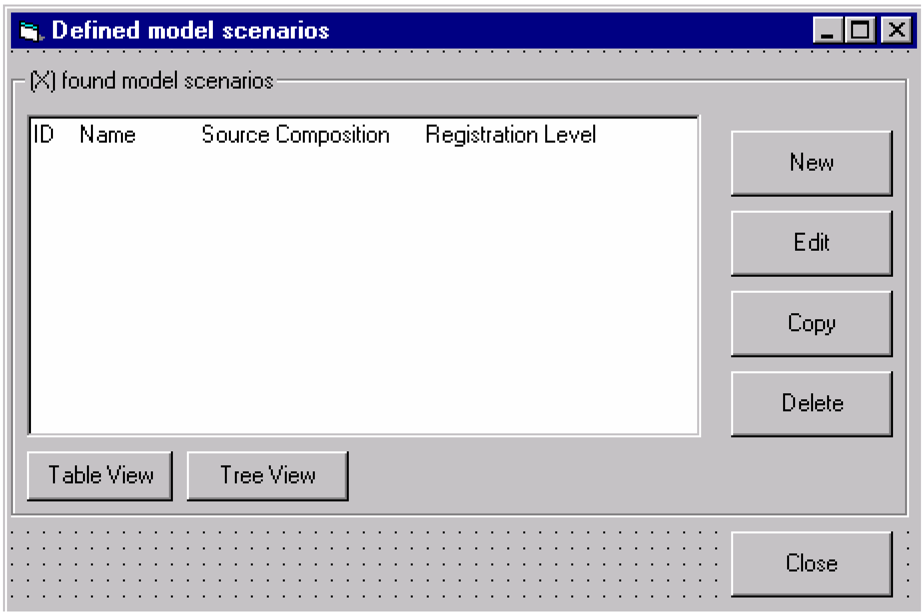
This is the list of source compositions. It shall be implemented a button saying "Copy", that takes the selected source composition, except from the ID, name, alternative and model config using present source composition (shall be left empty) and pastes it into a new form.



When a source composition is created, the source that is selected is automatically the base alternative. The user shall be able to select another alternative during the model setup definition. Manipulation of data shall all be done in the model scenario forms. For this reason, there shall be a model scenario field in the source composition forms.

The form shown is the upper part of the source composition form, as specified in the extension of pollution inventory, pollution budget model and water quality model document.

5.2.2 Model scenario

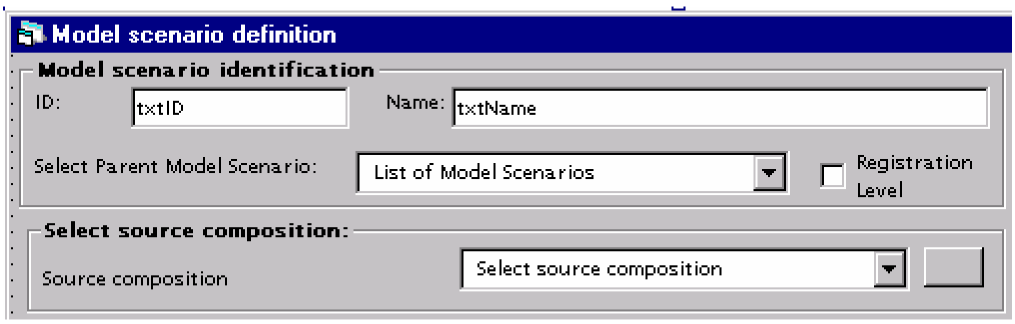


This is the list of defined model scenarios for the pollution budget model. Be aware of the fact that there shall be a copy button on this form, coping everything, except for ID, name, Source composition and registration level to from the selected model scenario into a new definition form. Table View should be the default view. If tree view is selected the table view should be changed to tree view with only ID and Name shown.
The alternative hierarchy can be organised different according the problem of concern. Below are given 2 different ways/examples of organising the alternative tree views.

Example 1. Schematically examples of the use of the model scenario hierarchy. This is done within a Norway project.

Alternative level 1	**Alternative level 2**	**Alternative level 3**
Reduction alternatives	Pollution problems	50% reduction agriculture
		Improved WWTP treatment
	Water allocation	Flushing
		Added water
Future scenario	Pollution problems	30 % more PE
		No agriculture
		More industry
	Water allocation	Droughts
		Floods

This example shows three levels of the scenarios. The scenario structure shall be completely generic.

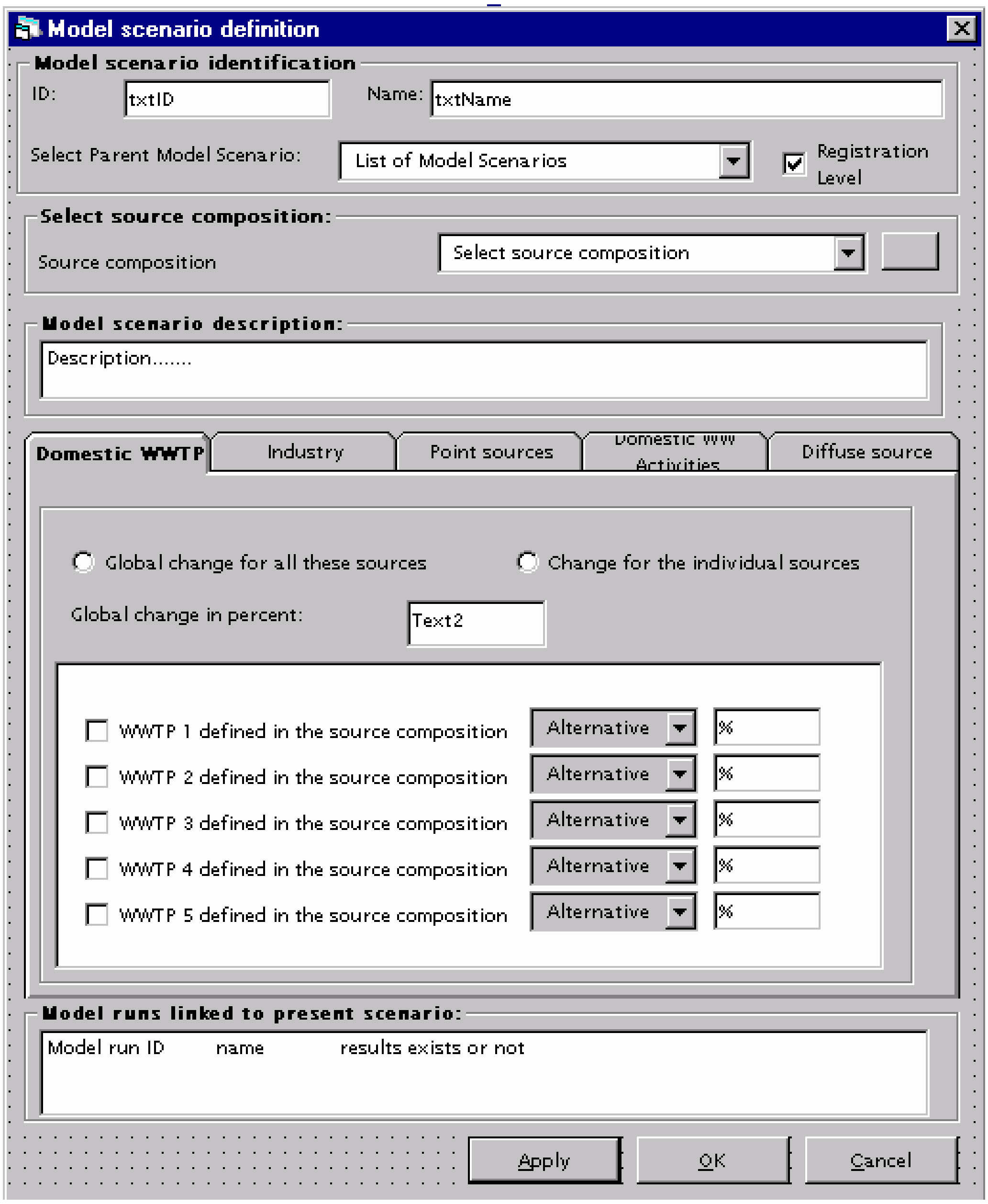


Model scenario is given above. The Model scenario is in a hierarcic structure and parent model scenario must be given. The level of scenario could either be a ”empty” scenario or a scenario where registrations have been made.

If the Registration level has been checked, the form below should be shown. This is the form where the user can manipulate the source composition (adjust discharges, etc) for analytical purpose. The tabs are analogue to the tabs of the source composition. The following tabs to adjust data must be implemented, in the given order (from left to right):

- Domestic WWTP
- Industry
- Point sources

- Domestic ww activities
- Diffuse source



Description: This shall be a standard text field (256 characters) where the user can enter information about the Model Scenario.

The changes the user can do, are to adjust the sources defined in the selected source composition by a certain percentage. 0 % means no change, -100% means no discharge, and 100 % means doubled discharge. Number smaller than -100% are not relevant and shall not be allowed to enter. The sources can be adjusted globally for the whole tab, or individual for the defined pollution sources. The user should also be able to adjust alternatives of sources. By default the base alternative is selected for each source.
Model scenario ID and name: Standard ENSIS functionality.

Select source composition: The user must select which source composition to adjust. As soon as this is selected, the five tabs will be automatically filled out with the sources defined to be included in the calculation.

The connection between scenarios and model setups/runs in this Model scenarios definition forms is only for information. All the linking is done via the Models menu. When more models are implemented, also these models shall be able to make use of the linking to the scenario.

Model runs linked to Model scenario: Information that should be given in the table are listed below.

For the water pollution budget model:

- Name of the model (water pollution budget model)
- Source composition ID and name (only relevant if base alternatives or sub of base alternative)
- Model scenario ID name (only relevant if alternative different from base alternatives or sub of base alternative)
- Model configuration ID and name
- If results exist (Yes/No)

For the water quality model

- Name of the model (water quality model)
- If results exist (Yes/No)

Be aware that yellow tool tip or scrolling must be implemented in a way that the user can see all the information.

Tab Domestic WWTP:

Global change for all these sources: The user shall be able to manipulate all sources displayed in the list of sources globally. The user can enter a number in percent. When this choice is selected, the list of pollution sources shall be disabled (the sources shall all be checked) except for the alternative combo boxes that should be enabled for the user to select which scenario to use for each source. This option shall be present for all the 5 tabs.

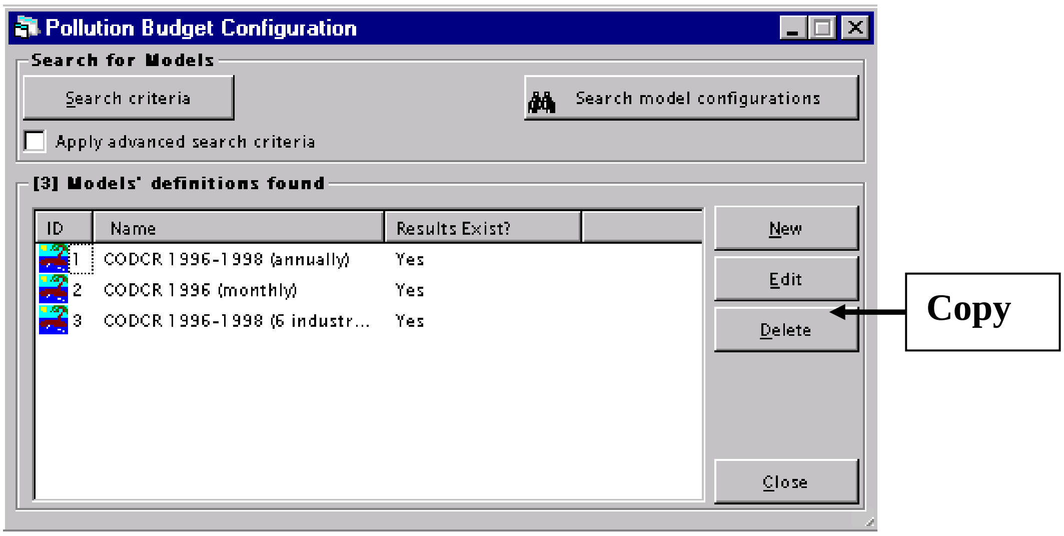
The field "Global change in percent" shall only be enabled when the global option button is selected.

Change for the individual sources: First the user should select which altenativ of the source that should be used (present version only base alternative). This is the second radio button. When the user selects this one, all the sources shall be available for defining individual reduction/increase in pollution discharge and alternativ selection. By default, all sources shall be checked (meaning included), and all shall have the change in percentage = 0 % (no change). This option shall be present for all the 5 tabs.

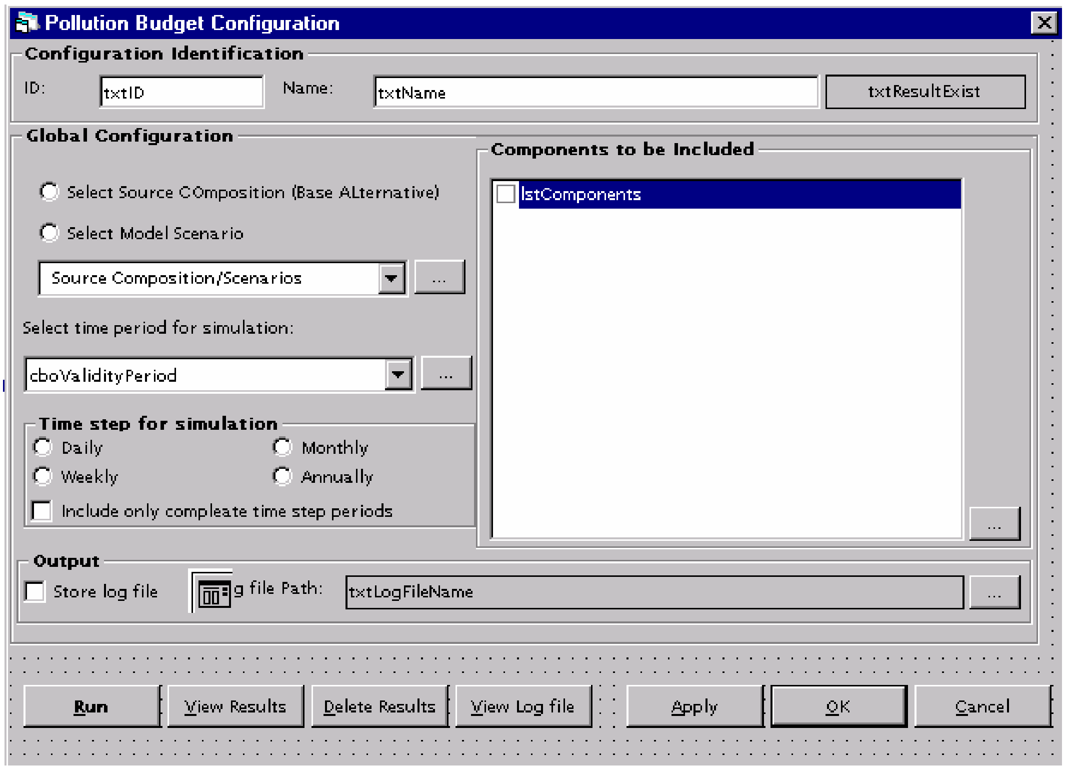
There shall be 4 other tabs, working similar to the domestic WWTP tab. These four tabs are not explained further.

5.2.3 Model Configuration

List of model configurations



The list of model configurations must be extended with an extra property saying which Model Scenario it is linked to. There shall also be a copy button, allowing the user to copy one model configuration into a new. All the information from the selected model configuration shall be loaded into a new form, except for the ID, name and if results exist (shall be NO).

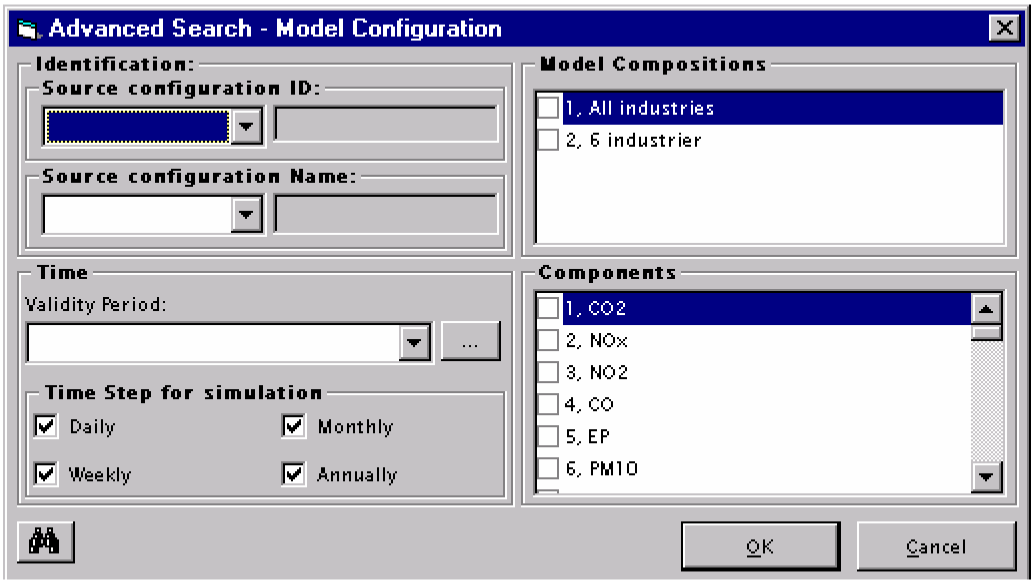


This shall be kept unchanged, except for a few minor changes. There shall be introduced 2 option buttons:

- Select source composition (base alternative), and
- Select model scenario

If the user selects source composition – all source compositions will be listed in the combo box. If the user selects model scenario, the user can be able to select another alternativ for the source if this is defined in the model scenario or if there have been some manipulation of the sources– which is is defined in each model scenario definition.

Advanced search for model configurations

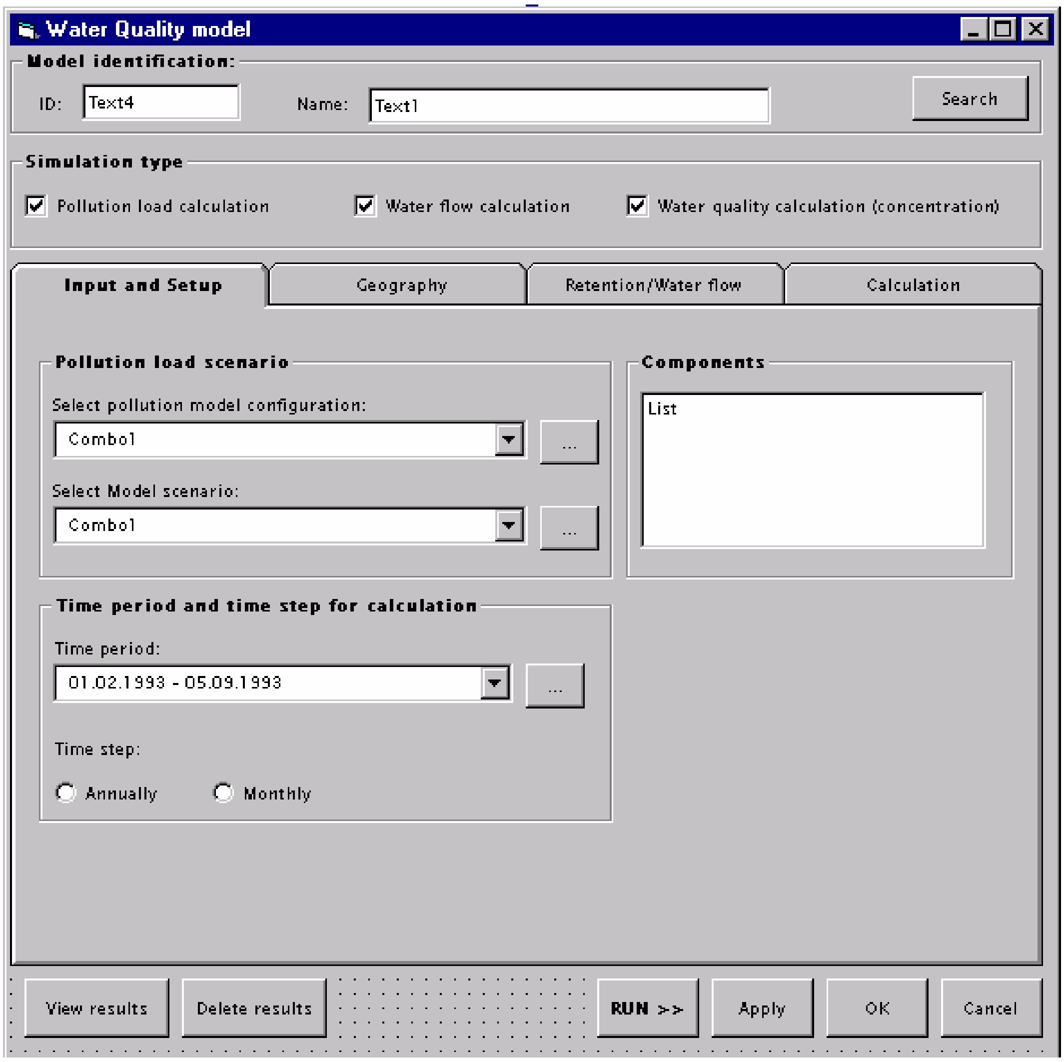


This form must be extended with a tree view where the user also can search as a function of which model scenario it is linked to.

5.2.4 Model presentation

This shall be kept unchanged.

5.3 Consequences for the water quality model



There will not be any major consequences for the water quality model. A model configuration and a model scenario will be defined in exactly the same way as an ordinary water quality model run.

This is the definition form for the water quality model. This is described in detail in the pollution inventory document.

Pollution load scenario: The user shall be able to select one of the available water pollution budget simulations (model configurations). The ID and the name of the model configurations shall be shown in the combo box. This shall be optional information. If the user wants to calculate the water quality without any sources discharging to the river system, but only based on boundary condition, this should be possible.

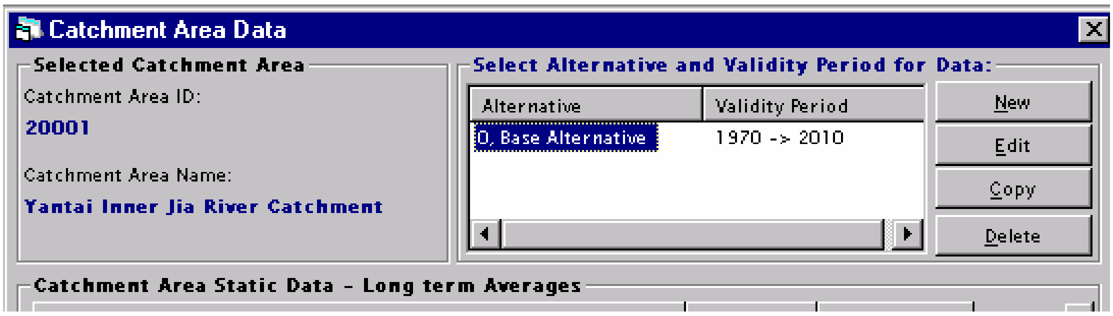
Scenario: The user must select which model scenario the simulation shall be linked to. The default shall be the same scenario as the selected pollution model configuration. The user shall be able to select other scenarios as well, but only the scenarios that have been linked to the selected model configuration.

5.4 Changes in flagging of data with alternative

We refer other documents regarding which changes in the menu structure the proposed changes in the dataset imply.

The user is able to link/flag lots of data (pollution sources, data related to geographical objects) with which alternative they belong to. When the objects are defined the user should mark the object according to what alternative it is. The base alternative should be chosen if nothing else is done.

The data that in present version are linked/flagged with alternative, are also flagged with a validity period. The flagging with validity period shall be kept.



This is where the alternative/validity period combination is entered for the catchment to hold static data (long-term averages) related to the catchment.

Geographical objects where the alternative shall be entered:

- Catchment
- River link
- Lake
- Coast and marine

In a similar way, the alternative shall be placed on the pollution sources module. This is also specified in the pollution inventory, pollution budget model and water quality model document. If the alternative is left out in some part of the specification, it should be programmed according to this chapter. Pollution sources should also include this alternative combobox.

The alternative should be included in all search and advanced search forms for geographical objects and pollution sources.

5.5 Alternative

Alternative should be a standart look up table where the user can define as many alternatives that are wanted. It should be build as a tree view.

6 ANNEX 1 - Aggregation, interpolation and extrapolation

The part enclosed in annex 1 is taken from chapter 4 (Measurements) of the user documentation of ENSIS 2.05.

6.1.1 Aggregation

6.1.1.1 What is the purpose of aggregation ?

Aggregation is used for calculating a new time series based on another (often longer for regular time series) time step than originally measured, like when calculating daily averages from hourly measured data, getting a time series of 31 daily values from 744 hourly values.

For irregular time series the aggregation tool will often be used to create regular time series, for instance used as input to model simulation. The "regularisation" is for the water pollution budget model done automatically by the model. The aggregation tool is also able to fill in "gaps" in time series where measurements do not exist. In this manner the tool works as an interpolation routine. In a similar manner, the aggregation tool is also able to extrapolate data outside the time period there exist data from. A more detailed explanation of extrapolation and interpolation is provided later in this section, before the section about scaling.

The results of the aggregation will be a new time series that will be stored in the database as a calculated time series, if the operator choose to store the new data series to the database.

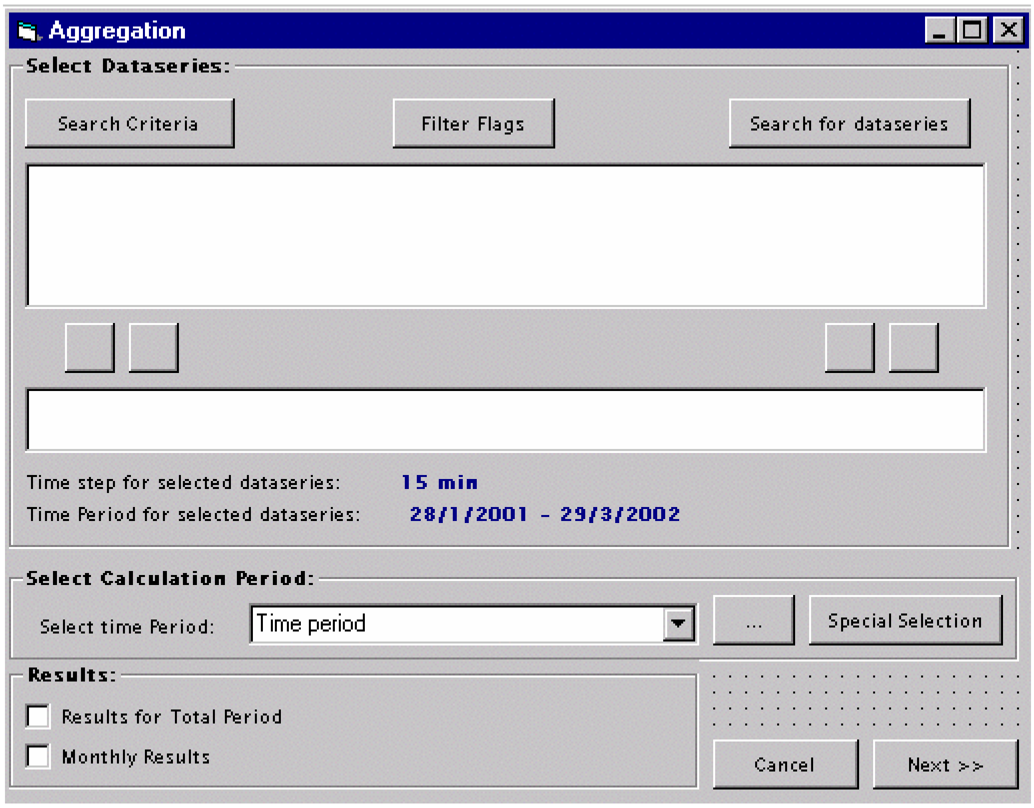
6.1.1.2 Aggregation functions

Aggregation can be performed in different ways, based on which aggregation routine that is selected. In some cases the maximum value that exist inside the aggregation period (new "averaging" time) is the most relevant, while in other cases some sort of average is the desired output.

There are 3 types of averaging routine the system can support, arithmetic average, time weighted average and time weighted interpolated average. For regular time series the arithmetic average, time weighted average and time weighted interpolated average will give the same result. In addition to these methods, moving average can be calculated. A more detailed explanation of different types of averaging is provided later in this section, before the section about scaling.

The aggregation routines that are present in this part of ENSIS is also applied when the quality classification system is used..

6.1.1.3 DataSeries Aggregation



Select Dataseries

The upper part of the form is used to search for data series. Pressing the "Search criteria" button opens up a standard form to set the search criteria for data series. This form is explained earlier in this chapter.

Pressing the button "Search for data series" executes the search with the defined series behind the "Search criteria" button. The data series that match your criteria will be displayed in the frame below. You select the one you want to aggregate

The label "Time step for selected series" displays if the series (the highlighted one) is regular or irregular, and the length of the time step if a regular series is selected.

Select calculation period

The first step will be to select a time period for the calculations. A new dataserie will be calculated for this period. If the validity period of the input data series does not fill out the entire calculation period, extrapolation will be performed. A pre-defined calculation period can be taken from the combo-box, or can be defined via the "..."-button

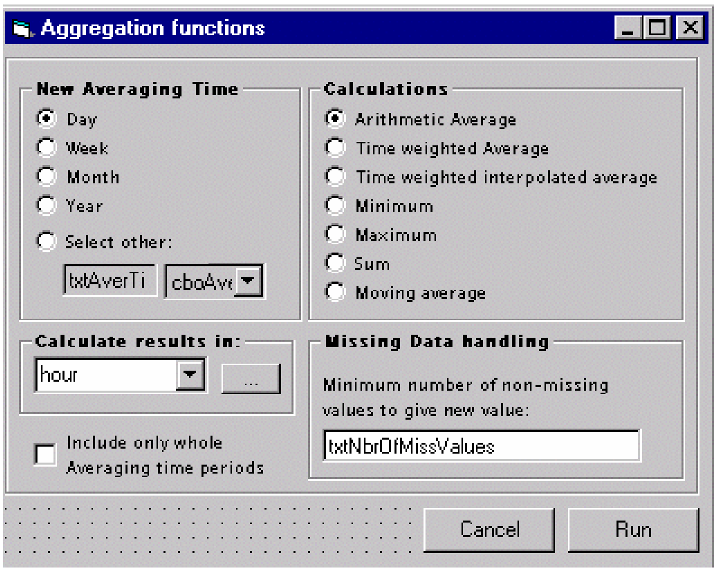
The Special Selection option gives you an opportunity to exclude parts of your data, and base the calculations on parts of them. An example is if you have a continuous time series of hourly measured values, and you want to create averages for a day based on the day-time hours. You then have to select "New averaging time" equal to day and "Special selection" of the hours 8 to 17.

New averaging time

You may choose day, month or year, as your new timestep for the calculated series, or you may define your own by choosing other and entering the time step you want.

When "new averaging time" equal to day is selected, the new values will be 24-hour values starting at the time of the day given as start time for the period. When "new averaging time" equal to month is selected the new values will be monthly values by the calendar months. When "new averaging time" year is selected, the new value will be yearly values starting from the selected start time for the period.

Include only whole averaging time periods: If this is checked only whole time steps will be included in the output. Sometimes the time step does not exactly match the total time period of the calculation (time period divided to time step is not an integer). This is for instance the case when weekly time step is selected and one year is the time period. If you don't check this the last week in the year will also be included. This last week will contain less than 7 days, and hence the calculations for this week will also be based on less than 7 days.



Calculations

This is the statistical function that will be applied for the aggregation. For instance, if arithmetic average is selected, ENSIS will calculate the average of the samples within each time step. The arithmetic average will hence give the values in the aggregated series. In similar way, selecting the maximum will take the maximum value among the samples within each time step and make this value be the value stored in the new, aggregated series. The aggregation functions available are:

Term	**Explanation**
Arithmetic average	Sum of all samples within the time step, divided on the number of samples. See further explanation later in this section.
Time weighted average	Each sample has duration. The value is valid as *a constant value* until the end time. The aggregation takes the validity period of each value into account. See further explanation later in this section.
Time weighted interpolated average	Each sample has duration, but the system calculates ("draws") a linear equation between the samples, and. Aggregation takes the time period between the samples and the slope of line into account when calculating the new value for the time step. See further explanation later in this section.
Minimum	The minimum value of all samples within each time step
Maximum	The maximum value of all samples within each time step
Sum	Sum of all samples within each time step
Moving average	Based on hourly measured values, an 8 hour floating average means that a new value is given for each hour, that is the average of the values for the given hour and the preceding 7 hours.

The method for calculating arithmetic average is the same as for descriptive statistics.

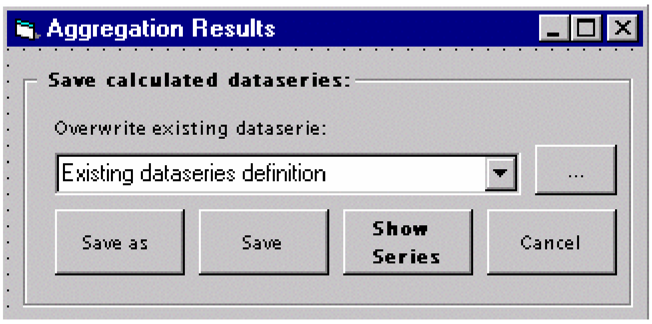
Calculate results in

The user must select which output unit he/she wants. All units derived from the same unit type as the unit of the input data series will be available from the combo box. The system automatically converts between the different units.

Missing data handling

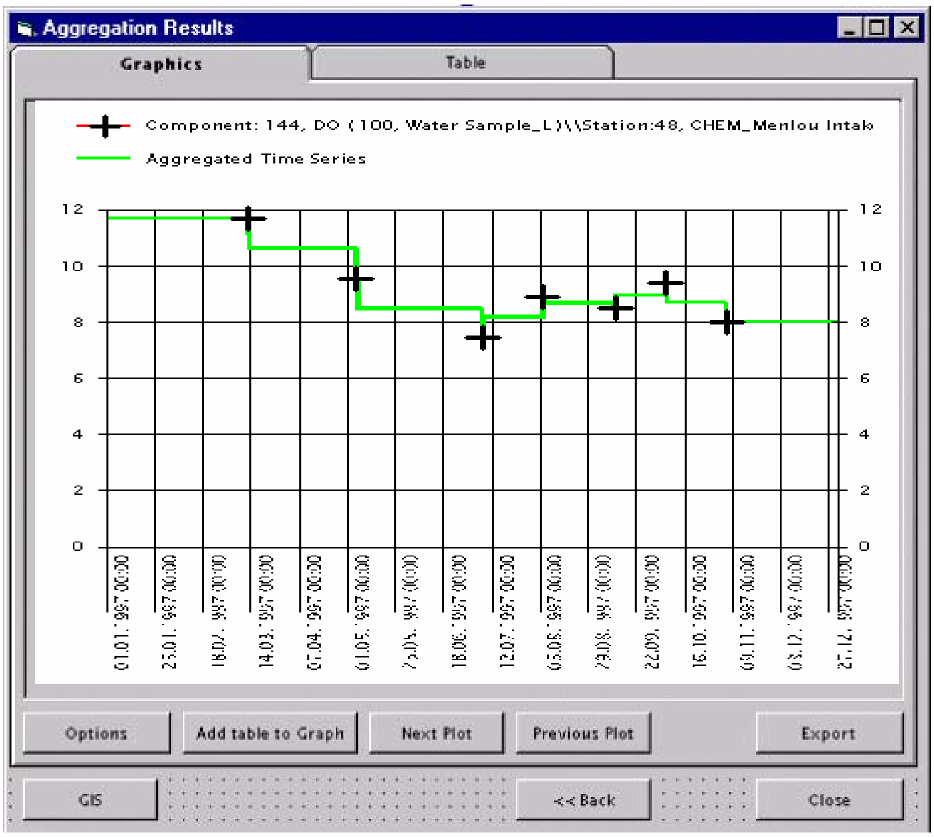
Under missing data handling the user specifies the lowest number of input values which can be allowed to calculate a new aggregated value. If the dataseries contains less valid data for a given aggregation time step than the given minimum, the result for this timestep will be “missing”. If you set the number of non-missing values to zero, extrapolation shall be carried out meaning that the system will calculate a value also for this time step.

<RUN>: Pressing this button starts the calculations.



<Show series>: To inspect the results as a graphic or a table presentation you press this button. A graph window will appear, presenting the aggregated values.

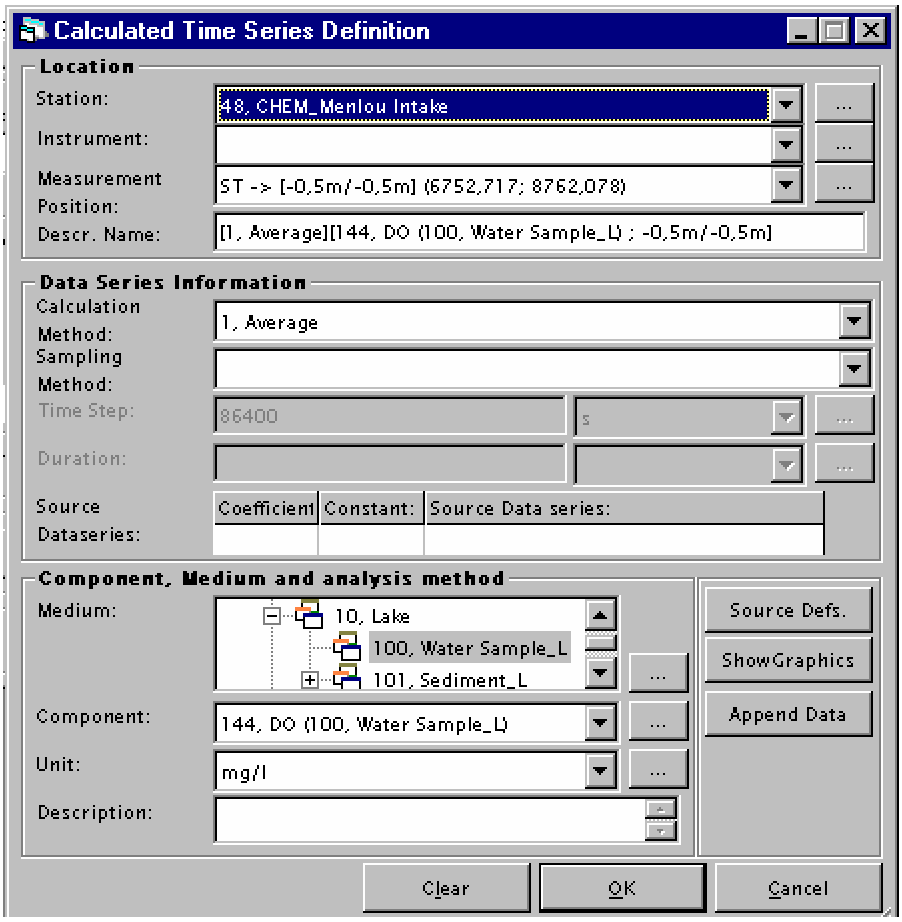
The graph window has the same buttons and possibilities as described for dataseries previous in this chapter.

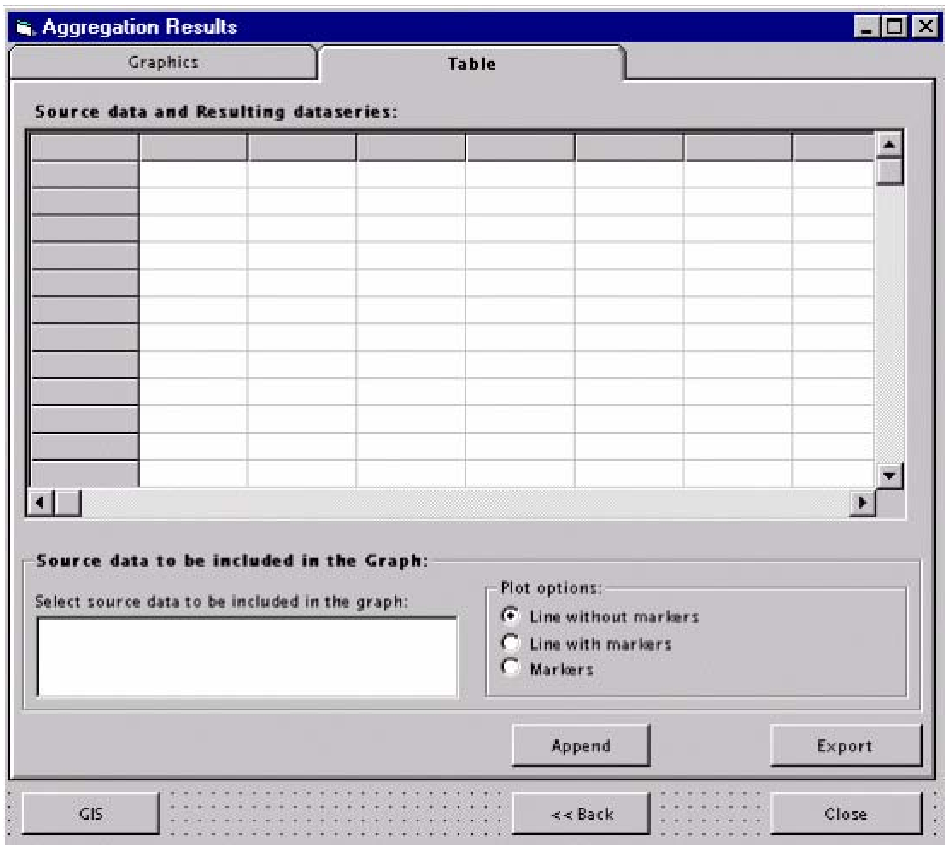


If the results are what you wanted and you want to save the aggregated data, you return to the Data Series aggregation window and press the <Save Series> button. Before you can save the aggregated series to the database you have to select a data series definition of the aggregated series from the combo box "Select target data series to store results in". If the proper data series definition is not valid in the combo box, you must first create it. Pressing the "..." -button beside the combo box does this.

This aggregated time series definition form is very similar to a measured time series definition form. Much of the information is automatically filled in based on the information from the previous form. The aggregated data series will be saved as a calculated time series with the same references to station, medium, component, and measurement position as the original data. The user can change the descriptive name and must select a sampling method (even though the series is not really "sampled"). In addition, the user can enter another description (for instance about the history of the series) at the lower part of the form.

<Source Defs>: the user can via the aggregated series see the definition of the original data series, meaning the measured series the aggregated series is based on.


Calculated Time Series Definition
Location
Station:
48, CHEM_Menlou Intake
Instrument:
Measurement Position:
ST -> [-0,5m/-0,5m] (6752,717; 8762,078)
Descr. Name:
[1, Average][144, DO (100, Water Sample_L) ; -0,5m/-0,5m]
Data Series Information
Calculation Method:
1, Average
Sampling Method:
Time Step:
86400
Duration:
Source Dataseries:
Coefficient
Constant:
Source Data series:
Component, Medium and analysis method
Medium:
10, Lake
100, Water Sample_L
101, Sediment_L
Component:
144, DO (100, Water Sample_L)
Unit:
mg/l
Description:
Source Defs.
ShowGraphics
Append Data
Clear
OK
Cancel


Aggregation Results
Graphics
Table
Source data and Resulting dataseries:
Source data to be included in the Graph:
Select source data to be included in the graph:
Plot options:
Line without markers
Line with markers
Markers
Append
Export
GIS
<< Back
Close

<Table view>: This will view both the aggregated series and the original measured series in the same table, with use of the standard graphical package included in ENSIS.

<Append>: This will have no function from this location. Append is only used to add more calculated values to an already calculated series. If a serie already have been calculated you search for this through the Measurements | Dataseries | Dataseries menu and choose append. Detailed explanation is provided there.

<OK>: Pressing this button will store the aggregated data series definition to the database.

<Cancel> will close the form.

<Copy to clipboard>:

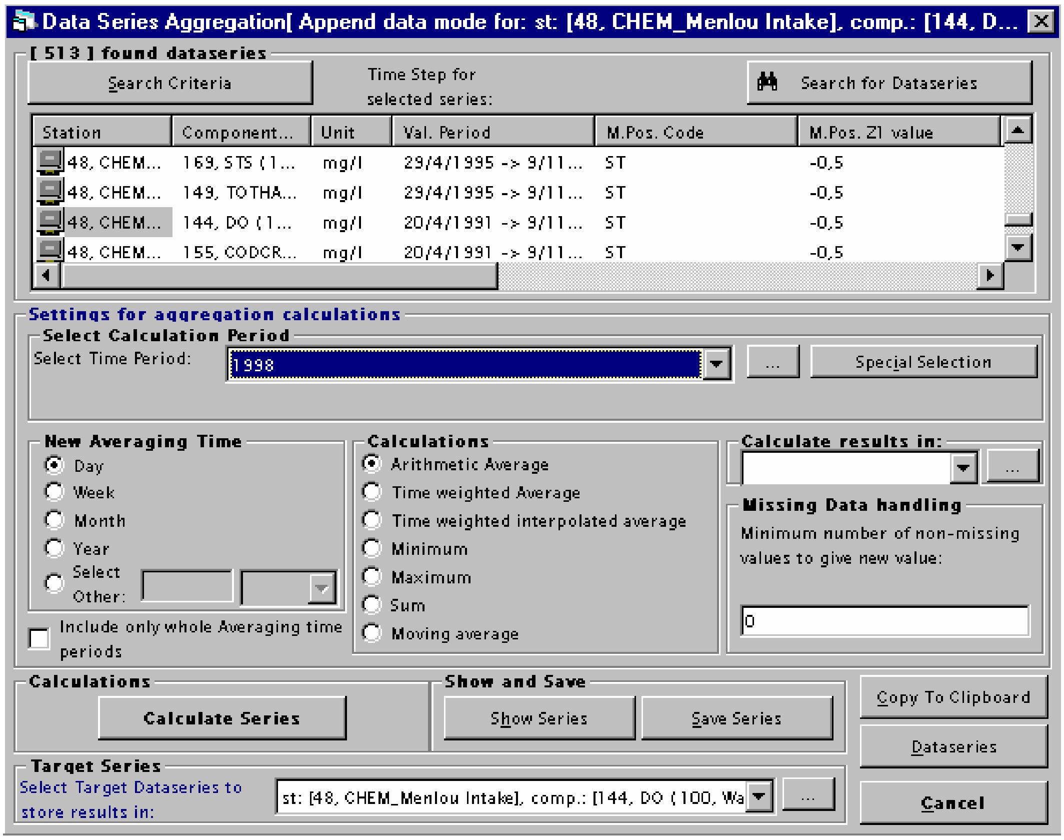
This loads the source series and the aggregated series, if the aggregation is done, into the memory of the computer, which makes it able to paste the data into other Windows applications.

<Dataseries>:

This buttons takes the selection of data series at the top of the form into the standard data series form. The user can here analyse the data with other tools than in the aggregation form.

The dataseries aggregation form in append mode

If you come from the Measurements | Dataseries | Dataseries menu and is append modus, all the information in this form will be filled in except the period you want to extend the calculated series with (i.e. 1998), and the unit you want to use for you calculated results. All the rest will be a result of the definitions you have done earlier for this calculated series, and the target series will be the calculated serie you want to append. The only predefined settings you can change before calculating the results for the append period is the number of non-missing values to give the new value. The form below should be replaced by the new aggregation form given above.



6.1.1.4 Clarification of terms

Aggregation is used for calculating a new time series with another (often longer for regular time series) time step than originally measured, like when calculating daily averages from hourly measured data, getting a time series of 31 daily values from 744 hourly values. Another example is getting a regular time series with monthly resolution out of a series of grab samples.

Interpolation

Sometimes there are "gaps" in the data series. An example is when data is measured in January -98, February -98, March -98, October -98, November -98 and December -98. If the user wants monthly values for the entire 1998, he has to do an interpolation for the months April, May, June, July, August and September. In principle, this is very similar to aggregation, except for the fact that the output of an interpolation might have a finer resolution than the input series (the measured series).

Figure 1 shows a time of the year where an interpolation is needed, if the user wants output with time step = month. The interpolation is linear.

The interpolation can either be done by using time weighted average or by using time weighted interpolated average. This is explained in detail later in this section.

Extrapolation

In some cases the user wants to use the existing data series and say something about the state of a certain variable outside the period where measurements exist. For instance, the user has only measurements for 1998, but wants to get values for January in 1999, or for November in 1997. Then he has to extrapolate the data outside the period measurements exist.

Constant extrapolation is always used when the user wants values outside the period data exist for. For instance, if the last value in the data series is 7.56, then all extrapolated samples later shall be considered to be 7.56.

There is no restriction in how far the user can extrapolate data. If the user wants to extrapolate data for 1998 back to 1972, there is no technical constraint in doing this. It is, of course, scientific reasons for not doing such an extrapolation.

Figure 1 gives an example for a period where the user has extrapolated data (upper end).

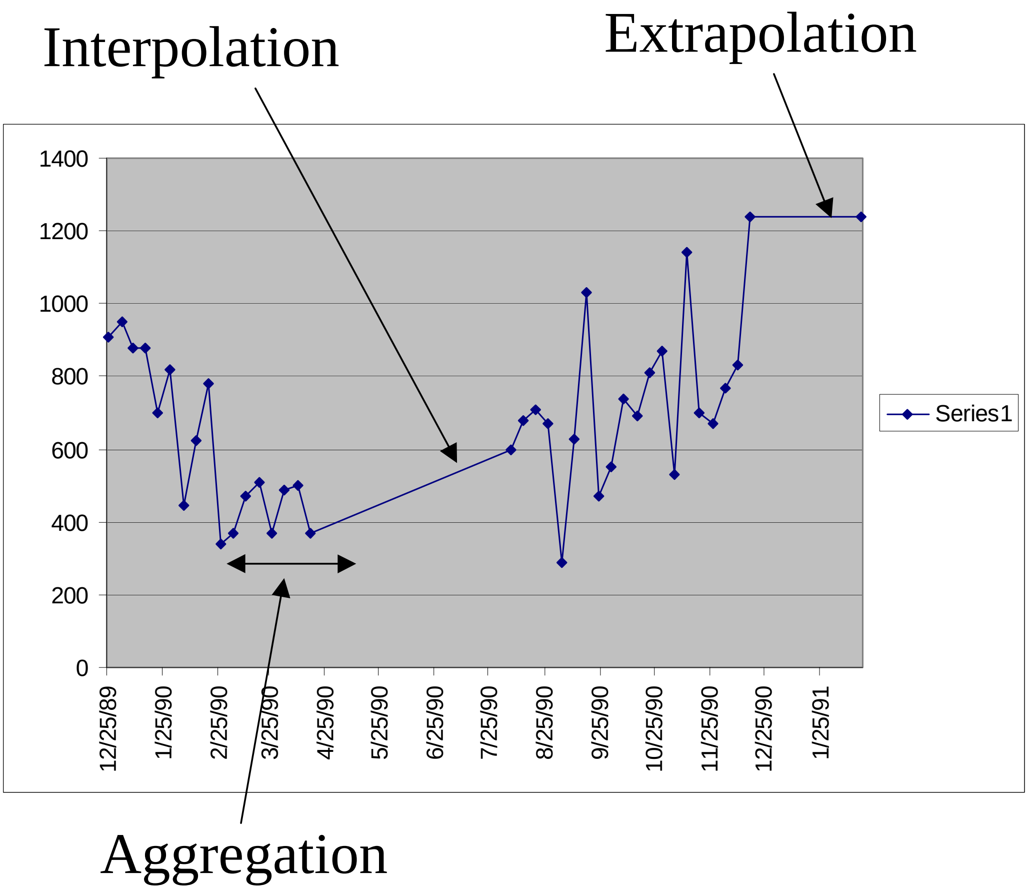


Figure 1. The figure shows the different possibilities for aggregation, interpolation and extrapolation.

Arithmetic average

This is a common method to use for data series with a value type = instant. To use this method when a data series shall be divided into equal time steps is not smart, because you sometimes need an interpolation, due to the fact that there might be time steps without any samples at all. When you know that all time steps have one or more samples within the period, then arithmetic average is OK. This is typical for use of the water quality classification system, when the user takes data for a longer time period and there are always samples within the period.

Time weighted average

Times weighted average is a method that is first of all applied when value type is partly or full (duration). The time weighted average values will then be given higher weight when the duration is longer.

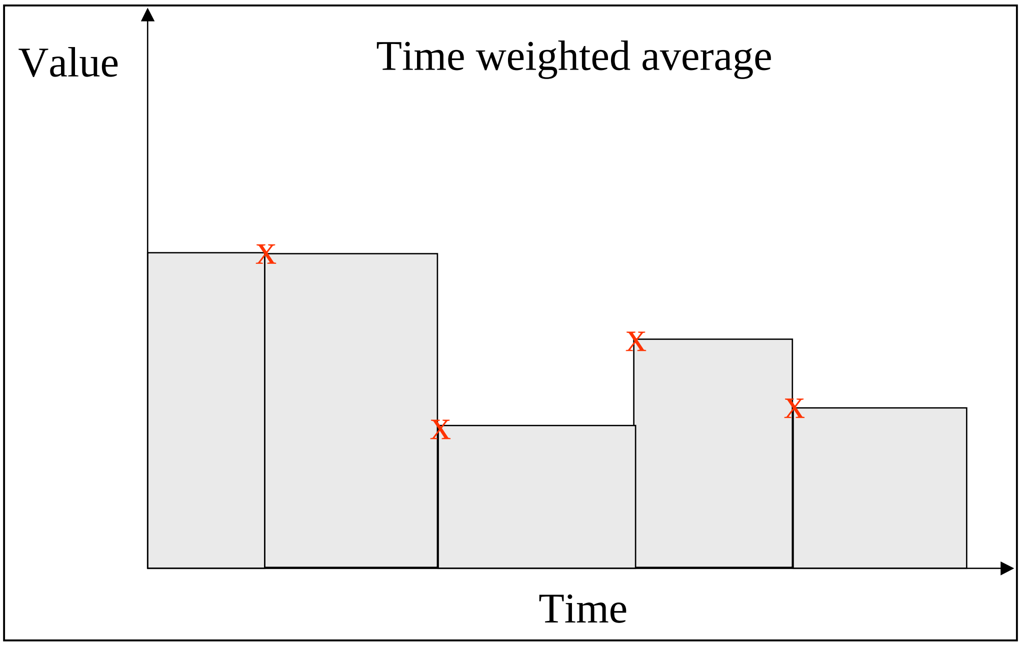


Figure 2. The figure shows graphically how time weighted average is calculated. The Xs represent points in time where samples are taken. The blocks represent duration in time. Extrapolation is carried out at the lower end.

Time weighted interpolated average

Time weighted interpolated average is a common method to find values "between real samples" in time. This method of interpolation should be the default way of calculating new time series out of measured series with **instant** value type. Most irregular water series are of instant type. The interpolation shown in figure 3 is linear (interpolation can also be of higher degree). Linear interpolation is what type of interpolation that is in most cases automatically (in the pollution budget model, see details in this chapter) applied to irregular time series in ENSIS.

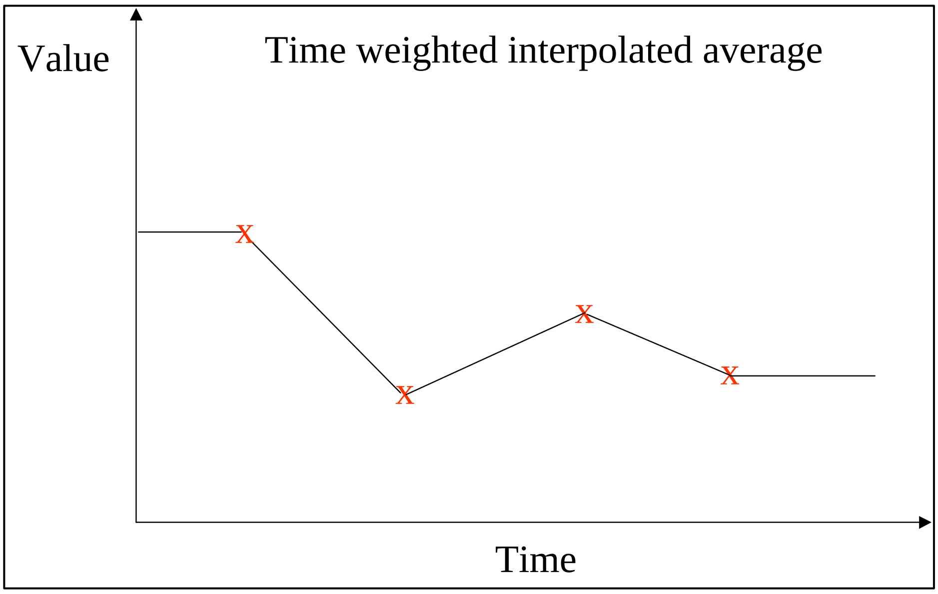


Figure 3. The figure shows graphically how time weighted interpolated average is calculated. The Xs represent points in time where samples are taken. The graph is extrapolated both in the lower and in the upper end.

Values on dates without time-specification, is automatically set to 00:00 AM. Calculated time-weighted interpolated averages are assumed to be at 12:00 (noon). In this case the time-weighted interpolated average value (V) for a day (d) is:

$$V_d = (V_d + V_{d+1})/2$$