Institute of Hydrology

PC-Quasar

Quality Simulation Along Rivers

Version 1.1

January 1999

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Centre for Ecology & Hydrology

This manual was produced by the
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Version Control

Version	Date	Software Release	Notes
1	May 97	V1.0 of PC-Quasar	
		V2.0 of PCQ-Map	
2	Jan 98	V1.1 of PC-Quasar	

Glossary

Boundary Conditions

The condition and status of a river at a set point. These are usually considered to be:

For a river	at the river head
For a tributary	at the confluence with the river
For a discharge	at the confluence with the river

Indirect Discharge

A direct discharge into a tributary

Lag

A part of a reach - a sub-reach.

Reach

A discrete section of a river, defined by the user according to the point (s) interest found in that section of river.

Tributary

A river that is not modelled.

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1. Introduction

1.1 Overview of the software

The PC-Quasar software package, from the Institute of Hydrology, is a Microsoft Windows application for modelling water quality and flow in river networks. The flow and quality of a river network can be simulated for any 12 month period, using daily or monthly data, to predict changes in water quality resulting from changes in discharges to, and abstractions from, a river. The model is composed of a set of equations describing the changes in water quality and flow over time in a series of river reaches. The parameters modelled are:

? flow

? nitrate

? dissolved oxygen

? ammonia

? un-ionized ammonia

? temperature

? E Coli

? pH

? biochemical oxygen demand (BOD)

? conservative pollutant or tracer

PC-Quasar is designed for use by river regulatory authorities and water/sewerage utility companies in the setting and monitoring of River Quality Objectives. It is useful in making river quality management decisions, for example, in setting consent standards and defining operational procedures.

The model can be run in either **dynamic** or **planning** mode. In the dynamic mode, time series data are input to the model to generate flow and quality estimates at each reach boundary over a period of time. Travel times are incorporated so that pollution pulses can be tracked downstream. Two sets of output data will be generated in this mode. One is based on 'observed' values (referred to as default or normal values throughout this manual) and the other on user-edited values. This mechanism allows a change in the river system to be defined by the user-edited parameter set and the possible effects on the river to be examined, thereby allowing appropriate operational procedures to be suggested.

The planning mode uses the Monte-Carlo simulation method to provide a cumulative frequency distribution of selected water quality variables from a given set of hydrological inputs and operating conditions. The output data generated in this mode will help in setting consent standards to meet river quality objectives.

1.2 About this User Guide

This User Guide provides detailed information on the use and operation of the PC-Quasar software package. It is intended to be used as a reference manual and as a tutorial.

Section 0 (this section) gives an overview of PC-Quasar

Section 2 describes the PC-Quasar hardware and software requirements and installation procedure.

Section 3 provides basic information on PC-Quasar menus.

Section 4 gives a simple tutorial.

Section 5 describes the on-line Help available.

Section 6 describes the PCQ-Map utility, which is used for setting up new river networks.

Section 7 describes the format of map files.

Section 8 lists the files and file types used by PC-Quasar.

Appendix A lists the map file used in the tutorial.

1.3 Conventions used in the manual

Command buttons, menus, option names and other items generated by the PC-Quasar software are shown in italics, e.g. *File* menu

Data values are shown in single quotes, e.g. 'Tale Water - Escot'.

Keyboard keys are shown enclosed in parentheses, e.g. <Tab>.

2. Installation

2.1 Hardware & software requirements

PC-Quasar will run on a minimum hardware configuration of a 386 PC with a maths co-processor, 8 Mb RAM, 5 Mb of hard disk space (for program and data storage), SVGA colour monitor and mouse.

However the recommended hardware configuration would be a 486 PC, 16 Mb RAM, 5 Mb of hard disk space (for program and data storage), SVGA colour monitor and mouse.

PC-Quasar will run under Microsoft Windows version 3.1 or higher, Windows 95/98 or Windows NT.

A permanent Windows swap file with a capacity of at least 8 Mb must be set up (refer to your Microsoft Windows manual for information on swap files). It is recommended that the hard disk drive be de-fragmented first, and that the maximum size of permanent swap file suggested by Windows should be accepted. The size of the page file required in operation depends on the size of the model to be run.

2.2 Installing PC-Quasar and the copy protection system

Installation is a two stage process, as described below. The PC-Quasar program files must be installed first and then the copy protection system. PC-Quasar can be installed to any hard disk but it will not run unless the protection system is also installed to the same hard disk directory.

2.2.1 Installing the PC-Quasar system

Windows software must be running before PC-Quasar can be installed. The set-up program is accessed via the *Run* command. (For Windows 3.1 and Windows NT 3.5, this can be found under the *File* menu of the Windows Program Manager. For Windows 95/98 and NT 4.0 or later, this can be found under the *Start* menu.)

In the *Run* command box, type:

A:SETUP

If the PC-Quasar distribution disk 1 is not in drive A, substitute the correct drive letter in the command. Then click on *OK* or press <Enter>.

The installation routine will prompt to confirm that installation should proceed. Other prompts will be displayed as necessary allowing the user to specify installation details, for example, the name of the directory where the program is to be installed. C:\PCQUASAR is offered as the default directory but this may be changed if required. A new directory will be created by the installation program if it does not already exist. The user will be prompted to insert further installation disk(s) as required. The PC-Quasar program files will be copied to the directory and a Windows program group will be created. This will contain the PC-Quasar application icon that is used to start the PC-Quasar program. It will also contain an icon for the copy protection system program which installs/uninstalls the copy protection system token, an icon for the uninstall program plus an icon for any release notes (if present).

Section 12 lists the files used by PC-Quasar.

2.2.2 About the copy protection system

The PC-Quasar distribution disk incorporates a copy protection system to prevent unauthorised use. The protection system must be transferred to the hard disk drive where the PC-Quasar package is installed. You are only allowed to install each licensed copy of PC-Quasar onto a single PC. However the protection system can be uninstalled if you want to move PC-Quasar to another computer or disk drive, or if you need to re-format your hard drive.

Uninstalling/reinstalling the software requires use of the original distribution disk. Therefore this should be retained.

Failure to install/uninstall the copy protection system correctly will cause an error message to be displayed when attempting to run PC-Quasar.

The protection system should not affect any normal disk management operations. Backup copies of the program and data files may be made if required. The hard disk may also be optimised (by using, for example, the optimisers supplied with Norton Utilities or PC Tools) without affecting the copy protection system.

2.2.3 Installing the copy protection system

Please see the separate copy protection leaflet for details about installing the copy protection system.

2.3 Moving PC-Quasar to another computer

If it becomes necessary to move the PC-Quasar package to another computer, or to a different directory, or hard drive, it is necessary to transfer the copy protection system back to the original program disk and then reinstall it on the required computer.

The copy protection leaflet also details the procedure for uninstalling the copy protection system.

Transferring the copy protection system is in addition to copying the various PC-Quasar program and user data files. Data files can be copied using normal file copying mechanisms. Program files can be removed by means of the uninstall program and reinstalled from the original software disk(s). Alternatively they can be moved using normal file copying mechanisms.

2.4 Uninstalling PC-Quasar

An uninstall program is also supplied with PC-Quasar. This will reverse the installation process, removing all supplied files, deleting program icons and removing the PC-Quasar directory. If data or other user files remain in the directory, the uninstall program will prompt the user to decide whether these files should be deleted or not.

PC-Quasar should only be uninstalled after the copy protection token has been returned to the original software disk.

2.5 File and directory organisation

Users are recommended to set up a suitable directory structure for the files to be used and created by PC-Quasar using standard Windows facilities.

Section 2.5 provides a suggested strategy for file and directory organisation.

3. Basic Operations

3.1 Introduction

PC-Quasar is a Microsoft Windows application that uses the standard Windows method of menus and forms (dialog boxes) to guide the user through all operations.

Before you begin working with PC-Quasar, you should understand the basics of Microsoft Windows. Like other Windows -based products, PC-Quasar presents an easy-to-use graphical user interface. Since PC-Quasar operates in the Windows environment, it uses the standard Windows rules for selecting icons, menus, menu items, and options in dialog boxes.

Before you use PC-Quasar, you should know how to:

? Choose and cancel commands.

? Use the Control menu for application windows and dialog boxes.

? Select and edit text.

? Move, move within, and cancel dialog boxes.

? Work with command buttons, text boxes, list boxes, radio buttons, and check boxes.

? Move, move within, and size windows.

3.2 The main menu

PC-Quasar, like most other Windows applications, runs in its own window which has a list of menu options displayed on a bar across the top of the window (see Figure 3.1). The bottom line of the window is a status bar that details which files and parameters are in use.

Figure 3.1. PC-Quasar main menu

This is the main menu bar and it gives access to all of the PC-Quasar functions. The general purpose of each of the main menu options is described in this section of the manual.

Every main menu option leads to other choices displayed on 'drop-down' sub-menus. The sub-menus are revealed by positioning the mouse pointer on the required main menu choice and then clicking once with the left mouse button. Figure 3.2 shows a typical sub-menu. Sub-menu choices are selected in a similar manner and may lead to other sub-menus.

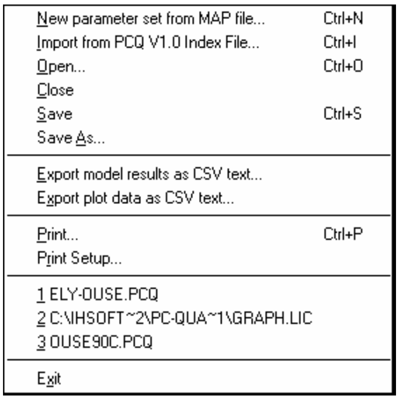

Figure 3.2. A PC-Quasar sub-menu

The ESC key may be used to escape from a sub-menu without making a selection. The main menu choices are briefly described below.

3.2.1 The File menu

This menu choice gives access to sub-menus for creating, opening and closing PC-Quasar parameter set files, for exporting table and plot data and for printing graphs. Parameter set files are used to store the variables that control the running of the PC-Quasar model. Further details of the *File* menu are given in section 5.

3.2.2 The View menu

The View menu is used to manipulate the graphic output generated by PC-Quasar. It is described in Section **Error! Reference source not found.** of this User Guide.

3.2.3 The Parameters menu

The data used by the model are stored as sets of variables known as parameter sets. These can be created, selected, saved or closed through the *File* menu and are edited using commands on the *Parameters* menu. Further details of the *Parameters* menu are given in section **Error! Reference source not found.**.

3.2.4 The Model menu

This menu choice is used to run the model after the required parameters have been selected and edited. A parameter set must be selected before the model can be run. Running the model creates a set of output data that can be viewed or printed via the *Results* menu option. Further details of the *Model* menu are given in section **Error! Reference source not found.**.

3.2.5 The Results menu

After the model has been run the output data can be plotted to the screen through this menu choice. Further details of the *Results* menu are given in section **Error! Reference source not found.**.

3.2.6 The PCQ-Map menu

The PCQ-Map option provides a link to the map creation utility, PCQ-Map. Further details about PCQ-Map are given in section 5.

3.2.7 The Help menu

The Help menu provides a method of viewing the entire PC-Quasar help file. The user can select a topic from a list of contents.

Help can also be displayed by clicking on help buttons in the dialog boxes. Further details of the *Help* menu are given in section 5. Tutorial

4. Tutorial

This tutorial demonstrates most of the features of PC-Quasar. It is designed to familiarise users with the basic operation of PC-Quasar. It is based on the small river network shown in the diagram below (Figure 4.1).

(Users should note that although the river network used in the tutorial is based upon a real example, the associated water quality data is entirely fictitious.)

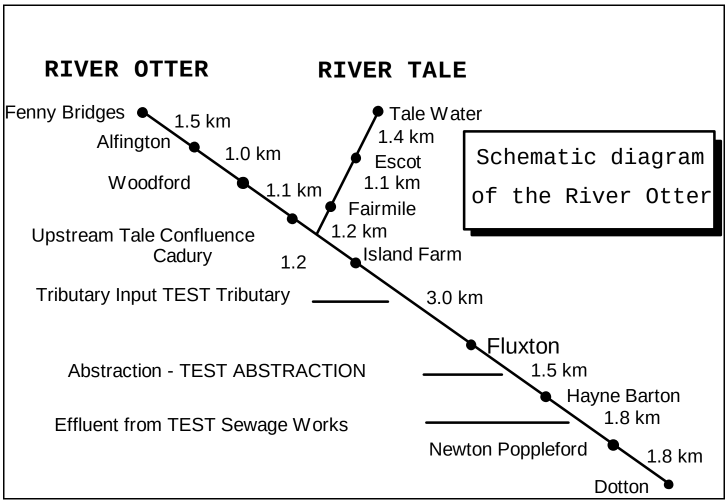

Figure 4.1. The river network used in the Tutorial

The tutorial consists of a number of discrete logical stages:

? Section 4.2 describes the definition of a river network

? Section 4.3-4.11 covers the basics of starting PC-Quasar, setting up an index file, creating and editing a parameter set

? Sections 4.12-4.13 take the user through a typical model run

? Sections 4.14-4.18 provide some further dynamic mode run variations

? Section 4.19 provides an example of use of planning mode.

4.1 Defining a river network

To model a river network with PC-Quasar, the river network needs to be defined. This is done by creating a map file. The map file describes each of the tributaries, river reaches, abstractions and inputs. It also contains the time series data of determinand concentrations required as inputs for the model run.

A sub-directory called TUTORIAL containing a sample map file, OTTER.MAP, will have been created during the installation of PC-Quasar. This is the river network (shown in Figure 4.1) that will be used for tutorial purposes.

Normally, map files will be created by using the PCQ-Map utility (see Section 5) but they can be produced using a text editor. The required format is described in section 11.

4.2 Starting PC-Quasar

If the 'IH Software' program group is not already open, open it by double-clicking on the appropriate icon in the Windows Program Manager or selecting the item from the Windows 95/98/NT *Start* menu. Select *PC-Quasar application*. This will display the initial menu (shown in Figure 3.1). Note that some menu options are unavailable at this point and so are greyed out.

4.3 Creating a new parameter set

PC-Quasar uses sets of variables known as parameter sets to control how the simulation runs. Parameter sets are saved in files that can be recalled for later use or modification. To create a new parameter set file, follow the sequence described below. For more information about parameter set files refer to section 5. From the *File* menu, choose *New parameter set from MAP file*. The *Select Map file to load* dialog box will open to allow the selection of a map file from which the parameter set will be created. Select the OTTER.MAP file from the TUTORIAL directory and then click on the *OK* command button. While the MAP file is being loaded, PC-Quasar checks it for format and data errors and will display dialog boxes allowing correction where appropriate.

Tip. All dialog and message boxes in PC-Quasar have explanatory help topics. Click on the Help buttons or press the F1 key to view help topics.

After the map file has been successfully read a dialog box is displayed to allow the entry of a name for the new parameter set. For the tutorial enter **Otter 1985 Tutorial Dynamic Set 1** and select the *OK* command button to save the new parameter set.

Parameter sets may be given any name that is meaningful to the user . However, names must be 1-40 characters long. (excess characters will be truncated.)

It is important to note that, when a parameter set is created, PC-Quasar generates **two** sets of data values: a default set derived from the map file and a duplicate of the default set that can be edited by the user. When the model runs (in dynamic mode) it can be set to use either the default data only or both default data and edited data (or selected edited data) on a point by point basis.

4.4 Selecting the operational mode for the model

As described in Section 1.1, there are the two modes in which the model can operate. The dynamic mode simulates water quality over a period of time. The planning mode uses one of three statistical methods to generate data for the water quality determinands and flow.

4.4.1 Selecting a mode

From the *Parameters* menu, select *Run Mode*. The dialog box that is displayed (Figure 4.2) is divided into three areas. Two radio buttons in the top area allow a selection of either dynamic mode or planning mode. If not already selected, select *Dynamic Mode* as this will be the mode for the initial tutorial model runs. Use the <Tab> key or the mouse to move the cursor into the next area of the dialog box where various dynamic mode options can be chosen or amended.

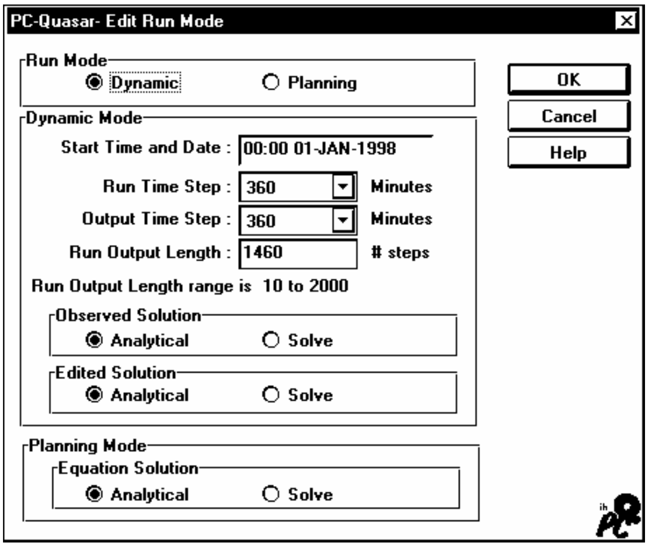

Figure 4.2. Mode selection

4.4.2 Mode options

The start time will default to 00:00 and the start date will default to 1 January of the current year. As the sample map file provides monthly data for a twelve month period commencing in January 1985, set the *Start Date* to 01/01/1985. Leave the *Start Time* at 00:00.

Using the drop down boxes as necessary, ensure that *Run Time Step* is set to 240 minutes (4 hours), *Output Time Step* is set to 1440 minutes (1 day) and *Run Output Length* to 50 output time-steps (T/S) (i.e. in this case 50 days).

For *Observed Solution* and *Edited Solution* select the *Analytical* radio buttons. (Note that the bottom area of the dialog box has two radio button choices for planning mode. Because dynamic mode has been selected these are greyed out.) Complete mode selection by clicking on the *OK* button.

4.5 Choosing the rivers to model

The *Rivers Modelled* menu option on the *Parameter* menu is used to select which river(s) will be included in the simulation run. Note that tributaries of a selected river are automatically included in a model run.

4.5.1 Selecting the rivers to be modelled

From the *Parameters* menu choose *Rivers Modelled*. A dialog box appears displaying a list of all the rivers in the network (Figure 3.1). In the tutorial example there are two rivers, the Tale and the Otter.

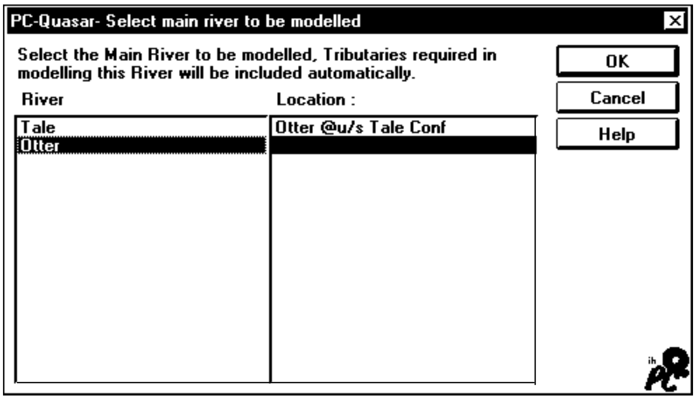

Figure 4.3. Rivers modelled

The order in which the rivers are listed is determined by the map file describing the river network. The order of listing is not actually important to the working of the model but it is a useful convention to list the higher tributaries at the top, and the main river (into which all the tributaries flow) at the bottom.

The PC-Quasar simulation can be run for all or part of the river network. PC-Quasar models the river selected plus any rivers which flow into the selected river or any of its tributaries. Any parts of the river network which are downstream of the selected river will be ignored. In this case, it would mean that selecting the River Tale would cause that river alone to be modelled, whereas selecting the Otter would cause both the Otter and its single tributary, the Tale, to be included in the simulation.

For the purposes of the tutorial, select the ‘Otter’ from the list and click on the *OK* button.

4.6 Editing data values

As well as editing values, PC-Quasar’s editing facilities can also be used to view and check the original data imported from the map file when the parameter set was created. This section of the tutorial demonstrates some data editing techniques.

Note that parameter sub-menu options are greyed out for any river features which are not present in the map file. For example, select *Dynamic Parameters* from the *Parameters* menu and it will be seen that the sub-menu *Indirect Discharges* is greyed out because this is a feature that is absent from the Otter river network.

4.6.1 Editing river quality data

From the *Parameters* menu select *Dynamic Parameters* (this is the run mode that was chosen - see Section 4.4.1) and then select *River Quality* from the sub-menu. This should display a list of rivers in the parameter set (Figure 4.4).

As it is the first river in the list, the Tale will be highlighted and some details about it are displayed alongside, in this case ‘Otter @u/s Tale Conf, which indicates that the river Tale enters the Otter at the upstream end of the reach described in the river network as ‘Tale Conf’.

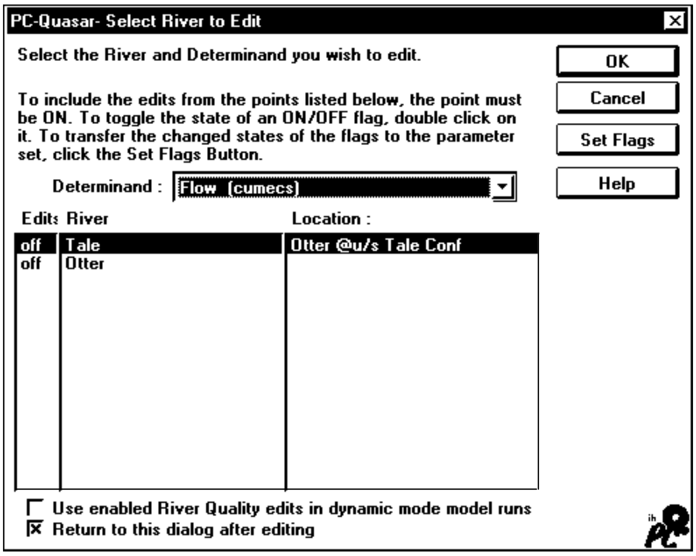

Figure 4.4. Select river to edit quality

In every river network there will always be one main river into which all the others ultimately flow. In the tutorial example the Otter is the main river and the Tale flows into it. This can be verified by selecting the Otter and clicking on the OK button to display the data editing dialog box (double clicking on the river name is an alternative method). The text at the top will show:

```
Editing: Flow(cumecs) for Otter
```

For rivers other than the main one, the text would be, for example;

```
Editing: Flow(cumecs) for Tale
which flows into Otter @u/s Tale Conf
```

4.6.2 Controlling use of default or edited parameter values

As mentioned previously, the simulation can be run using the default parameter set values only, or with the edited parameter values included as well. Furthermore, default values may be used for some parts of the river network while edited values are used for other parts. Modelling of edited values for each river is governed by two controls: an ON/OFF setting at river level plus a check-box override. These can be seen in Figure 4.4.

The individual setting for each river is shown by the word "ON" or "OFF" alongside the other descriptive detail(s) for the river. Subject to the setting of the override (described below), a value of "ON" causes PC-Quasar to model using both default and edited values for that river; a value of “OFF” causes PC-Quasar to ignore any edited values and to use only the default values for the model run. To change the setting for any river in the network simply double-click on the on/off setting in the ‘edits’ column.

The check-box override (labelled *Use enabled River Quality edits in dynamic mode model runs*) provides a “group-control” facility for all rivers in the network being modelled. It controls whether the various ON/OFF settings at river level are obeyed in the model run or not. If the check-box is not marked, then edited values will not be used for any river modelled in the model run regardless of whether the river is set “ON” or not. Alternatively, if the check-box is checked, then edited values will be included for any river set to “ON”, while any rivers set to “OFF” will be modelled using default values only.

Similar mechanisms also operates for other river features (e.g. reaches, abstractions, discharges, etc.).

Double-click several times on the on/off switch in the edits column beside the River Tale in the list box and observe that the on/off flag toggles between “on” and “off” to indicate whether edited values for the Tale will be used or not.

Make sure that both the Tale and the Otter are toggled ‘on’ then click on the ‘Set Flags’ button to incorporate the changes into the parameter set. Click on the check-box once so that it is checked. These settings will cause the simulation to model both rivers with edited parameter values.

4.6.3 Global User Value Flags

Edited parameters may need to be included or excluded for a series of model runs and a shortcut has been provided to facilitate this. Select the command *Global User Flags* from the *Parameters* menu to display the dialog box shown in Figure 4.5.

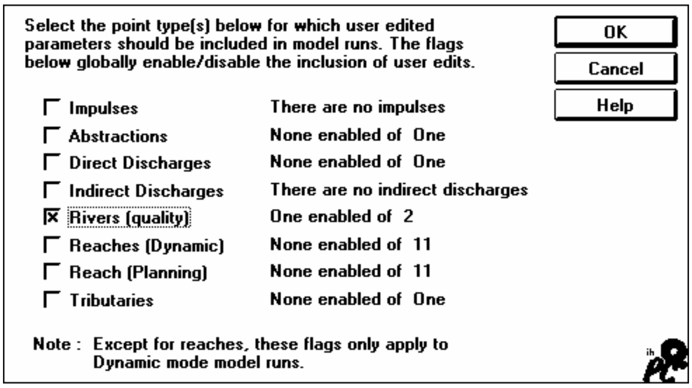

Figure 4.5. Setting global user flags

This dialog box lists the parameters that can be edited, and shows how many of each type there are and how many of these have been enabled (i.e., toggled to 'ON'). This example shows that edited parameters for *Rivers (quality)* has been enabled for one of the two rivers in the network. If the check boxes are set then the edited data will be included in the model runs, otherwise they will be excluded.

4.6.4 Editing parameter values

This section of the tutorial looks at the editing of determinand values in order to familiarise the user with the layout of the data and the editing functions.

From the *Parameters* menu select *Dynamic Parameters* then *River Quality*. Highlight the River Otter by clicking on it once and then select '*Flow (cumecs)*' from the drop-down list box labelled '*Determinand*'. Click on the *OK* command button to display a dialog box (Figure 4.6) that allows the user to edit the values for daily flow.

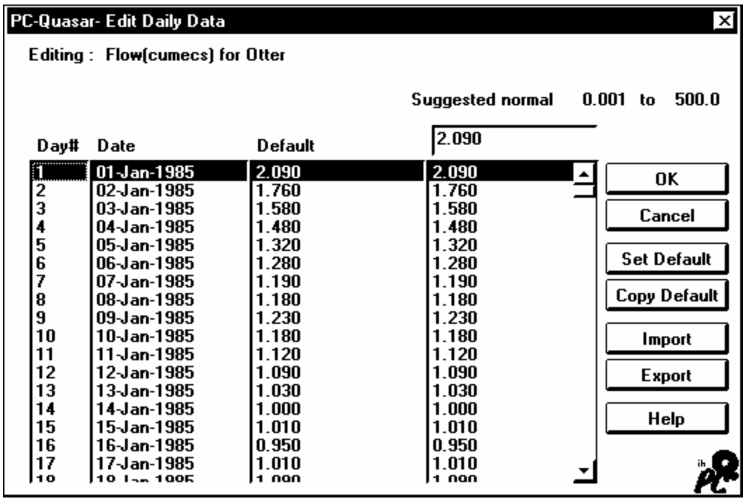

Figure 4.6. Edit daily flow data for Otter

In order to edit a value, the row containing the value to be edited must be selected using the mouse or the up-arrow/down-arrow cursor control keys. This highlights the required row in the dialog box, copies the editable value from that row to the edit box at the top of the dialog box and positions the cursor in the box (if cursor control keys are used rather than a mouse, press the <Tab> key to position the cursor in the edit box). The user can then enter the new data value into the *Edit* box, pressing the <up-arrow> or <down-arrow> key to accept each new value. When all editing is complete click on *OK* or press the <Enter> key to store the new edited value(s). <PageUp> and <PageDown> may be used to scroll through the data a page at a time.

Use of the *Set Default*, *Copy Default*, *Import* and *Export* command buttons will be examined in section 4.8.

For the purposes of the tutorial, practice editing by amending a few of the data values. These edited values are **not** required for the tutorial, so please do not click on OK or press <Enter>.

Finally, click on the *Cancel* button so that the original values are retained and all edits are cancelled. The dialog box listing the rivers will then be redisplayed *unless* the check box labelled *'Return to this dialog box after editing'* has been turned off. Close the *'Select River to Edit'* dialog box by selecting the *OK* button.

4.7 Editing other river network features and variables

The procedure for viewing and editing other model variables is similar to that used for river quality (described in section 4.6.1).

For the purposes of the tutorial these other variables will not be edited, but you may wish to call up each of these screens in order to familiarise yourself with the characteristics of the river being modelled in the tutorial.

The facilities for controlling use of edited data for other river network features (e.g. tributaries, direct discharges, etc.) are largely identical to those on *Select River to Edit Quality* (as described in section 4.6.1).

Note that, for an abstraction, only flow rates are available for viewing and editing.

4.8 Other editing facilities

In addition to editing the parameters manually, as described in sections 4.5.1-4.6.4, it is possible to amend any or all of the parameters in a parameter set by importing a set of variables from an ASCII file. This section describes how to amend variables by importing them from an ASCII file.

This section also describes how to restore amended values to their defaults and how to change the default values in a parameter set.

4.8.1 Importing and export of data

Dialog boxes used for editing data have buttons for importing and exporting data (see Figure 4.6 for an example). An example of the file format for import and export is shown below:

```
"Flow(cumecs) for Otter"
""
2,366
"Edited","Default"
       2.090,       3.140
       1.760,       1.900
       1.580,       0.630
       1.480,       1.000
       1.320,       1.010
       1.280,       1.500
```

Any remarks may be enclosed in quotes and are ignored by the import routine. The line `2, 366` in this example tells PC-Quasar that there are two columns and 366 lines. of data (the sample only shows the first six lines). The first column is the observed data and the second is the edited data. This facility allows users to manipulate data within a spreadsheet, such as Microsoft Excel? . PC-Quasar will display warnings if the imported data is in an invalid format.

4.8.2 Changing default values and resetting edited values

The default model variables held in the parameter set can be changed if the need should arise. This section describes the procedure. Note that amending the default values does not change the map file from which the values were originally generated. If there is a need to amend the principal physical characteristics of the river network, such as river and reach names, this must be done by amending the map file (using PCQ-Map or a text editor or spreadsheet as appropriate), and creating a new parameter set from the amended file. See sections 9 and 11 for further information about map files.

After editing the required values in the appropriate edit dialog box, click on the *Set Default* button (see Figure 3.1 PC-Quasar will display a warning message:

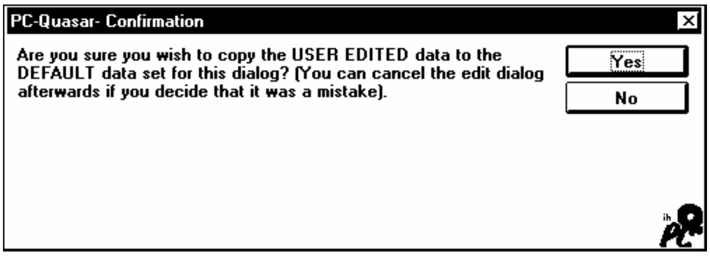

Figure 4.7. Changing default data set values

Selecting the *Yes* button will cause all edited values to be transferred to the default set for the parameters and location currently being edited. The new values will be displayed in the ‘Default’ value column of the data editing dialog box.

The *Copy Default* button provides a similar method for copying all of the default data values to the edited set. Experiment with both procedures to see how they work and then abandon any changes made by closing all dialog boxes (using the *Cancel* button), closing the parameter set without saving it (*File…Close*), and re-opening the original set (*File…Open*).

4.9 Parameter set management

It is not necessary to save the parameter set to run the model but, if it is to be recalled for later use, the edited parameter set may be saved under its original name (*File…Save*) or it may be given a new name (*File…Save As*).

4.9.1 Saving an edited parameter set

In order to record the changes made to the various parameters, the parameter set needs to be saved. From the PC-Quasar main menu select *Save* from the *File* menu to save the set under its original name. This stores the amended parameter set and allows it to be recalled for later user if required.

4.9.2 Saving a parameter set under a different name

This allows the user to make a copy of a parameter set and amend it, while still preserving the original.

Select *Save As* from the *File* menu to display the standard Windows file management dialog box which allows the user to select a file name and directory.

This procedure can be used at any time to create a copy of a parameter set, with a different name. This may be useful in creating a second similar set of parameters, or to copy the original set before experimenting with different parameter values.

4.9.3 Closing a parameter set

If a user has edited a parameter set but then decides to abandon the edits and re-open the original set, it is necessary first to close the open set. *Simply re-opening the original set will* ***not*** *over-write the edited data held in the computer's memory.* To close the parameter set, select *Close* from the *File* menu.

If the parameter set has been changed but not saved, PC-Quasar prompts the user to save it before closing it. Saving a set will cause the original parameter set file to be over-written. To avoid this, an edited parameter set can be saved with a different filename with the command *File…Save As.*

An open parameter is automatically closed when another one is opened or created.

4.9.4 Deleting a parameter set

PC-Quasar does not provide a method for deleting parameter set files. This must be done by using the appropriate Windows file management tool ('File Manager' for Windows 3.x and NT3.5x or 'Explorer' for Windows 95/98 and NT4).

4.10 Running a typical model

This section gives instructions for performing a typical model run, including the set-up steps described in the preceding sections.

4.10.1 Summary of preparation required

This section briefly summarises the main steps that have explained in the preceding sections of the tutorial. It begins with loading an original MAP file.

Select *New parameter set from MAP file* from the *File* menu and open the OTTER.MAP file that should be in the TUTORIAL directory. When the dialog box *Suspicious Parameter Set values found* is displayed, check the box labelled 'Don't ask again during this validation (always accept values as they are)' and then click on the *No* button. This will cause the parameter set to be loaded without the user being warned of other suspicious values in the set. During operational use, of course, users will probably want to check such values.

When loading of the MAP file is complete, click the *OK* button on the *Parameter Set Validation* dialog box. Note that this dialog box reminds the user that suspicious data values were seen.

PC-Quasar now asks for a parameter set name. Enter something like 'Otter 1985 Tutorial Dynamic Set 1' and click on the *OK* button . Although it is not absolutely necessary at this stage, it is good practice to save the newly created parameter set before continuing. Use the *File…Save As* command and save the set with a filename such as OTTER.PCQ in the TUTORIAL directory.

From the *Parameters* menu, select *Run Mode*. Ensure that the settings on the displayed dialog box are as follows:

Run Mode = Dynamic

Start Date and Time = 00:00 and 01-JAN-1985

Run Time Step = 240

Output Time Step = 1440

Run Output Length = 50

Observed Solution = Analytical

Edited Solution = Analytical

Correct the values if necessary, and then click on the *OK* button.

From the *Parameters* menu select *Rivers Modelled*. The entire river network needs to be included in this simulation, so click on the "Otter" (if it is not already selected) in the list of rivers, which will cause the model to include the Otter and the Tale (since it flows into the Otter). Click on the *OK* command button.

From the *Parameters* menu, select *Dynamic Parameters*, and then select *River Quality*. Double-click once on each river in turn to set the edited values to ON. Also click on the check box labelled *Use enabled River Quality edits in dynamic mode model runs* so that it is set to ON (i.e., the box is checked). Click on the Set Flags button and then the *Cancel* button to exit (Note: the *Cancel* button does not cancel your settings, it cancels further use of this dialog box).

At this point, save the parameter set so that any following model runs can use these settings. From the *Parameters* menu select *Save*.

4.10.2 Preparing the first model run

As an example to demonstrate a typical method of using the model, the reach rate coefficients for de-nitrification decay will be altered, the simulation will be run, and graphs will be produced.

This section of the tutorial sets up the additional edited parameter values which will be used in the first model run of the tutorial. This involves amending the rate coefficient for de-nitrification for the top two reaches of the Tale.

Select the required reach by selecting *Reach Parameters* from the *Parameters* menu. A dialog box (Figure 4.8) will be displayed showing all of the reaches in the network.

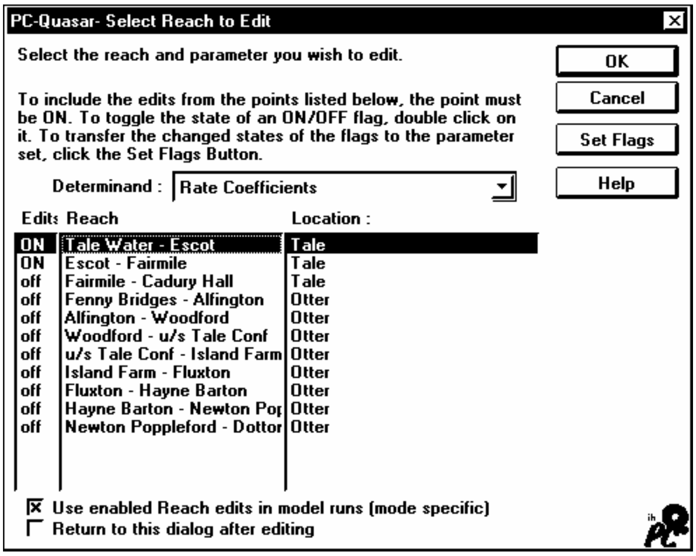

Figure 4.8. Select Reach to Edit

The top two reaches of the Tale are ‘Tale Water - Escot’ and ‘Escot - Fairmile’. Double-click within the ‘Edits’ column on each of these reaches so that the ON/OFF indicator is set to ‘ON’. This will cause the model to use the edited values in addition to the default values for these reaches when the model is run. Notice that all of the reaches can be turned on or off independently.

There is also a check box at the bottom left of the dialog box labelled *Use enabled Reach edits in model runs (mode specific)*. If the check box is checked, PC-Quasar will model edited (and default) values for all of the reaches that have been set to “ON” and default values only for the reaches that are set to “OFF”. If the check box is not checked, click on it once so that the edited values will be used during the simulation. To accept these settings, click on the *Set Flags* button. The checkbox labelled ‘Return to this dialog after editing’ should also be checked.

A drop-down list box allows the user to select the determinand to edit. Make sure that ‘Rate Coefficients’ is selected. Next, double click on the reach name for the ‘Tale Water - Escot’ reach. This will display a dialog box showing the rate coefficients for the selected reach (Figure 4.9).

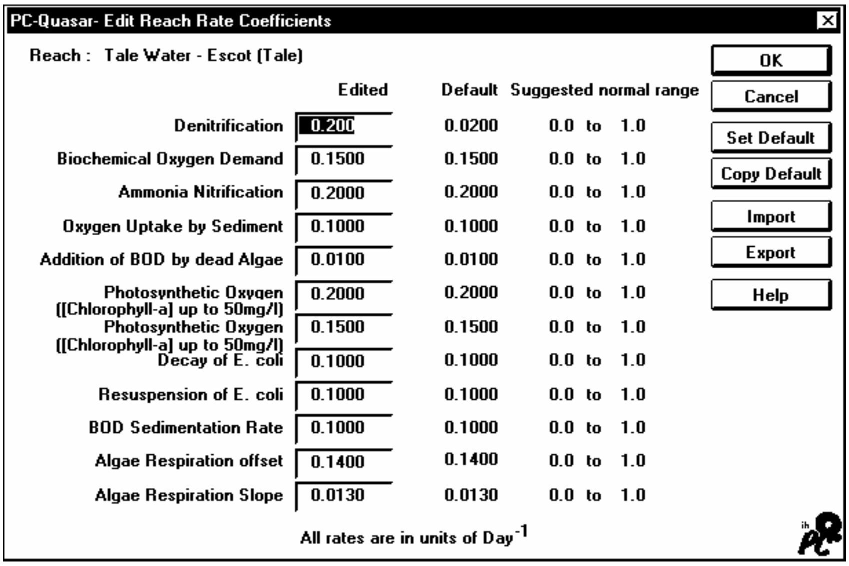

Figure 4.9. Edit Reach Rate Coefficients

Change the coefficient for denitrification from 0.02 to 0.20 (thereby increasing it by a factor of ten) and press <Tab> to enter the new value. Close the rate coefficients window by clicking on the *OK* command button and then close the previous dialog box by clicking on the *OK* command button to return to the list of reaches.

Repeat the same procedure for the next reach, 'Escot - Fairmile', and then click on *OK* to return to the *Select Reach to Edit* dialog box and click on the *Cancel* button.

4.10.3 Running the model

The model can now be run by selecting *Run* from the *Model* menu.

The model automatically runs two passes, first using the observed determinands and then using the edited determinands. The progress of each pass is displayed. The run can be cancelled at any time by clicking on *Cancel*.

4.11 Producing a graph

When the simulation run has finished it will be possible to produce various graphical plots. Graphs are first displayed on the screen and may then be printed to a hard copy device. Only one graph can be displayed at a time.

4.11.1 Displaying a graph on the screen

The *Results* menu (Figure 4.10) displays a list of the types of plot available.

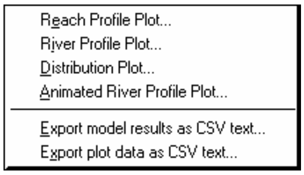

Figure 4.10. Results menu

Choose *Reach Profile Plot* to display a list of the reaches that can be plotted. First select the required reach then select ‘Nitrate’ from the drop-down list of determinands (note the addition of the determinand ‘Un-ionized Ammonia’; this is a determinand which is derived from other processes and it cannot be edited by the user).

Click on the *OK* command button to generate a nitrate time-series plot of observed and edited values for the ‘Tale Water - Escot’ reach as shown in Figure 4.11.

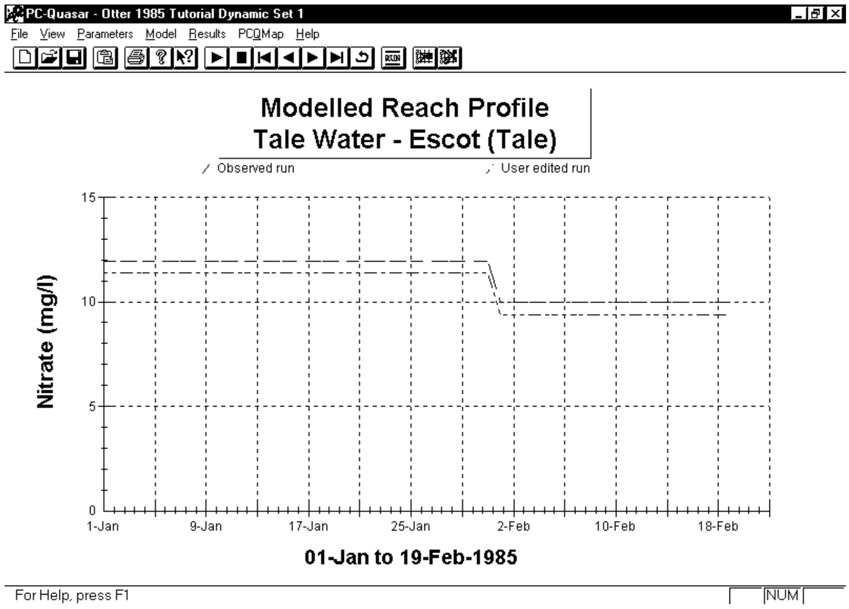

Figure 4.11. Nitrate profile plot for Tale Water - Escot

Repeat the sequence described above to produce graphs for the 'Escot - Fairmile' and also for 'Newton Poppleford - Dotton' reaches (the last reach in the river network). These are shown in Figure 4.12 and Figure 4.13.

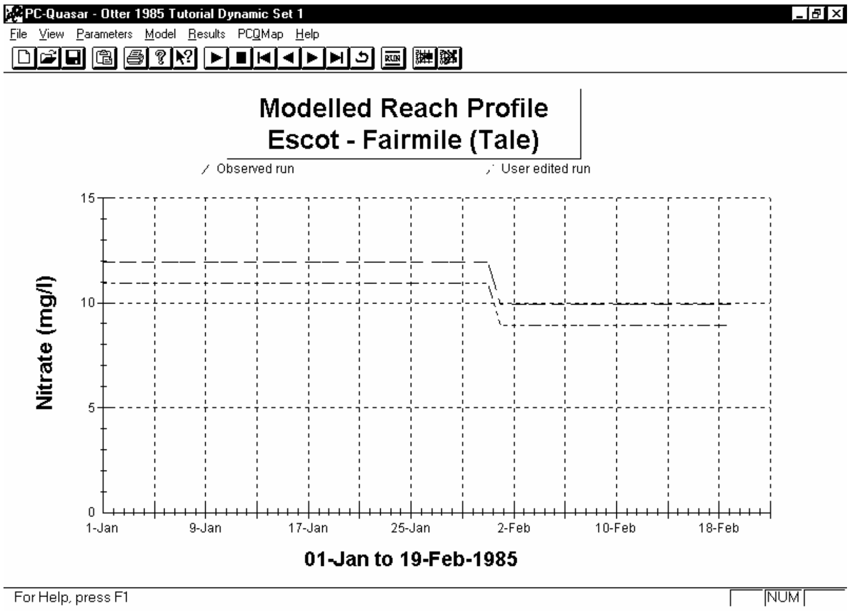

Figure 4.12. Nitrate profile plot for Escot - Fairmile

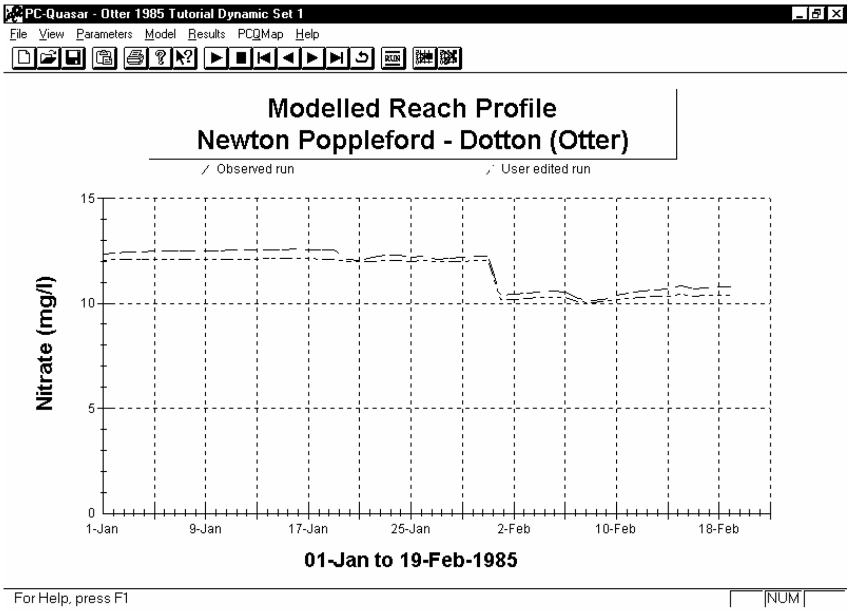

Figure 4.13. Nitrate profile plot for Newton Poppleford - Dotton

Note that each graph produced removes the previous one from the screen.

4.11.2 Printing a graph

To obtain a hard copy of any displayed graph select *Print* from the *File* menu. This should display a dialog box, similar to Figure 4.14, allowing you to specify the printer and printer characteristics to be used. The appearance and details of this dialog box will depend upon what version of Windows is running on the PC and also upon what printers are available. Specify your printer requirements and click on *OK*.

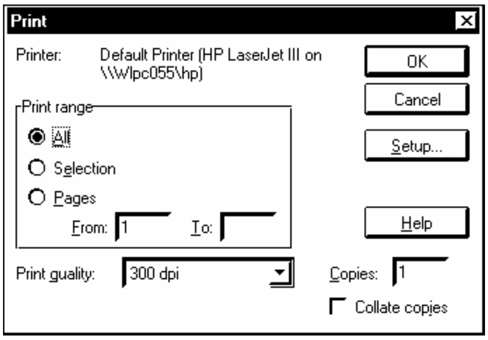

Figure 4.14. Print dialog box

4.11.3 Clearing the graph

To clear the current graph from the screen, choose *Reset graphics server* from the *View* menu, or the equivalent button on the toolbar.

It is not necessary to do this if another plot is to be displayed, as the screen will be cleared automatically.

4.11.4 Finishing the tutorial session

The user can end the tutorial session at this point or after any of the following model runs. Section 4.18 documents the required steps to end the session.

4.12 A model run to show relationships between parameters

This example demonstrates how the model may be used to investigate the inter-relationships, if any, between the model parameters.

The simulation will be run again, this time with an edited coefficient of BOD sedimentation rate.

The simulation mode and the rivers to be included in the run will remain the same as in the previous example and do not need to be reset. Also there is no need to reset the ‘use edited data’ flags for the rivers and reaches to be included in the run. All of these parameter settings will be retained from the previous simulation run and all that needs to be done is to reset the de-nitrification rate to its default value and to edit the BOD sedimentation rate.

Select *Reach Parameters* from the *Parameters* menu, then ‘Rate coefficients’ from the drop-down list of determinands. Highlight the ‘Tale Water - Escot’ reach by clicking on it once and then click on the *OK* command button (double-clicking on the reach name provides a shortcut for these two actions). The same dialog box is displayed that was used in the earlier example to edit the de-nitrification rate. All of the values should be as they were set in the previous example, i.e. with de-nitrification set at 0.20 (instead of the default 0.02) and all other values set to the defaults. Change the de-nitrification value back to the default value (0.02) either by typing the value in or selecting the *Copy Default* button. Increase the BOD sedimentation rate by a factor of five to 0.50. Select the *OK* command button to close the edit dialog box.

Follow the same procedure for the ‘Escot - Fairmile’ reach.

Run the model again and produce reach profile plots for both reaches for biochemical oxygen demand and then for dissolved oxygen. Figure 4.15 shows the biochemical oxygen demand plot for the Tale Water - Escot reach, while Figure 4.16 shows the dissolved oxygen plot for the same reach. Figure 4.17 and Figure 4.18 show the same graphs for the Escot - Fairmile reach.

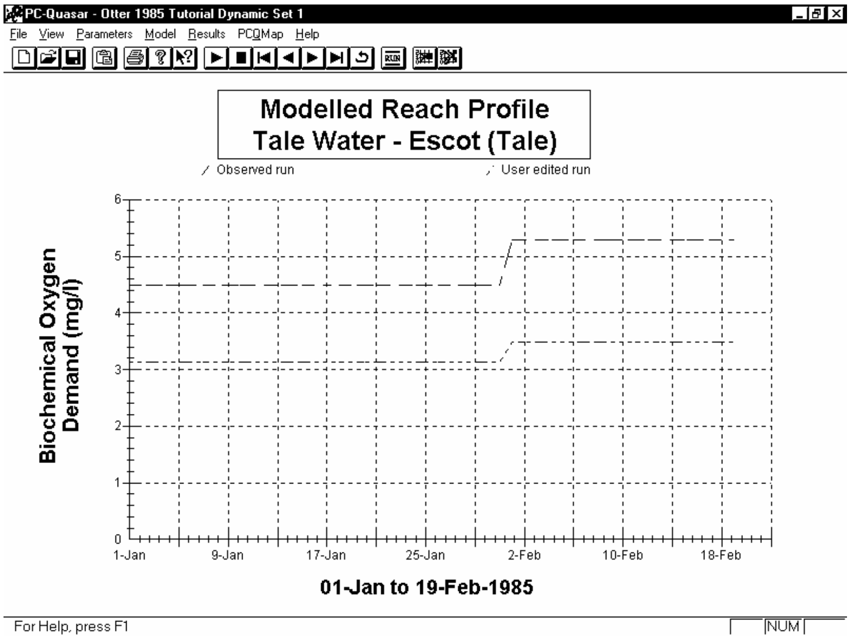

Figure 4.15. Biochemical oxygen demand plot for the Tale Water - Escot reach

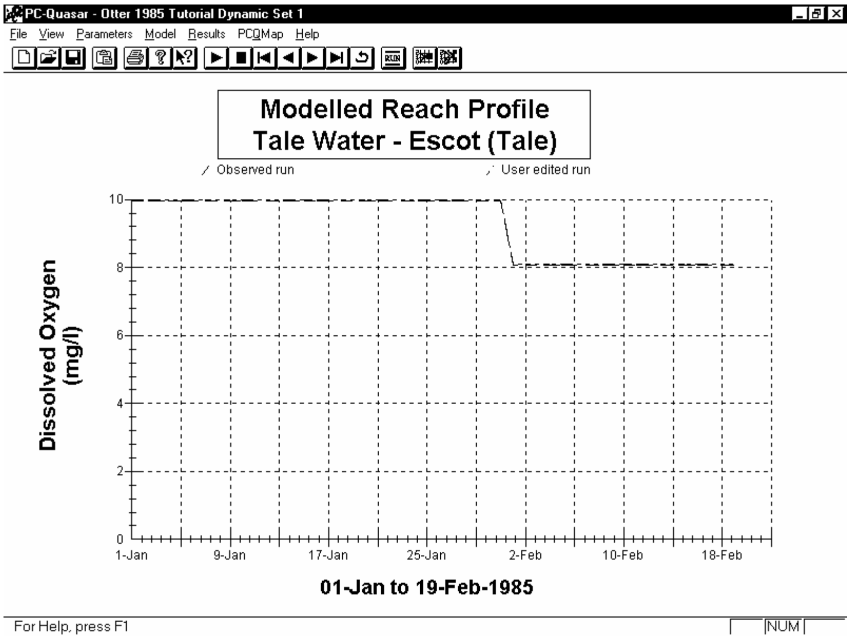

Figure 4.16. Dissolved oxygen plot for the Tale Water - Escot reach

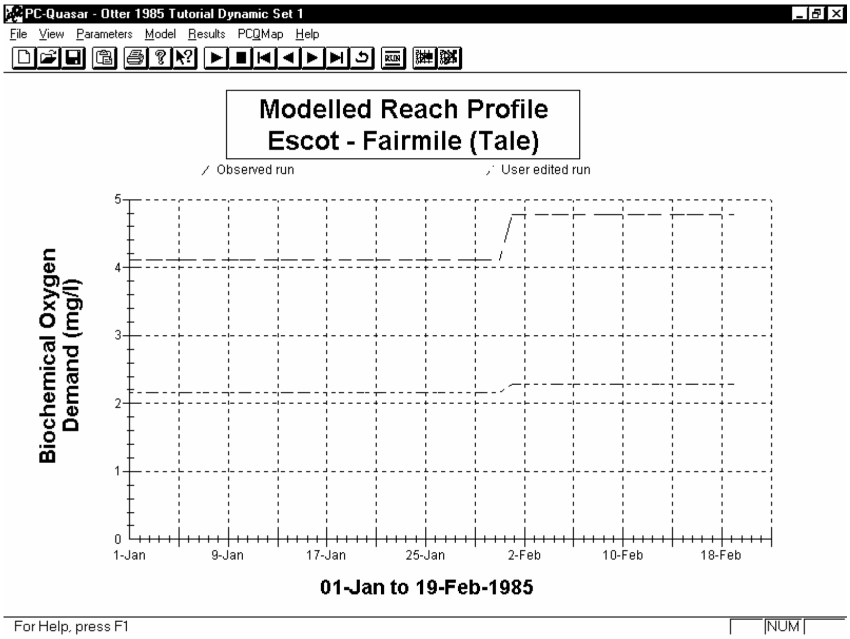

Figure 4.17. Biochemical oxygen demand plot for the Escot - Fairmile reach

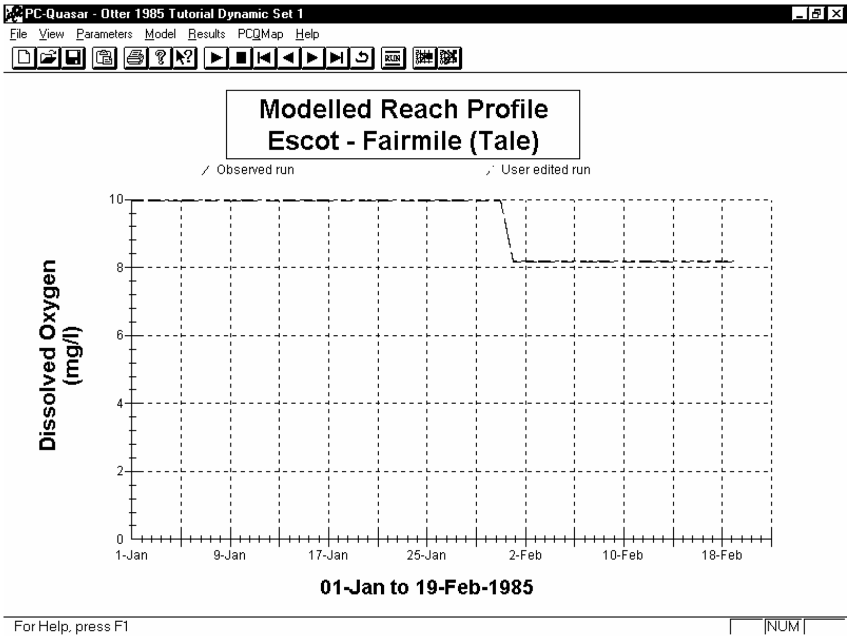

Figure 4.18. Dissolved oxygen plot for the Escot - Fairmile reach

The graphs show that changes in BOD sedimentation rates have had very little effect whatsoever on dissolved oxygen.

However, although dissolved oxygen is unaffected by changes in the BOD sedimentation rate, it is affected by changes in the BOD decay rate as the next example will show.

Select *Reset Graphics* from the *View* menu to clear the last graph from the screen.

4.13 A model run showing parameter interaction

This example demonstrates how the PC-Quasar model reflects any changes in dissolved oxygen caused by alterations in the BOD decay rate.

The simulation mode and the rivers to be included in the run will remain the same as for the previous examples and do not need to be reset. Also there is no need to reset the 'use edited data' flags for the rivers and reaches to be included in the run. All of these parameter settings will be retained from the previous simulation run and all that needs to be done is to reset the rate coefficients to their default values and to edit the Biochemical Oxygen Demand decay rate.

Select *Reach Parameter* from the *Parameters* menu. Select the ‘Tale Water - Escot’ reach from the list box and ‘Rate coefficients’ from the drop-down list of determinands. Click on the *OK* button to display the same dialog box that was used in the previous two examples to edit the rate coefficients for de-nitrification and BOD sedimentation. This time, instead of re-typing the original values, click on the *Copy Default* command button to reset all of the values to their defaults, selecting *Yes* when prompted for confirmation. Increase the Biochemical Oxygen Demand Decay rate from its default value of 0.15 to 0.375 (i.e. by a factor of 2.5). Select the *OK* command button to close the edit dialog box.

Follow the same procedure for the ‘Escot - Fairmile’ reach, then run the model and produce graphs for both reaches for dissolved oxygen. Note that the edited values show a small but noticeable decrease in dissolved oxygen.

Figure 4.19 shows the dissolved oxygen plot for the Tale Water - Escot reach, while Figure 4.20 shows the dissolved oxygen plot for the 'Escot - Fairmile' reach.

Select *Reset Graphics Server* from the *View* menu (or use the toolbar button) to clear the last graph from the screen.

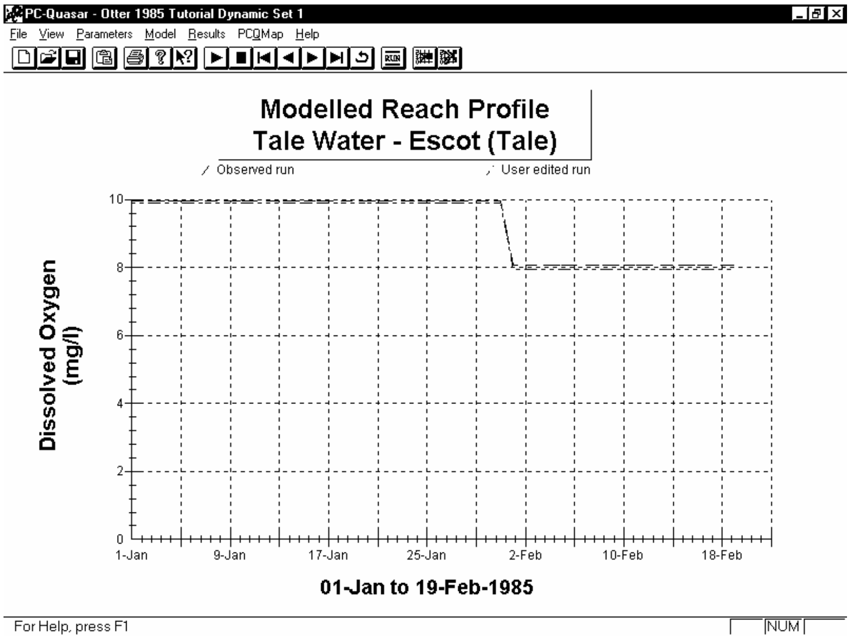

Figure 4.19. Dissolved Oxygen plot for Tale Water - Escot

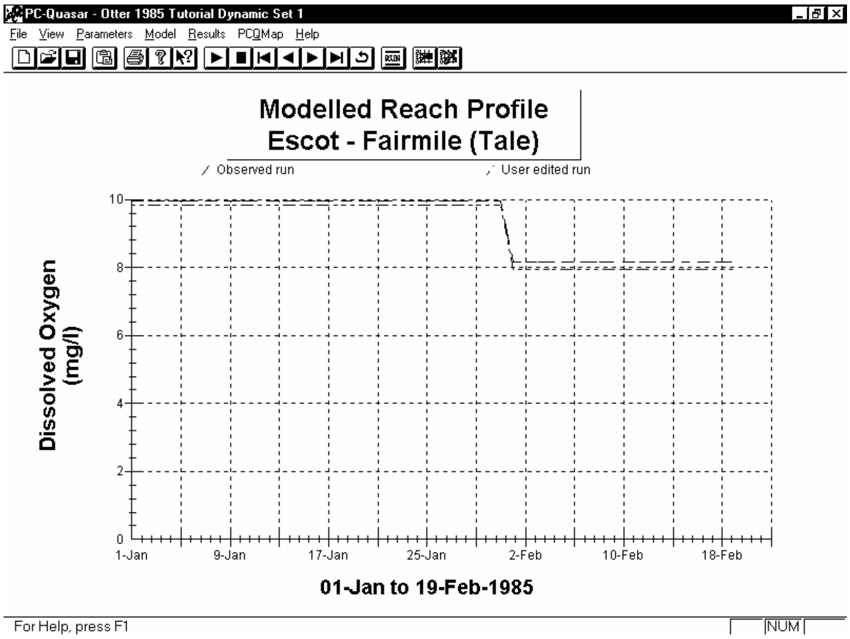

Figure 4.20. Dissolved Oxygen plot for Escot - Fairmile

4.14 A model run showing a weir

4.14.1 A quick way to restore default values

In the last example the coefficient rate of Biochemical Oxygen Demand Decay was edited for two of the reaches on the river Tale and it will be necessary to reset these to the default values. It is possible to do this by calling up the *Edit Reach Rate Coefficients* dialog box for both reaches in turn and then amending the previously changed values (or by using the *Copy Default* button). This, however, could be a time-consuming procedure if more complex parameter editing had taken place. An easier way to reset parameter values to their defaults is to close the current parameter set (assuming it has not been saved) and then to re-open the previously saved version.

To do this, select *Close* from the *File* menu, selecting *No* when prompted to save the parameter set. Then choose *Open* from the *File* menu, select the 'OTTER.PCQ file and click on *OK*.

4.14.2 Editing the weir specifications

This example is designed to demonstrate the effect on dissolved oxygen caused by adding a weir to a reach.

From the *Parameters* menu select *Reach Parameter* to display a list of reaches. Set the *Use enabled Reach edits in model runs* check box to *ON*, so that the values subsequently set at reach level will be used in the model run.

Double-click on the 'Edits' column next to the reach named 'Woodford - u/sTale Conf' to toggle the 'use edits flag' to ON. Select *'Weir specifications'* from the drop-down list box of determinands. Click o the *Set Flags* button to activate the edited data during the model run. Click on the *OK* button to show the dialog box used for editing of weir types and heights.

The 'Default' column should display 'None', showing that there are no weirs on this reach in the default data.

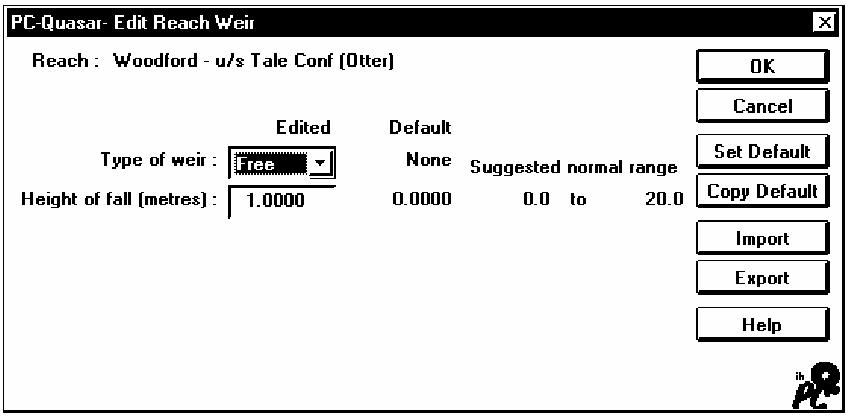

Figure 4.21. Edit Weir Type and Height

Select the *'Free'* type of weir from the drop-down list labelled 'Type of Weir'. Eter the height of the fall as 1 meter. Click on *OK* to exit from this dialog box, run the model and then produce a reach profile plot of dissolved oxygen for the 'Woodford - u/s Tale Conf' reach. (See Figure 4.23.) Observe the change in dissolved oxygen caused by the addition of the weir.

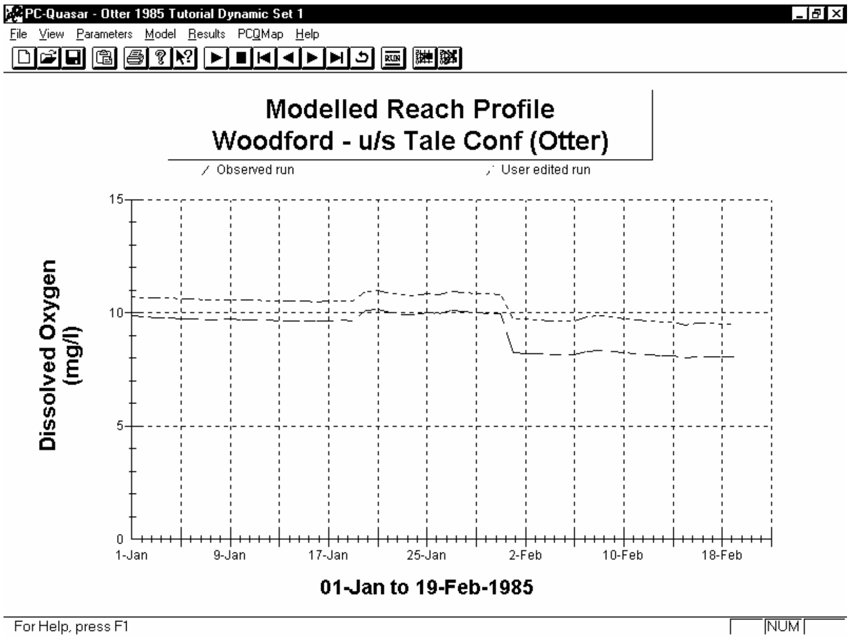

Figure 4.22. Dissolved Oxygen plot for 'Woodford - u/s Tale Conf'

The exercise can be repeated using different types of weir and fall heights. Remember to remove the weir from the reach (by selecting *None* from the drop-down list) and turning off the edits column for the 'Woodford -u/s Tale Conf' reach before moving on to the next exercise.

4.15 A model run exploring the effects of algae

This example looks at the effects on dissolved oxygen of increased algae in the lower two reaches of the Otter.

From the *Parameters* menu select *Reach Parameter*. Double-click on the 'Edits' column for the 'Hayne Barton - Newton Poppleford' reach to switch use of edited values to 'ON'. Select *Monthly Algae Data* from the drop-down list of determinands and click on the *Set Flags* button and then the *OK* button. Increase Chlorophyll-a to a value of 200 mg/l for January, February and March. Repeat this procedure for the 'Newton Poppleford - Dotton' reach. Run the model, and plot dissolved oxygen output for the both reaches. Figure 4.23 and Figure 4.24 show the expected output.

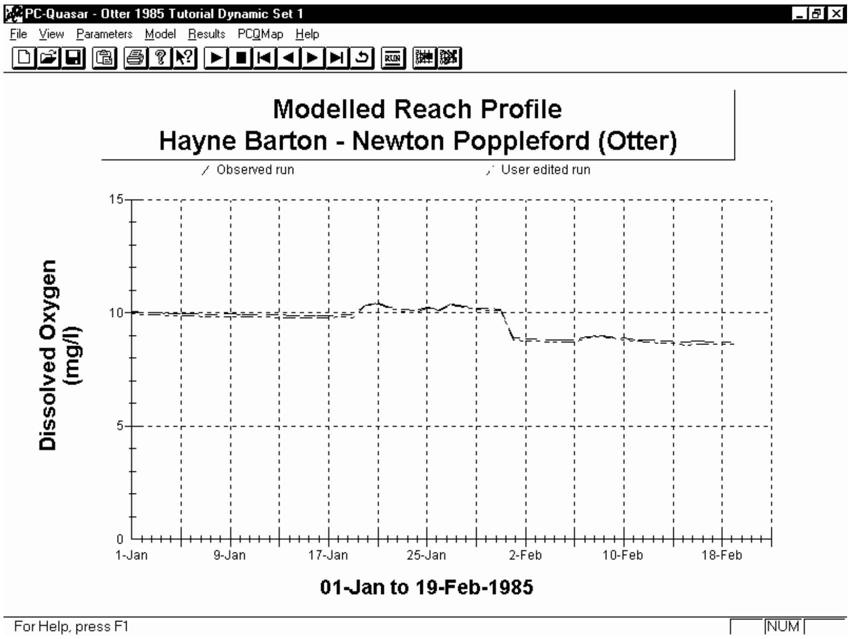

Figure 4.23. Dissolved Oxygen plot for 'Hayne Barton - Newton Poppleford'

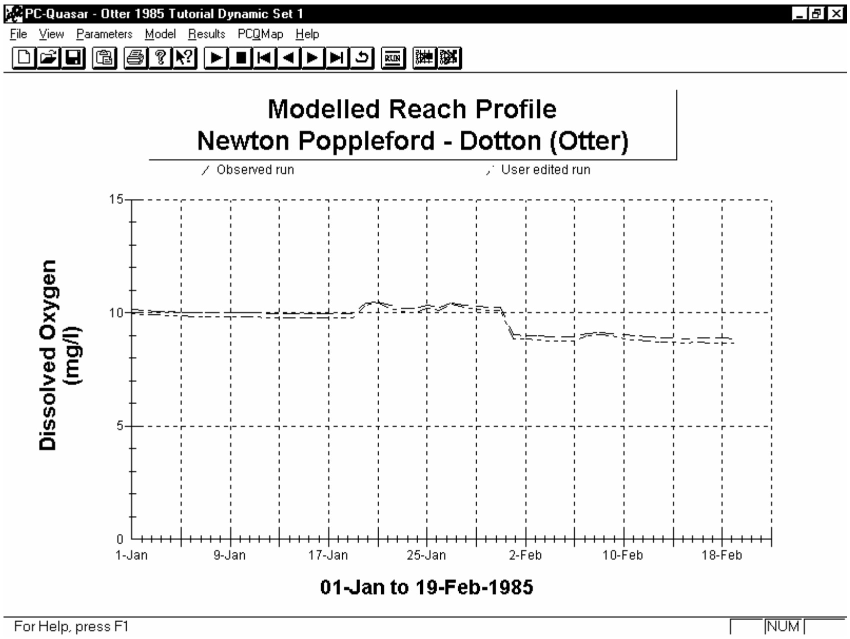

Figure 4.24. Dissolved Oxygen plot for 'Newton Poppleford - Dotton'

Repeat the run with the output time step amended to 240 minutes (4 hours) and amend the run length to 300 (i.e. 300 x 4 hours = 50 days). This is done through the *Edit Parameter Set* sub-menu, *Mode Select* option. Plot dissolved oxygen again for the lowest two reaches and observe the variation. The diurnal dissolved oxygen change caused by the presence of the algae can now be seen. The resulting plots are shown in Figure 4.25 and Figure 4.26.

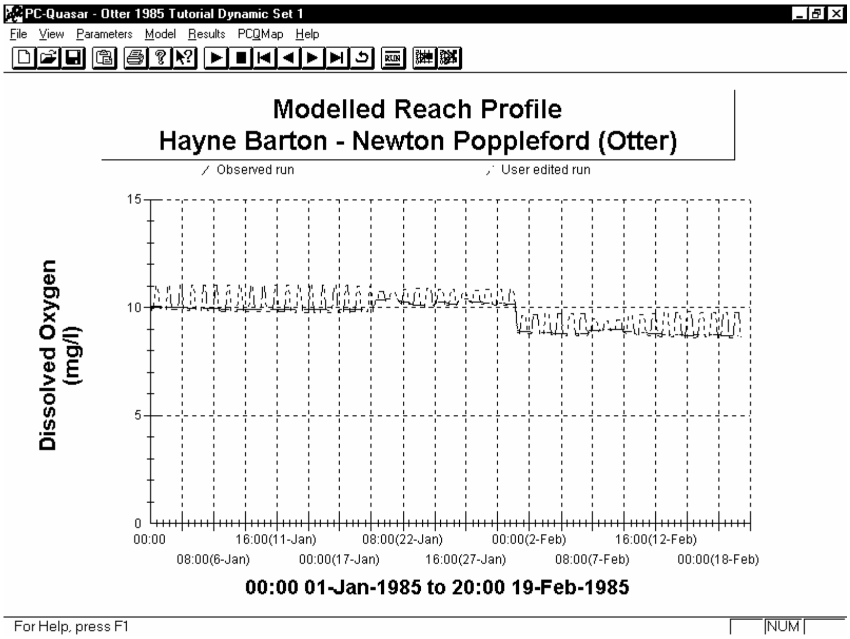

Figure 4.25. Dissolved Oxygen plot for 'Hayne Barton - Newton Poppleford' using different output time step

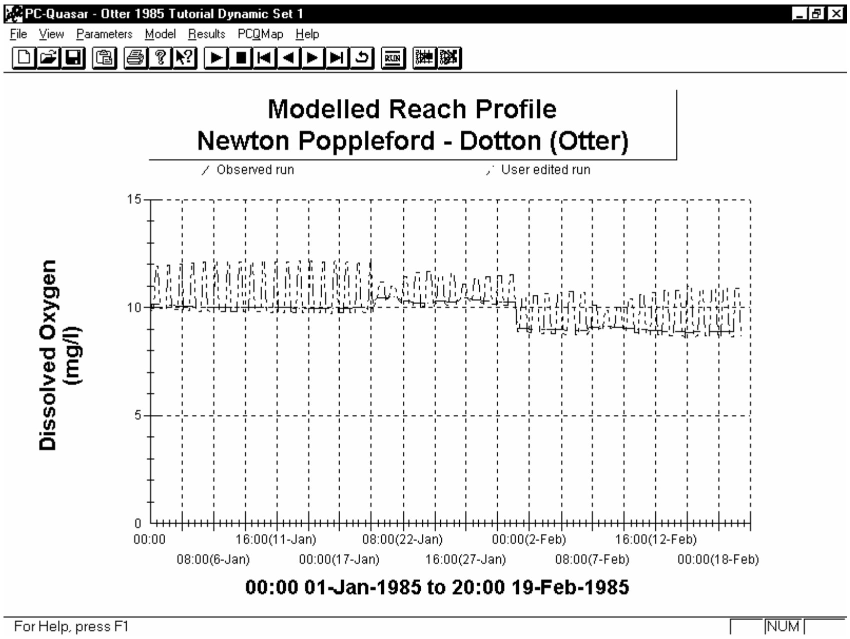

Figure 4.26. Dissolved Oxygen plot for 'Newton Poppleford - Dotton' using different output time step

4.16 Run using Impulses

This example looks at modelling an impulse; in this case the failure of a slurry lagoon, causing high Biochemical Oxygen Demand, nitrate and ammonia levels for a short time.

Firstly, the values entered in the previous section of the tutorial need to be reset. Do this by closing the parameter set (selecting *No* when prompted to save the parameter set) and then re-opening it.

From the *Parameters* menu, select *Run Mode.* Alter the run time step and output time step from the previous value to 60 minutes. This is necessary because of the relatively short duration of the impulse (8 hours) such that the effects of the impulse can be seen in the output. Also amend the run output length to 100, so as to focus more on the time period immediately following the impulse event.

From the *Parameters* menu, select *Dynamic Parameters*, and then *Edit/Create Impulses*. This displays a list of any existing impulses (none in this case) as shown in Figure 4.27.

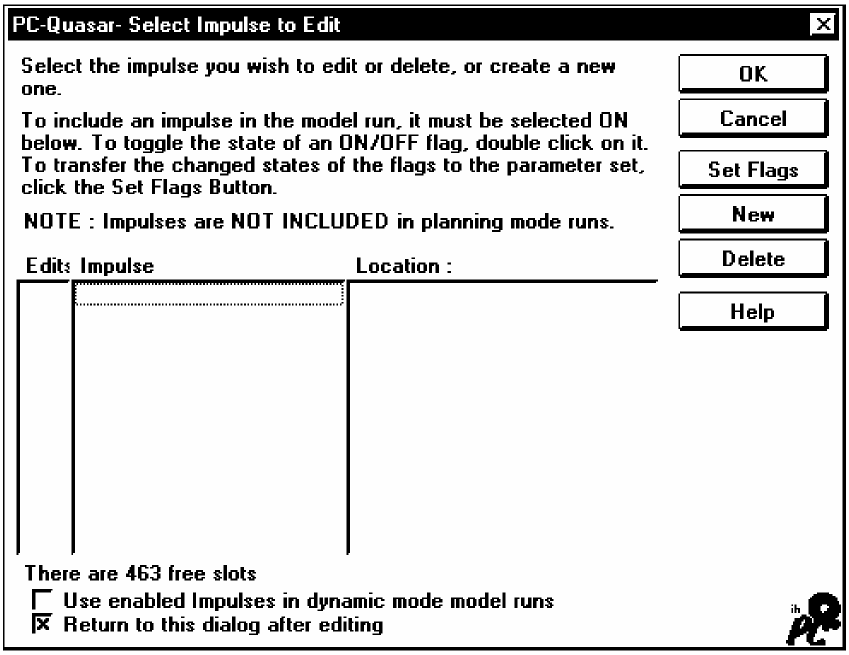

Figure 4.27. Select Impulses to Edit

Set the check box, *Use enabled impulses in dynamic mode model runs*, to ‘ON’. Click on the *New* command button to display a dialog box (Figure 4.28) in which details of the impulse may be entered.

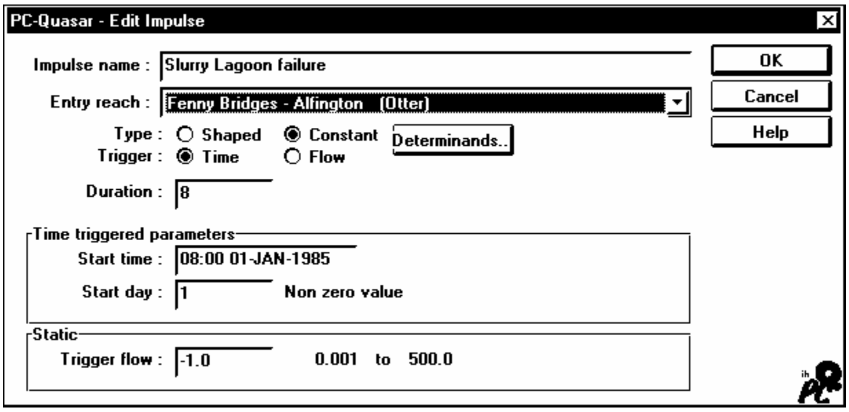

Figure 4.28. Edit Impulse Parameters for Slurry Lagoon Failure

Enter the impulse name 'Slurry Lagoon Failure' and select 'Fenny Bridges - Alfington (Otter)' as the entry reach. A group of radio buttons allow the impulse type and trigger to be set. Set the type to 'Constant' and the trigger to 'Time'. Specify *Duration* as '8' (meaning 8 hours, as the time-step is set as 60 minutes), *Start time* as '08:00' and *Start day* as '1'. Now click on the *Determinands* command button to display a dialog box (Figure 4.29) into which the required determinand values can be entered.

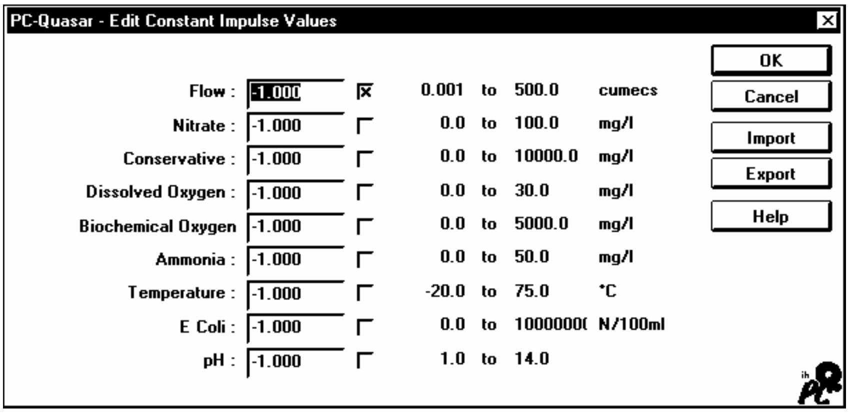

Figure 4.29. Edit Constant Impulse Values

Set *Flow* to '0.1' cumecs, *Nitrate* to '100' mg/l and *Biochemical Oxygen Demand* to '1000' mg/l ensuring that the check boxes beside each of these three determinands are checked. Determinands that do not have the boxes checked will not be used as impulse variables during the model run. Click on *OK* to return to the previous dialog box and on *OK* again to return to the 'Select Impulse to Edit' dialog box. Here you must double-click on the 'Edits' column to activate inclusion of the edits in the model run. Finally, click on the *Set Flags* and then on the *Cancel* buttons to return to the main menu.

Run the model and produce reach profile plots of BOD, nitrate and dissolved oxygen for the reach. These are shown in Figure 4.30-Figure 4.32. Note the increased nitrate and decreased dissolved oxygen values.

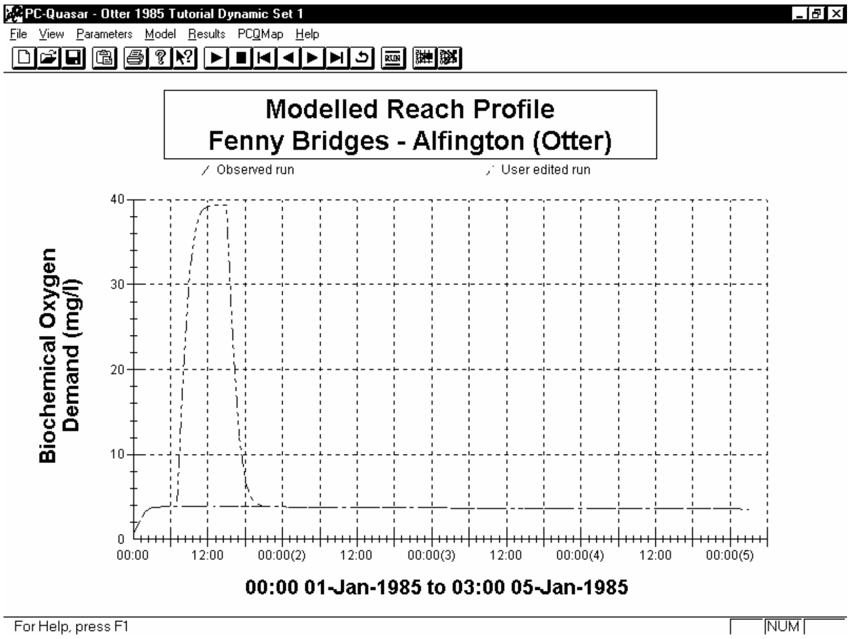

Figure 4.30. BOD plot for Fenny Bridges - Alfington

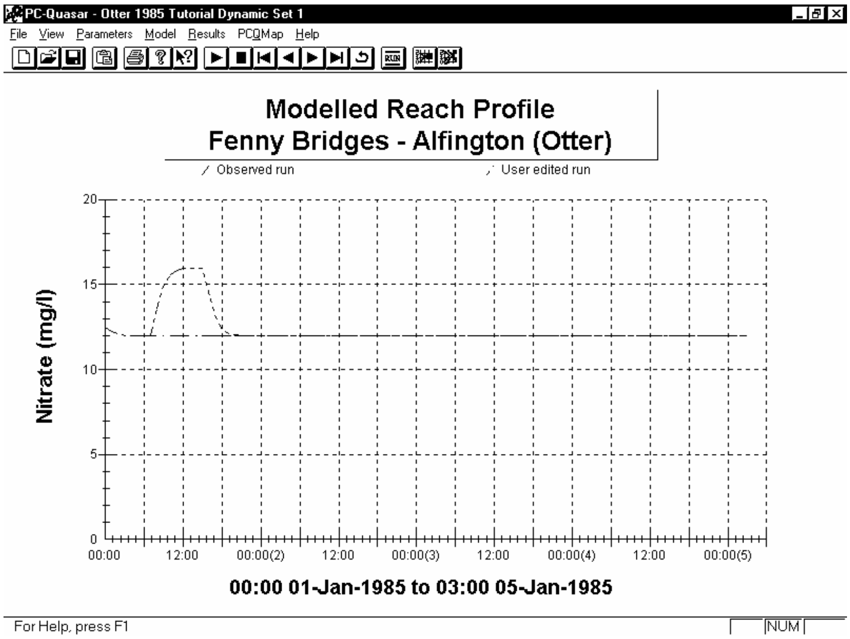

Figure 4.31. Nitrate plot for Fenny Bridges - Alfington

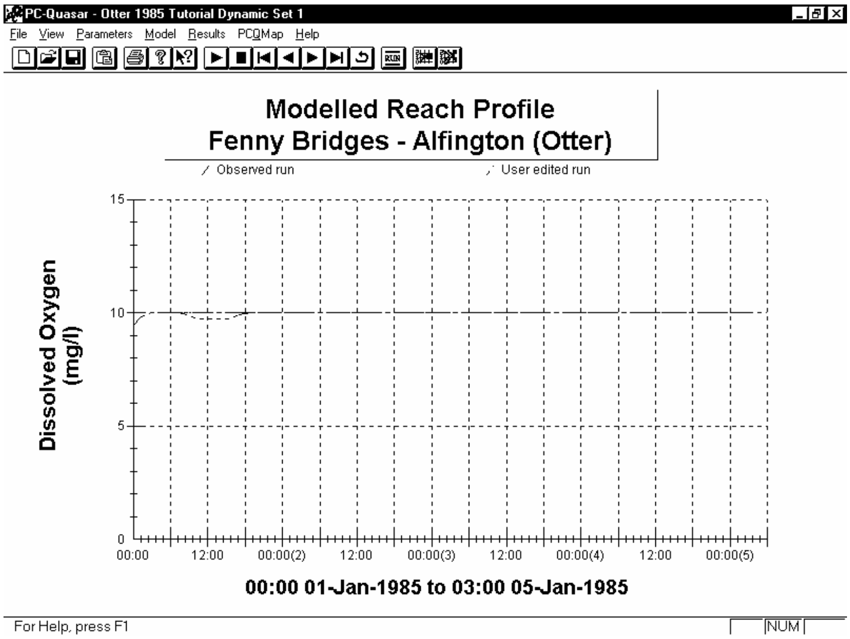

Figure 4.32. Dissolved Oxygen plot for Fenny Bridges - Alfington

4.17 Run using planning mode

The example to be used for demonstrating PC-Quasar in planning mode, is that of an application to increase the discharge from the sewage treatment works (STW) on the 'Hayne Barton - Newton Poppleford' reach by 50%.

The first step is to set up the relevant basic data for the river(s) to be modelled and for the STW. (In this case, flow, nitrate, BOD and ammonia would be the relevant factors.) This data can be obtained from PC-Quasar when in dynamic mode. The model can then be run to provide the data against which the proposed change can be compared. The second step will then be to change the parameters relating to the STW and re-run the model to demonstrate the effects of the change.

Note that any dynamic mode boundary data which exist (either default or edited) will have no effect on a planning mode run and there is no need to reset these values before starting this section of the tutorial. However, values for reach parameters are used in planning mode to govern whether edited <u>or</u> default data (but not both) are used in the model run.

Select *Run Mode* from the *Parameters* menu and use the radio buttons to change the Run Mode to 'Planning' (see Figure 4.2). Click on the *OK* button to confirm this.

From the *Parameter set* menu, select *Planning Parameters* and then *River Quality* to display a list of rivers (as shown in Figure 4.33). Select the 'Otter' and click on the *OK* command button. This will display a further dialog box (Figure 4.34). Note that the values supplied are standard defaults, provided by PC-Quasar, and are not based upon the values held in the map file.

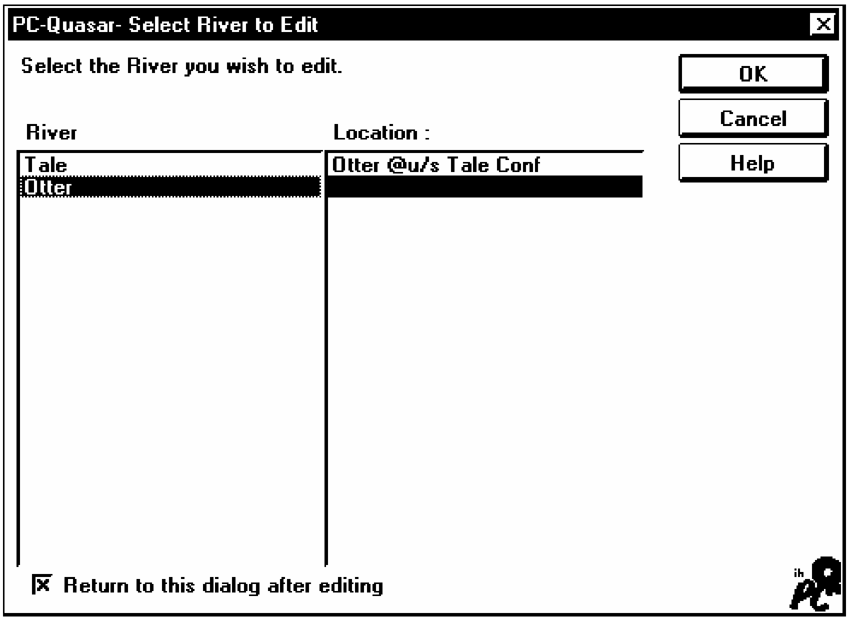

Figure 4.33. Planning Distributions

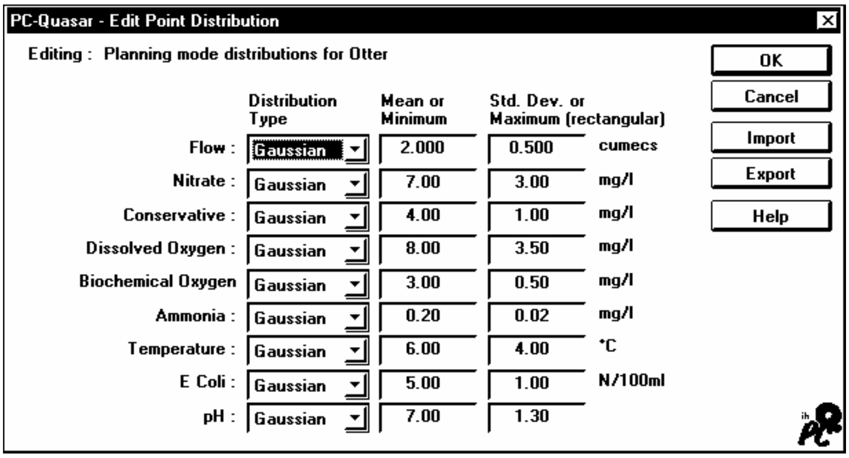

Figure 4.34. Edit Planning Distributions

Using the drop-down list box next to the determinand 'Flow', select *Lognormal* and then enter the *Mean* value as '8' and the value for *Std. Dev.* as '6'.

Repeat this procedure until all of the following values have been set up for the Otter.

	Distribution	Mean	Standard Deviation
Nitrate	Gaussian	8	4
BOD	Gaussian	7	3
Ammonia	Gaussian	0.5	0.2

Now repeat the procedure to set up the values for the Tale:

	Distribution	Mean	Standard Deviation
Flow	Log Normal	0.8	0.5
Nitrate	Gaussian	10	4
Biochemical Oxygen	Gaussian	7	3
Ammonia	Gaussian	0.5	0.2

From the *Parameters* select *Planning Parameters* then *Direct Discharges* and follow a very similar procedure to set up the values for the Test STW.

	Distribution	Mean	Standard Deviation
Flow	Gaussian	0.2	0.03
Nitrate	Gaussian	30	10
BOD	Gaussian	20	8
Ammonia	Gaussian	2.0	1.0

Now run the model. Once the run is complete, select the *Distribution plot* option from the *Results* menu. Select, from the new dialog box, the determinand 'Biochemical Oxygen Demand' (from the drop-down list box) and the reach 'Hayne Barton - Newton Poppleford'. Click on *OK* to display a dialog box listing some standard statistics about the predicted flow values for the reach (Figure 4.35).

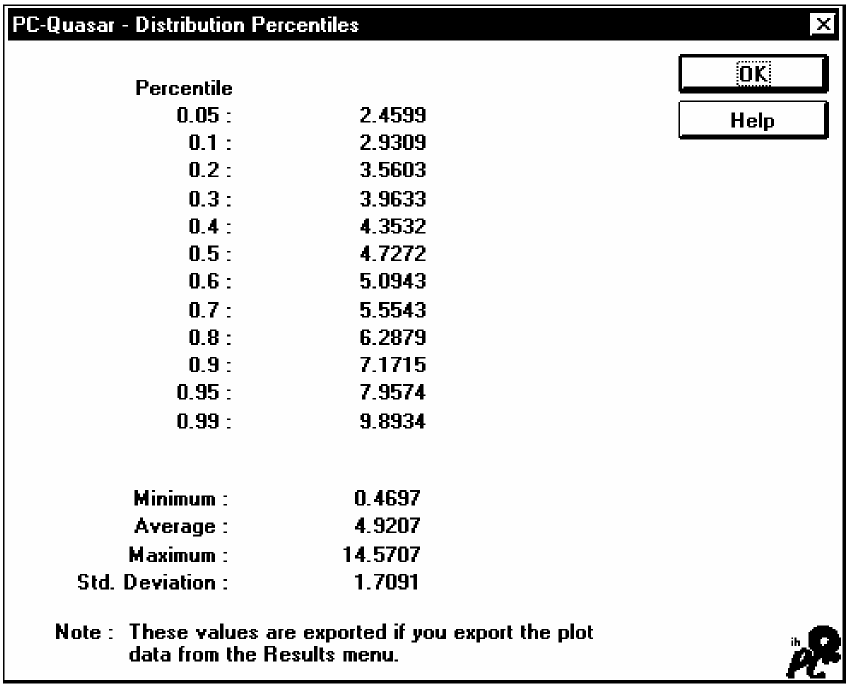

Figure 4.35. Statistics for Biochemical Oxygen Demand

Now click on the *OK* button to close the dialog and reveal a combined Frequency Distribution and Cumulative plot for BOD values (Figure 4.36).

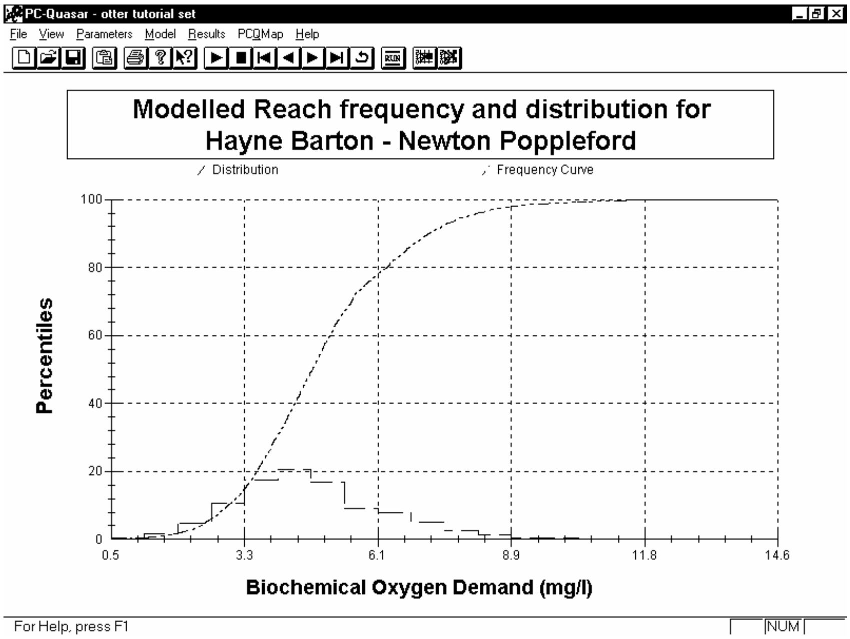

Figure 4.36. Cumulative and distribution plot for BOD

Follow the same procedure to produce statistics and plots for nitrate, flow and dissolved oxygen.

Having obtained the base data, the planned changes to the STW effluent can be now be input and modelled.

Using the *Direct Discharges* option from the *Edit Parameter Set* sub-menu, amend the values for the flow parameter for the STW to:

Mean 0.4

Re-run the model and produce revised statistics and plots for flow, nitrate, BOD and dissolved oxygen. The revised statistics and plots for BOD are provided as Figure 4.37 and Figure 4.38.

The "before" and "after" figures provided by the statistics and plots for BOD and the other parameters can then be assessed to determine whether the change in river quality caused by the increased effluent would be acceptable or whether additional treatment of the effluent would be required before it could be discharged.

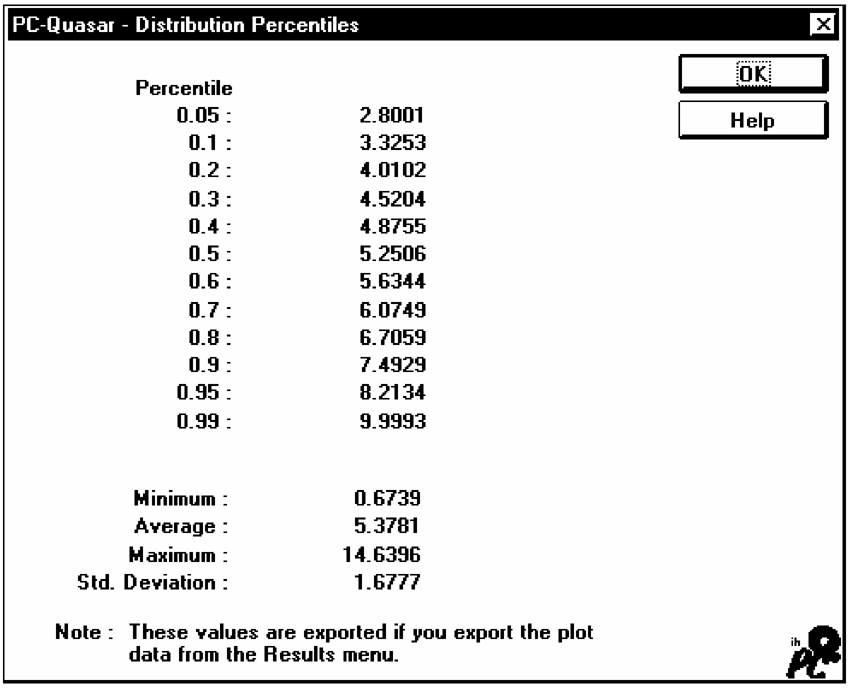

Figure 4.37. Statistics for BOD

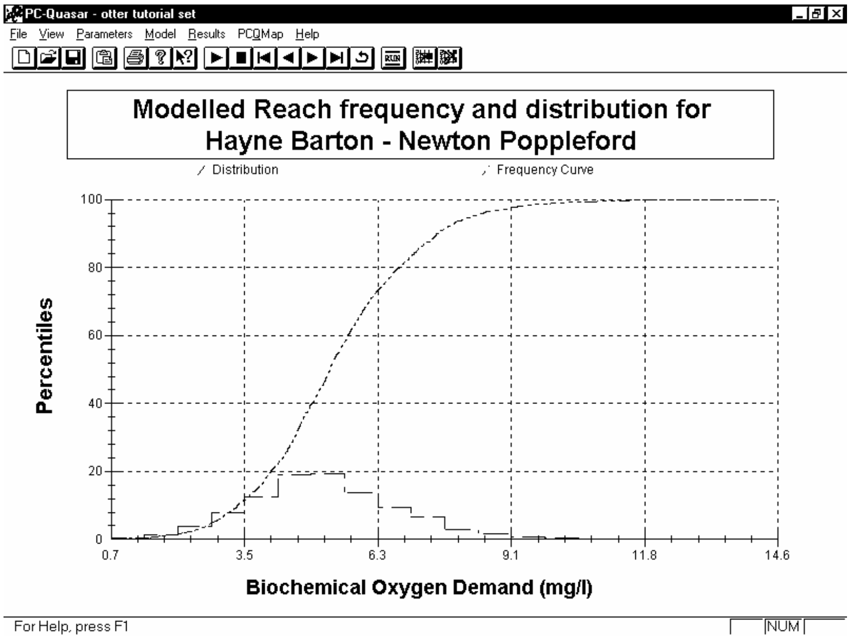

Figure 4.38. Cumulative & distribution plot for BOD.

4.18 Ending the PC-Quasar session

To terminate PC-Quasar simply select *Exit* from the *File* menu. The user will be reminded if any edited data has not been saved and may choose to save the parameter set or not as required. It is possible that the Graphics Server may remain loaded. This can be safely ignored.

4.19 Re-running the tutorial

Assuming that the tutorial has been carried out up to and including section 4.10 the parameter set 'Otter 1985 Dynamic Tutorial Set 1' should have been saved with the basic settings required for the tutorial. Thus PC-Quasar can be re-loaded, the parameter set re-opened and any of the model runs described in sections 4.10.1 to 4.17 carried out.

5. On-line documentation

Using the Microsoft Windows Help application, PC-Quasar provides on-screen documentation for every function within the package. This help file is intended to supplement the information contained in this User Guide.

You can re-size, move, tile, or cascade the Help window and the PC-Quasar window so that you can keep both of them displayed.

5.1 The Help command on the main menu

One of the main menu options is *Help* and this has three sub-commands, *Contents*, *Using Help* and *About PC-Quasar*, each of which is described below.

5.1.1 Contents

This option on the *Help* menu opens the PC-Quasar help file and displays the table of contents. Any highlighted item may be selected and will display further relevant help information. Alternatively the help *Index* may be searched for a particular keyword.

5.1.2 Using Help

This option provides standard Windows information on how to use the help system.

5.1.3 About PC-Quasar

This option on the *Help* menu displays a PC-Quasar copyright notice and the program version number.

5.2 The Help pointer.

One of the tool bar buttons is the help pointer (the button with the arrow and the question mark). This can be used to explore the features of the PC-Quasar main window. First, click on the help pointer button (the mouse cursor changes its appearance) and then on any feature of interest within the PC-Quasar main window. This will open a window displaying the relevant topic from the PC-Quasar help file.

5.3 Context-sensitive help

Most of the dialog boxes within PC-Quasar have a *Help* button that can be selected to display the appropriate topic from the help file. It is also possible to use the **F1** function key to call context-sensitive help at any stage of operations.

6. The PCQMAP Utility

6.1 Overview of PCQMAP

PCQMAP is a utility for creating and editing the ASCII map files that are required by PC-Quasar when creating new parameter sets. PCQMAP enables the description of the river system and its inputs and outputs, whilst constructing a map file. The format of map files is both complex and precise. Hence it is usually preferable to use PCQMAP, a screen-based utility, rather than a word processing package or text editor. The full specification for map file layouts is provided in section 11 for reference. PCQMAP can be run directly, by selecting the appropriate icon from the Windows Program Manager, or from within PC-Quasar by choosing the PCQMAP option from the main menu.

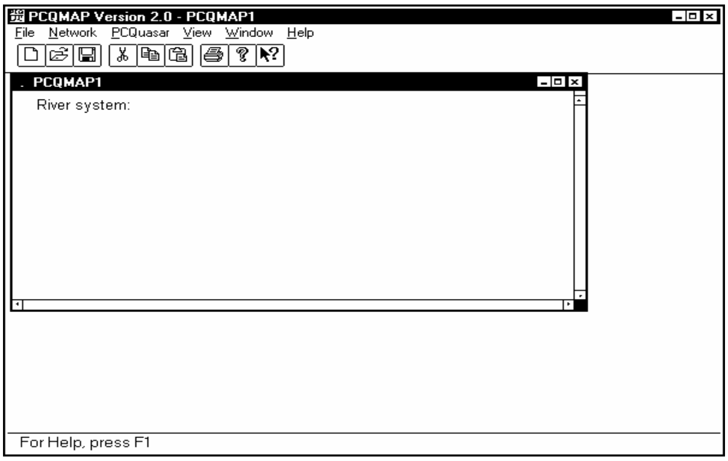

Figure 6.1 PCQMAP opening window

The opening window of PCQMAP is shown in Figure 6.1. The main menu along the top of the window offers six options. Beneath the main menu is a toolbar with nine icons providing short-cuts to some of the menu choices. A status bar is displayed at the bottom of the main PCQMAP window. The main part of the window area, below the toolbar, contains a document window displaying brief details about the map currently being defined. The main menu, toolbar, status bar and document window are described in the following sections.

6.2 Steps involved in setting up a river network using PCQMAP

In broad outline, the following are the steps necessary to create a new map file:

1. Define the name of the network and each of the rivers included (using the *System* option from the *Network* menu*).*

2. Divide the rivers into appropriate modelling units and define the boundary conditions, the inputs to and the outputs from the river (using the *Reaches* option).

3. Define the connections of rivers (through the *Connectivity* option).

4. Save the map file and proceed to PC-Quasar to convert the newly created map file to a parameter set for modelling use.

6.3 The PCQMAP main menu

All of the PCQMAP functions may be accessed from the main menu. Selecting any of the main menu choices causes drop-down sub-menus to be displayed.

6.3.1 The File menu

The *File* menu (Figure 6.2) allows creation of new map files and editing of existing ones. It also allows the files to be printed to a hard copy device. Each of the available sub-menu choices is described below:

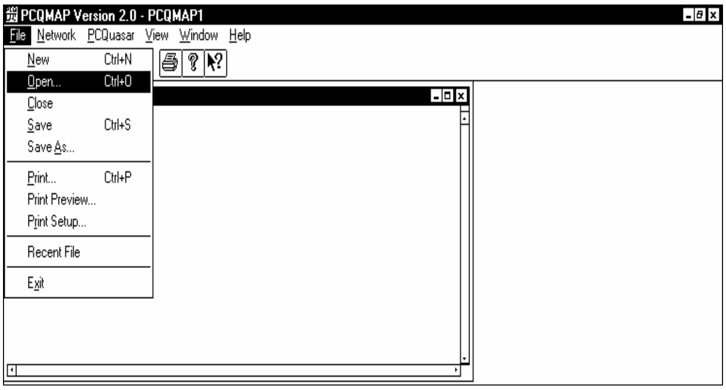

Figure 6.2 The PCQMAP file menu

New. This option opens a new document window ready for the creation of a map file. When PCQMAP is first started, a document window labelled 'PCQMap1' will be displayed. 'PCQMap1' is the default name for the first new document opened. Several document windows may be open simultaneously. The limit to the number of documents that can be open at any one time is dependent on the available memory of the computer. Only one document window (and hence one map file) may be active at a time. The title bar of the currently active document window will be highlighted.

Open. This option displays a file selection dialog box similar to the one shown in Figure 6.3.

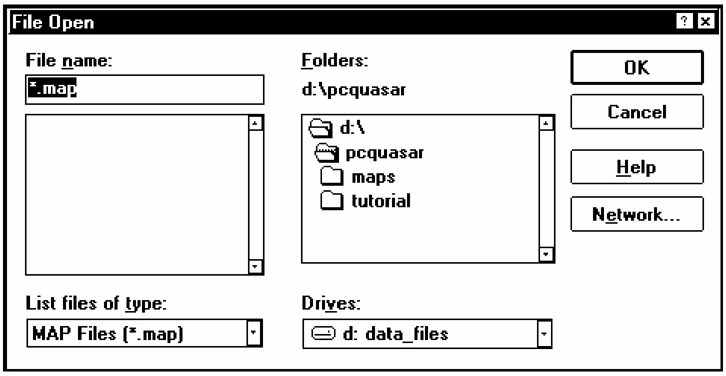

Figure 6.3 File Open Dialog Box

The file dialog box allows the selection of a drive, directory and file name. The file type defaults to .MAP. Open the selected file by clicking on the *OK* command button. (To abort the procedure, use the *Cancel* command button.) The selected map file is then displayed as a schematic network map (Figure 6.4).

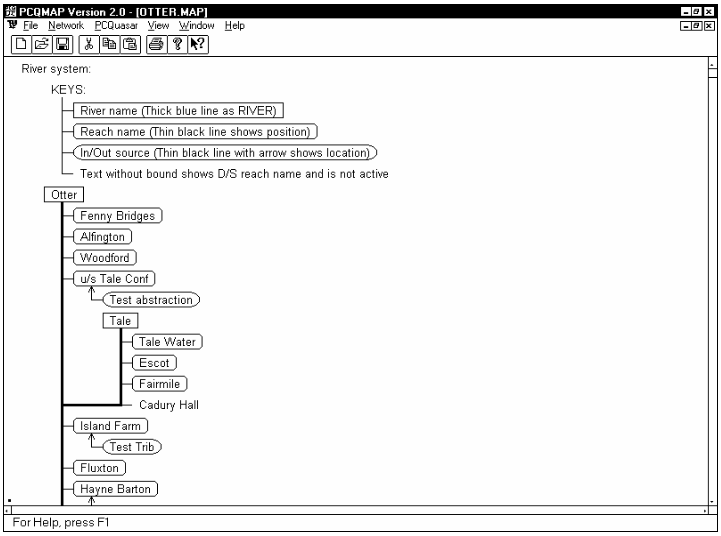

Figure 6.4 PCQMAP schematic network map

Close. Use this option to close open document windows and their associated map files. If more than one document window is open, only the currently active one is closed. If the file has not already been saved, PCQMAP prompts the user to do so.

Save. Selecting this option will cause the active map file to be saved in the current directory using the title displayed in the title bar of the document window. To save the map file under a different name, or in a different directory, use the *Save As* menu option instead.

Save As. This menu option displays a file dialog box allowing the active file to be saved with the required name in a chosen directory. The dialog box is similar to the one shown in Figure 6.3. When it appears, any files in the current directory will be displayed ‘greyed out’. To use one of these names select it from the list box by clicking on it once. The directory or drive to save the file in can be selected from the appropriate list boxes. PCQMAP prompts for confirmation before overwriting an existing file. On most occasions, however, a new name will be assigned to the map file by typing directly into the *File Name* text box. The file is saved when the *OK* command button is selected. To abort the save procedure, use the *Cancel* command button.

Print Preview. This option provides an indication of the layout if a print is produced. The top of the window has a number of command buttons allowing the user to page backwards and forwards and to zoom in and out. *Close* returns the user to the document window and *Print* displays the standard print dialog box.

Print. Selecting this option displays a standard Windows 'Print' dialog box. The *Print* menu option allows hard copy of the currently active document window to be produced. It also provides access, via a *Set up* command button to printer selection and set-up options.

Print Set-up. This option allows selection of a default printer and printer set-up options.

Recent files. This area of the *File* menu will usually display the titles of the last four document windows open, with the most recent one at the top of the list. It offers a quick way of opening files that are currently being worked on. When PCQMAP is started for the first time there will be no filenames listed.

Exit. This menu option prompts the user to close all open files, quits the PCQMAP program, returning to PC-Quasar if called from there.

6.4 The Network menu

The *Network* menu (Figure 6.5) leads to sub-menus allowing the complete description of the river connectivity, inputs and abstractions. The complete map file may be initially defined through the *System* option. Once defined the other options provide a rapid route for making specific changes to an existing map file.

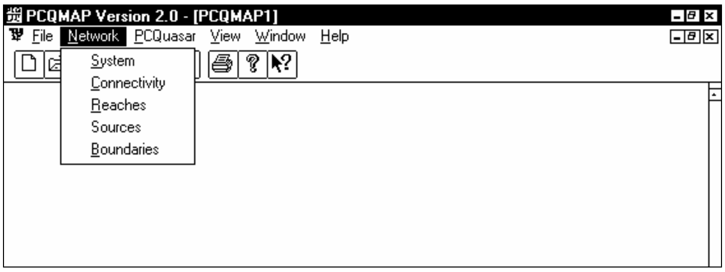

Figure 6.5 The Network menu

6.4.1 The System option

The *System* option provides a dialog box for the Network name (the name used to define the complete river system to be modelled), and the river names within the network. Once the network name has been defined, choose *Add River* to provide the name for the river(s) in the system.

6.4.2 The Connectivity option

The connectivity of rivers within a river network is defined through the reach in the main river at which the subsidiary river enters it.

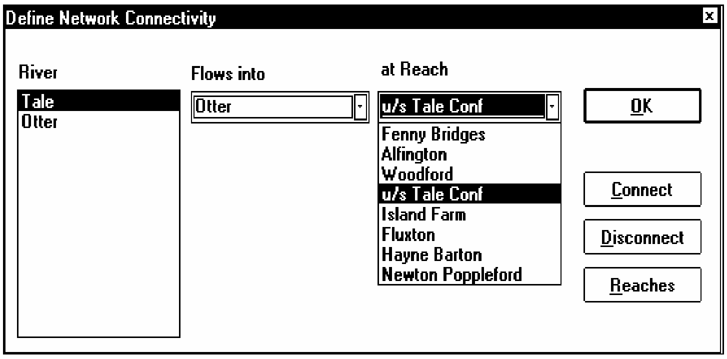

Figure 6.6 Define Network Connectivity

The *Connectivity* option on the *Network* menu displays a dialog box (Figure 6.6) containing a list of all the rivers defined within the network. The subsidiary river to be connected should be highlighted in this box. The main river should be highlighted in the *Flows into* box (which also provides a complete list of the rivers defined). The reach in which the river is connected to the main river is chosen from the drop-down list shown in *At Reach*. In practical terms the subsidiary river is assumed to enter the main river at the downstream end of the reach.

Once these choices have been made the *Connect* command button may be selected to confirm the connection and update the schematic network map. Alternatively if only one connection has to be made, selecting *OK* will perform the same function and return the user to the preceding dialog box.

The *Disconnect* command button may be used to remove connections defined previously. The user is prompted to confirm the disconnection before the schematic network map is updated.

The *Reaches* command button may be used to directly access the reach definition dialog box, returning to the *Connectivit*y dialog box on completion. This can be useful if the reach for connection has not been defined previously. (See section 6.4.3 for details about defining reaches.)

OK saves the information to the map file and returns the user to the PCQMAP main menu.

6.4.3 The Reaches option

The *Reaches* option on the *Network* menu provides facilities for dividing the river network into manageable sections. This enables the position of abstractions and inputs to be reasonably defined, and also avoids excessive dispersion in the model simulation. It is suggested that reaches should be approximately 2-5 km in length unless the river conditions are expected to be very stable. Each river is automatically assigned one reach with the end points "River Head" and "River Foot". Adding, deleting, changing the names of reaches and defining characteristics and inputs and outputs are all carried out within the *Reaches* option.

The upstream or downstream name assigned to any reach may be changed by clicking on the reach in the *Define Reach Names* dialog box (Figure 6.7) and then selecting the *Edit Reach* command button.

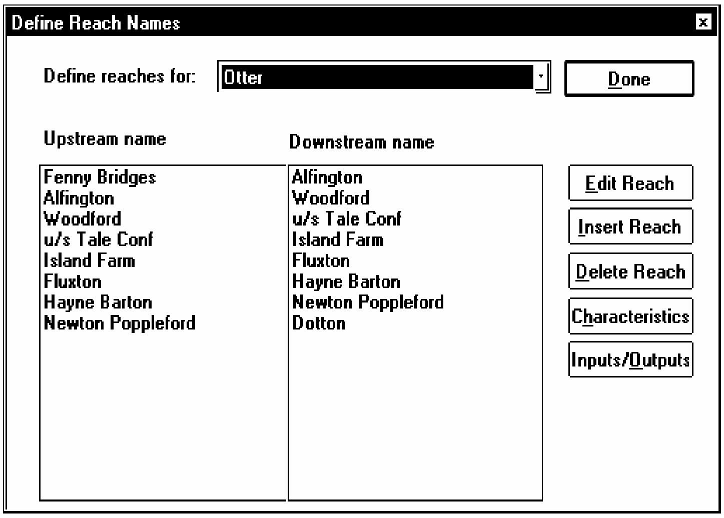

Figure 6.7 Define Reach Names

A dialog box is provided for the new upstream and downstream names. *OK* should be chosen once new names have been entered. The new river reach names will be updated immediately.

Additional reaches may be added via this dialog box. The river name should be selected in the *Define reaches for* box, the reach containing the new reach should be selected (this will be River Head to River Foot initially) and the *Insert Reach* command button selected.

A *Reach Definition* dialog box. is then displayed, into which a name representing the head of the reach should be entered. Select *OK* to update the map file with the new reach and return to the *Define Reach Names* dialog box.

A reach may be deleted by highlighting the downstream reference to it in the *Define Reach names* dialog box and then choosing *Delete Reach*. If there are data associated with the reach a warning will be provided, as deletion of the reach will also delete all attached information. In this case confirmation of deletion is required.

The characteristics of a reach can be amended by selecting the *Characteristics* command button,. The resulting dialog box is shown as Figure 6.8.

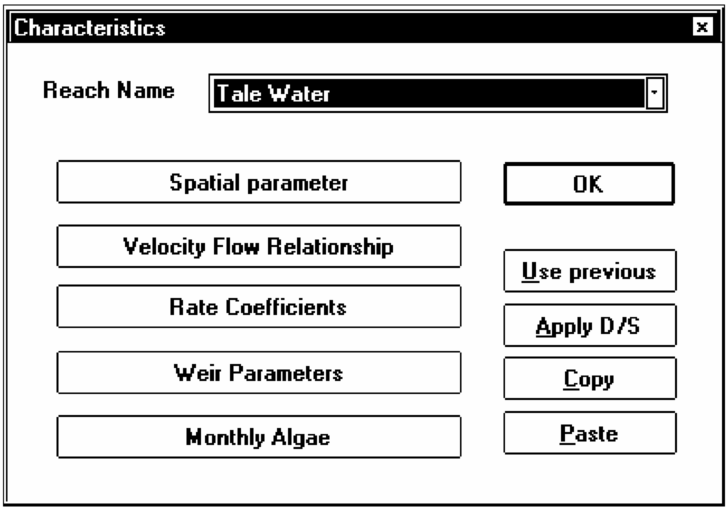

Figure 6.8 Characteristics

Reach characteristics are divided into the following groupings: Spatial parameter, Velocity Flow Relationship, Rate Coefficients, Weir Parameters and Monthly

Algae. Valid entries can be made into each of these through the relevant menu option. Each of these panels have common features described here:

New values may be entered, using <Tab> to navigate between values. Validation of these values is the same as in PC-Quasar. The entered values may be applied to all downstream reaches of the same river by choosing *Apply D/S*. If *Copy* is chosen the values are copied to the clipboard for future use so that the values can also be pasted into other rivers' reaches. (The copy/paste function can be applied at reach level and at individual characteristic level.) *Save* stores the entered values and *Exit* returns to the preceding dialog box.

Spatial parameter

This includes the reach length, width, depth, number of lags, latitude, longitude and time zone. The defaults for all of these are set to 0. The number of lags within a reach is synonymous with the number of sub-reaches used by PC-Quasar. More efficient mixing is obtained with a greater number of lags. The latitude and longitude is intended to define the head of the reach, however it is used in the modelling to define daylight hours and is therefore a conservative parameter which does not require precise definition.

Velocity Flow Relationship

This requires the entry of the three parameters A, B and C in the equation:

$Velocity\ (m/s) = A + B \times \text{Flow}^{C}$

Each of these default to 0. The velocity is calculated from the flow entering the reach and is used in modelling the mixing within reaches.

Rate Coefficients

These include a number of different determinand rates describing biochemical and chemical processes within the reach. All values default to 0.

Weir Parameters

These define the weir type and height. The weir type must be chosen from :- free, slope, step, cascade or none. The height of fall must be provided in meters. The default is none with 0 fall.

Monthly Algae

This must be defined as 12 values, each representing chlorophyll-a concentration in micrograms/litre for a month. There is an additional option here to copy values from an ASCII file called *From file*. This option prompts for an ASCII file name. The file should contain a single column of 12 values to be input to the map file.

6.4.4 The Sources option

The inputs and outputs required in each reach are defined through the *Sources* option on the *Network* menu. The first dialog box allows definition of the river and reach required. A list of existing input and outputs will be Figure 6.9).

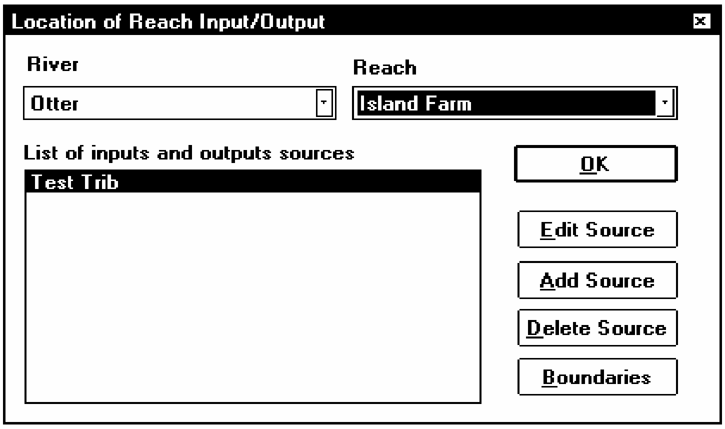

Figure 6.9 Location of Reach Input/Output

Highlight the required source and select the *Edit Source* command button to change the type of input/output. The choices available are:-

? Abstraction
? Discharge
? Effluent
? Tributary

A radio button labelled Indirect Discharge is shown, but must not be selected as PCQMAP is unable to set them up correctly..

The *Add source* command button enables the addition of a new input/output in the reach activated, specifying its name and type.

The *Delete source* command button should be used to remove sources no longer required. Highlight the source and choose *Delete source*. A warning message will prompt for confirmation of deletion.

The *Boundaries* command button leads the user directly to the boundaries option (described below) and return to the *Location of Reach Input/Output* dialog box on completion.

6.4.5 The Boundaries option

The *Boundaries* option is used to describe the determinands and time series information that are required for inputs at the upstream boundary of each river within the network, and inputs and outputs within reaches of the rivers (defined at the upstream extreme of each reach). However, as already noted above, reach inputs and outputs are defined through the Boundaries command button in the *Sources* dialog box. In each case the information required is the same.

The *Boundaries* option enables the definition and import of appropriate determinand time series for rivers and for input /output sources. The initial dialog box (Figure 6.10) allows the user to select whether boundaries are to be defined for the river or for input/output sources, and to select the feature for which boundary conditions are to be defined. Selection of the *Determinands* command button gives access to the determinands for the selected item (Figure 6.11).

(Note that if defining boundary conditions for Input/Output sources, they should first have been defined via the *Add Source* option on the *Location of Reach Input/Output* dialog box.)

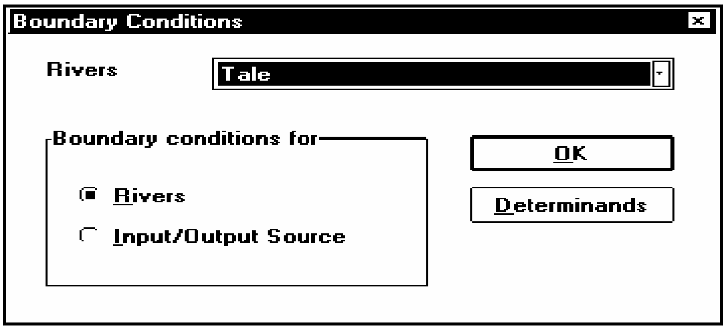

Figure 6.10 Boundary Conditions

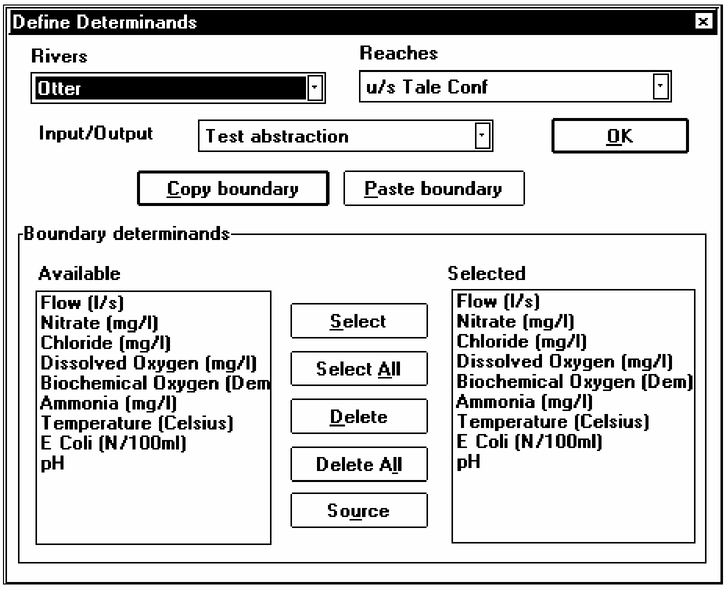

Figure 6.11 Define Determinands

(It should be also be noted that, because PCQMAP and PC-Quasar distinguish tributaries from rivers (in that tributaries do not have reaches whereas rivers do), river boundary conditions are at the upstream extreme of the river and tributary boundary conditions are at the confluence with the river i.e. the downstream extreme of the tributary.)

Default determinand information will be assumed for all available determinands. The source of each determinand information should then be defined through the *Source* command button. Figure 6.12 shows the available options.

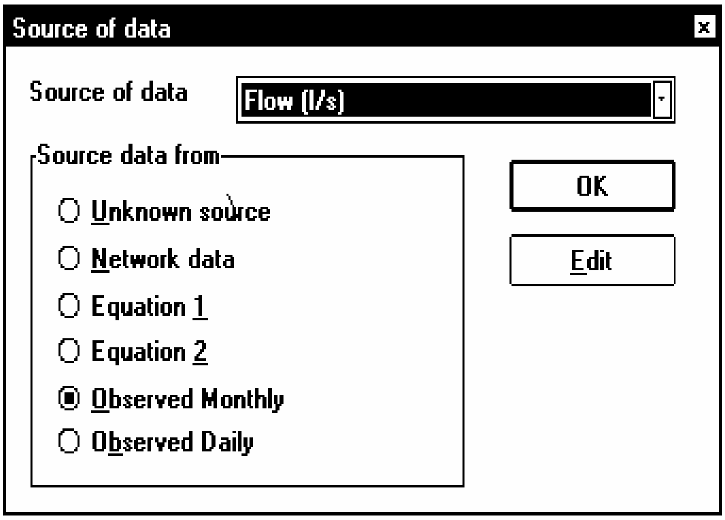

Figure 6.12 Source of data

Unknown source and *Network data* are not available in version 2.0 of PCQMAP. The most frequent sources of information will be observed monthly and observed daily data. In these two cases data can be input directly through the *Edit* option.

The time series data editor (Figure 6.13) is accessed through *Edit*. This allows manual input of data through the keyboard by changing the number in the *Value* window and confirming with <Enter>. When data entry is complete *Save* can be chosen to save the data to the map file and exit the dialog box. Alternatively, *Cancel* may be chosen to exit the dialog box without saving the data.

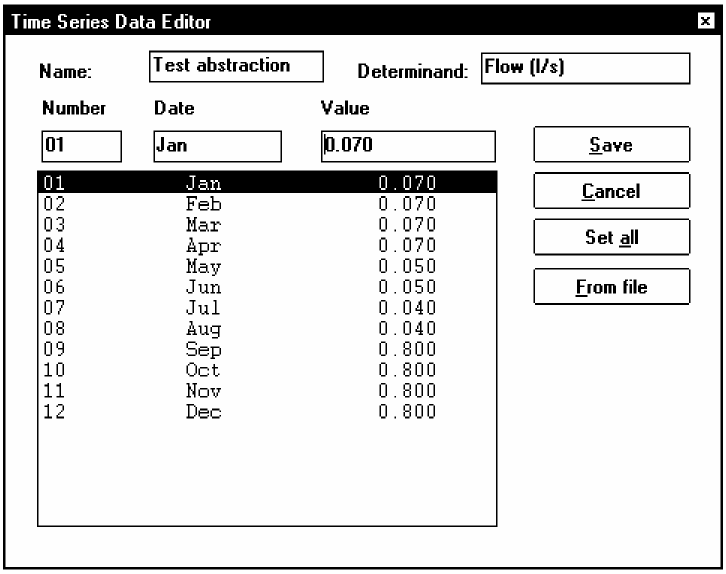

Figure 6.13 Time Series Data Editor

There are two other options in this dialog. *Set all* will set all the values for each month or day to the value typed in the *Value* window. This is useful for constant or default information.

From File will display the Open file dialog box to enable the definition of a file which contains data for automatic import. The data should be formatted in free format, with one value per line. By default, the file extension is .DAT.

Once a set of data has been entered and saved, the user is returned to the *Source of Data* dialog box. From here the user may change the determinand through the pull-down list-box labelled *Source of data* and proceed with source and data definition as above. This removes the need to go back through the various windows.

When all determinand information has been defined for a particular source, the *Source of data* dialog box can be exited using *OK* (returning to the *Define Determinands* dialog box). Further inputs/outputs can be selected from the pull-down list-box labelled *Input/Output*. The *Define Determinands* dialog box can also be used to change the river and reaches.

Once a boundary has been fully defined (for either a point source or the upstream condition of a river) the definition can be stored for other boundaries using the *Copy Boundary* option. Once the boundary has been copied a new point source may be selected and *Paste Boundary* chosen to copy the determinand values to the new source.

The *Select, Select All, Delete* and *Delete All* command buttons are all unavailable in PCQMAP v2.0

It is important to note that, in dynamic mode, quality determinands may be set to zero, but PC-Quasar must have flow values defined for all rivers, tributaries, and direct discharges.

6.5 The PC-Quasar menu

The *PC-Quasar* menu option is not used in version 2 of PCQMAP and will be permanently greyed out. It is intended to provide links to PC-Quasar in future releases.

6.6 The View menu

The *View* menu offers a number of options that govern the way PCQMAP displays the document window and the map features.

Toolbar. The toolbar offers quick access via icons to some of the main menu choices. Click on this option once to turn it on or off.

Status Bar. The status bar is an information line at the bottom the PCQMAP window. Short help messages are displayed on the left of the bar and at the right are three indicators showing the status of the Caps Lock, Num Lock and Scroll Lock keys on the keyboard.

Fill Node with colour. This option controls whether river features (or nodes) are shown with a coloured outline, or filled in with the corresponding colour (i.e. rivers in blue, reaches in green etc.). Click once to switch between the two options.

Map Keys. This option controls whether the explanatory information regarding the conventions used in the river network diagram (shown at the top of Figure 6.4) is displayed or not. Click once to hide or display the map keys.

Input/Output Sources. This option displays or suppresses information about inputs and outputs in the river network diagram Click once to suppress or display the input/output source information.

Expand all Branches. This option displays the diagram for the entire river network in full

Collapse Branches. This option reduces the defined river system to an icon. Double-clicking on this expands the display to the next level of detail. Further expandable branches are marked with a '+' sign. This can be useful if working on a small section of a complex network. When at the bottom level of the network, double clicking on a higher node collapses underlying branches back again.

Change Font. This option provides a standard Windows dialog box allowing the user to control typeface, font style, size, colour and special printing effects.

Zoom. This option allows the user to control the magnification of the screen display. The available range is 25-300%.

6.7 The Window Menu

The *Window* menu option provides standard Windows facilities for opening new or existing windows and controlling how they are displayed on the screen.

6.8 The Help Menu

The PCQMAP *Help* menu is similar to the PC-Quasar *Help* menu. For further information, see section 10.

6.9 Using map files on different versions of PC-Quasar

Once produced, a map file can be used with the PC, VAX or UNIX versions of QUASAR and can therefore be useful for conversion from one computer to another.

Within PC-Quasar a map file is converted to a parameter set and stored in the index file. The parameter sets are then secure and more rapidly accessible during model runs than would be the case with an ASCII file of information. However it must be noted that amendments made to the PC-Quasar parameter set do <u>not</u> affect the map file itself.

7. Understanding Map Files

The map file format used by PC-Quasar when creating new parameter sets is a plain ASCII file. Early versions of QUASAR were written in the FORTRAN language and the map files required a very strictly defined structure. This structure has been retained in PC-Quasar for Windows so that any existing map files will be able to be loaded into PC-Quasar without major changes.

The sample map file used in the tutorial is comprehensively commented to provide a description of the method. A listing of this file is provided as Appendix A.

Map files will normally be created through the PCQMAP utility but they can also be created by using any plain ASCII text editor. Users may have access to existing data in ASCII files or perhaps in spreadsheet format. It may sometimes be easier to edit these files than to re-enter all of the data via PCQMAP. For this reason the structure required by the map files is described here.

7.1 A note about the format of numerical fields.

The format of numerical fields in the map files must be very strictly adhered to. Any deviation will result in a failure by PC-Quasar to read the map file. In the following descriptions numerical data fields will be described using FORTRAN conventions so that the numerical field definition 'F6.2' would indicate a number occupying a total of six positions including the decimal point and two decimal places (e.g. 149.27). A four digit integer would be indicated by 'I4'. Numbers having a value less than 1 may have a leading zero (e.g. 0.45) but apart from this any blank, leading positions *must* be filled by spaces. As an example, consider a line of data containing two numbers, 212.53 and 89.5, that need to be represented in the numerical field formats F10.2 and F6.2. This line would be represented in the ASCII map file as follows:

```
----212.53-89.50
```

Blank spaces have been indicated by hyphens for clarity - they must not be used in actual map files. Notice that there is no separator (not even an extra space) between the two numbers, unless otherwise stated, and that the line starts at the left margin (i.e. there is no indentation).

7.2 Overview of the map file structure

The sample map file OTTER.MAP provided with PC-Quasar should be examined to help clarify the descriptions given in this section.

Map files must contain the record lines, in the sequence shown in the layout below.

Network definition

$

River description

Reaches and dummy fields

Boundary condition data source
Boundary condition values } **9 pairs**

Reach name

Spatial parameters

Velocity-flow relationships

Abstraction/discharge/effluent/tributary description

Dummy field(s) and indirect discharges

Indirect discharges

Dummy fields

Boundary condition data type

Boundary condition data values

Boundary condition data type

Boundary condition data values

$

End of file marker

The group of record lines shown between the dollar symbols is repeated for each river in the network, starting with the lowest numbered river. Each of these record lines is described in the following sub-sections.

7.3 Line lengths

The maximum permissible line (i.e. record) length is 80 characters.

7.4 Comment lines

Comment lines may be placed anywhere in the map file. All lines containing comments must begin with the dollar symbol, as in the following example:

```
$ This is a comment line
```

7.5 Network definition

This is a record line containing two numerical fields. The first is the number of rivers (not tributaries) described by the map and is in the format I6. The second is the version number of the map file and is in the format F6.2. This version number describes to PC-Quasar the layout of the map file data that follows and has been included to allow future changes to the file structure. The version described here is 1.02. The format of these two numerical fields is I6 and F6.2.

```
 2 1.02
```

Rivers must be numbered so that the main river is last and therefore has the highest number. Each river is then described in its entirety, starting with the lowest numbered river and proceeding sequentially. Each description must contain the record lines described below.

7.6 Rivers

7.6.1 River description

The main feature record is used to indicate the type of feature being described (river, tributary, effluent, discharge or abstraction) and its position in the river network. The record has three fields and takes the following form:

```
%004_002 RIVR Tale
```

The record begins with a field containing the percent symbol (%) and two three-digit numbers separated by an underscore character. In the above example the pair of numbers 004 and 002 indicate that the river being described flows into reach 4 of river 2.

The next field, separated from the first by a single space, is a four character code and, for rivers, must be RIVR. (There are codes for other features, which are described later.)

The last field, separated from the previous one by a single space, is the name of the river and can contain up to 40 characters.

7.6.2 Reaches and indirect inputs

This record line contains two numeric fields of 6 digits (leading blank spaces must be used if necessary). Each of these fields is an integer and there is no separator between them. The first field represents the number of reaches in the river being defined, the second is a dummy field that must be set to zero. The record line appears as follows:

```
 3 0
```

7.6.3 Boundary condition data type

This is a four digit integer (with leading blank spaces where required) indicating the type of data in the next record line, which is one of the boundary condition values. The current codes are as follows:

0 = unknown source

1 = network data

2 = equation 1

3 = equation 2

4 = observed monthly data

5 = observed daily data

Code 0 is used for determinand values that are not derived from one of the other four categories.

Code 1 is used for data obtained from a river network out-station.

Code 2 (for flow only) is used for data obtained from the equation:

value = exp(A + B ? In(FLOW)) ? FLOW

Code 3 (for flow only) is used for data obtained from the equation:

value = exp(A + B ? FLOW) ? FLOW

Code 4 indicates that the data comes from a table of monthly values.

Code 5 indicates that the data comes from a table of daily values.

7.6.4 Boundary condition data values

These are determinand values in a format that depends on the data type code described above. They must be placed in the file in the order shown, with one set of values for each determinand:

Flow (cumecs)

Nitrate (mg/l)

Conservative

Dissolved Oxygen (mg/l)

Ammonia (mg/l)

Temperature (Celsius)

E. Coli (N/100ml)

pH

Daily and monthly values used for boundary condition data types 4 and 5 are set out as tables. Monthly values are expressed as a single record line with 12 fields, each being a value in the format F6.2 with no separator between fields (leading spaces are required). The example below shows the data type field (4 = monthly data) on the first line and the monthly values for flow on the second line (only the first 6 values are shown here). A comment may be included on the first line after the data type field; in this example the determinand name and units are used

```
4                     flow (cumecs)

    1.00 0.80 0.80 0.90 0.33 0.30 ...
```

Daily values (data type 5) are expressed in a similar form but must have 366 values arranged in 45 lines of eight fields and one of six fields, with leading blank spaces and no separators. Each field in is the form F10.3. A part of the record is shown in the example below.

```
5                    flow (cumecs)

2.500  2.060  1.230  1.590 ...

2.500  2.060  1.230  1.590 ...

    2.500  2.060  1.230  1.590 ...

.

.
```

The data values for each boundary condition parameter must appear in the map file in the proper order, beginning with 'flow' and ending with 'pH'.

7.7 Reaches

7.7.1 Reach name

The name of each reach is a single field containing up to 40 characters. Reaches are entered sequentially, starting with the reach at the head of the river. The usual naming convention is to combine the names of the upstream start of the reach with the downstream end of the reach in the form, for example,

```
Fenny Bridges - Alfington
```

7.7.2 Spatial parameters

This record line consists of six numeric fields as follows:

Reach length in metres	(F11.1)
Mean width in metres	(F8.2)
Mean depth in metres	(F8.2)
Time Zone	(I4)
Latitude	(F10.3)
Longitude	(F10.3)

Leading blank spaces must be used and there are no separators between each field. An example of this record line is shown below.

```
1400.0 1.00 1.20 1 50.000 3.000
```

7.7.3 Velocity-flow relationships

These are a group of four record lines. The first record line has four fields:

Number of lags (I9)

Flow-velocity relationship A (F10.5)

Flow-velocity relationship B (F10.5)

Flow-velocity relationship C (F10.5)

Leading blank spaces must be used and there are no separators between the fields. The record appears as in the following example:

```
1 0.00000 0.04140 1.00000
```

The three parameters A, B and C are used to define the relationship between the velocity of the water in the reach (in metres per second) and its flow (in cumecs). The equation is in the form:

$$\text{velocity} = A + B \; ? \; \text{FLOW}^{C}$$

7.7.4 Rate coefficients

This record line has nine fields, each in the format F8.4. *This line must begin with three blank spaces.* Each of the fields represents the following determinands and the range of values. They must appear in this order:

Denitrification rate, 0.0 to 0.5

Biochemical oxygen demand decay rate, 0.0 to 2.0

Ammonia nitrification rate, 0.0 to 0.5

Rate of oxygen uptake by sediment, 0.0 to 1.0

Rate of biochemical oxygen demand addition by dead algae, 0.0 to 0.1

Rate of photosynthetic oxygen production for chlorophyll-A concentrations 0.0027 to 50 mg/l

Rate of photosynthetic oxygen production for chlorophyll-A, concentrations above 50mg/l

Rate of decay of E. Coli

Rate of re-suspension of E.Coli

The third record line is a continuation of the second. It has three fields, each in the format F8.4. *Additionally the line must begin with three blank spaces.* Each of the fields represents the following determinands and they must appear in this order:

BOD sedimentation rate

Algae respiration offset

Algae respiration slope

7.7.5 Weirs

The fourth record line has two fields that define a weir type and height in metres. The fields have the numeric value format I9 and F9.3. Weir types are assigned codes as follows:

0 = none

1 = free

2 = slope

3 = step

4 = cascade

The record line for a step weir having a height of fall of 1.5 metres would look like:

```
3  1.5
```

7.7.6 Algae

The fifth, and final, record line in this group has 12 fields representing monthly values for algae in micrograms per litre. The fields all have the format of F6.2 and an example record line is shown below (just the first six values are shown):

```
 3.44 4.01 4.50 4.75 4.23 4.67
```

7.8 Abstractions, discharges, effluents and tributaries

Any tributaries, abstractions, discharges or effluents associated with a river are defined immediately after all the reach definitions.

The first record line of each group is used to indicate the type of feature being described (tributary, effluent, discharge or abstraction) and its position in the river network. The record has three fields and takes the following form:

```
%004_002 ABS Test abstraction
```

The record begins with a field containing the percent symbol (%) and two three-digit numbers separated by an underscore character. In the above example the pair of numbers 004 and 002 indicate that the feature being described is located at reach 4 of river 2. The next field, separated from the first by a single space, is a four character code defining the type of feature and must be one of the following:

`ABS ` - abstraction

`DISC` - discharge

`EFFL` - effluent

`NONE` - unknown source (used for an indirect discharge)

`TRIB` - tributary

Note that the first of these, ABS, is made of only three alpha characters plus a single space. The last field, separated from the previous one by a single space, is a descriptive name for the feature and can contain up to 40 characters.

Please note that only the codes ABS , EFFL and TRIB are recognised by PC-Quasar.

7.8.1 Indirect discharge flag

This record line contains two numeric fields of 6 digits (leading blank spaces must be used if necessary). Each of these fields is an integer and there is no separator between them. The first field has no function and should be set to zero. The second field is only used to indicate the number of *indirect discharges* into a *tributary*. If there are any indirect discharges they must be described immediately *before* the tributary data. If there are no indirect discharges, the field should be set to zero. The line appears as follows:

```
     0     0
```

7.8.2 Boundary condition data type

This is a four digit integer (with leading blank spaces where required) indicating the type of data in the next record line, which will be a set of boundary condition values. This field is exactly the same as that described in section 8.6.2 and uses the same codes, i.e.:

0 = unknown source

1 = network data

2 = equation 1

3 = equation 2

4 = observed monthly data

5 = observed daily data

7.8.3 Boundary condition data values

These are determinand values in a format that depends on the data type code described above. They must be placed in the file in the order shown, with one set of values for each determinand:

Flow (cumecs)

Nitrate (mg/l)

Conservative

Biochemical Oxygen Demand (mg/l)

Dissolved Oxygen (mg/l)

Ammonia (mg/l)

Temperature (Celsius)

E. Coli (N/100ml)

pH

Daily and monthly values used for boundary condition data types 4 and 5 are set out as tables. Monthly values are expressed as a single record line with 12 fields, each being a value in the format F6.2 with no separator between fields (leading spaces are required). The example below shows the data type field (4 = monthly data) on the first line and the monthly values for flow on the second line (only the first 6 values are shown here). A comment may be included on the first line after the data type field; in this example the determinand name and units are used.

```
4                     flow (cumecs)

    1.00 0.80 0.80 0.90 0.33 0.30 ...
```

Daily values (data type 5) are expressed in a similar form but must have 366 values arranged in 45 lines of eight fields and one of six fields, with leading blank spaces and no separators. Each field is in the form F10.3. A part of the record is shown in the example below.

```
5                     flow (cumecs)

2.500  2.060  1.230  1.590 ...

    2.500  2.060  1.230  1.590 ...

    2.500  2.060  1.230  1.590 ...

.

.
```

The data values for each boundary condition parameter must appear in the map file in the proper order, beginning with 'flow' and ending with 'pH'.

7.9 Indirect discharges

If indirect discharges are required, then they can only be set up using the ASCII map file method described in this section.

Groups of record lines for indirect discharges follow exactly the same format as those for abstractions, etc., described above. They are used to describe discharges into tributaries.

```
%005_001 TRIB Mill Stream
$
$ The next record line shows one indirect
$ discharge into the tributary
$
  0  1
$
$ The indirect discharge must be defined
$ before the tributary data is listed.
$
%005_001 DISC Discharge into Mill Stream
  0  0
 4                                    Flow (cumecs)
 2.50 2.06 1.23 1.59 1.16 ( ...etc.)
$ After the indirect discharges have been
$ defined, the data for the tributary is
$ listed:
$
 4                                    Flow (cumecs)
 1.67 1.56 1.45 1.35 1.32 ( ...etc.)
```

Notice that the indirect discharge must flow into the same river and reach as the tributary it is associated with.

7.10 File end marker

The last line of the map file is the file end marker and it takes the form:

```
%XXX_XXX END
```

8. Files used by PC-Quasar

The PC-Quasar installation should contain the following files:

In the Windows System directory:

GSWAG16.DLL	Graphics server link library
GSW16.EXE	Graphics server program

In the main PC-Quasar directory:

CC.DLL	Copy protection
CCCHANGE.DLL	Copy protection
CCMOVE.DLL	Copy protection
PCQUASAR.EXE	PC-Quasar program
PCQMAP.EXE	Map file generation utility
PCQUASAR.HLP	PC-Quasar help file
PCQMAP.HLP	PCQMAP help file
PROTECT.EXE	Copy protection
README.TXT	Installation notes

In the TUTORIAL sub-directory:

OTTER.MAP	Map file used for the tutorial
FLOW.DAT	Example flow data

PC-Quasar uses the following file types:

.IDX	index file
.DBS	database file (linked to index file)
.DBB	used for internal processing (linked to index file)
.RPT	model list output file

.MAP map file