REALM

WORKED EXAMPLES

(REALM Version 6.0 16/12/2008)

VICTORIA UNIVERSITY

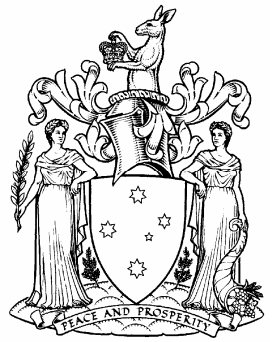
AND

DEPARTMENT OF SUSTAINABILITY AND ENVIRONMENT

December 2005

Previous versions of manual: June 2001 (with REALM version 2.30f)

December 2005 (with REALM version 5.0)



Department of Sustainability and Environment

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Conventions used in this text

c:\REALM\WorkedExamples	Phrase in Italic is either a name of a file/ directory or complete path of a file or both
Bold	Phrases in Bold format is used to highlight.

Chapter 1

1 INTRODUCTION

The **REALM Getting Started** manual trains the novice user to get acquainted with REALM, while the **REALM User Manual** contains detailed information on various aspects of the software, including theory. The **REALM Worked Examples** manual leads the user through a set of warked examples of gradually increasing complexity. Once the user completes these worked examples, it is anticipated that he/she is sufficiently skilled in using REALM for typical water resource planning applications.

The user is advised to create a separate directory for these worked examples. In this manual, it is assumed that the user has created a directory called *work* under *c:\realm* (ie. *c:\realm\work*) using REALM Program Manager.

This manual is prepared mainly for use in REALM workshops. Therefore, the instructions on how to use REALM for these examples are not given in the manual. Instead, the purpose of the worked example problems and the procedure on how to use REALM for these problems are briefly outlined. The solutions to these problems are given in the second part of the manual.

The function of each worked example problem is briefly described below.

- **Worked Example 1**: Preparation of REALM format streamflow and demand files from MS EXCEL files.

- **Worked Example 2**: Illustration of basic REALM capabilities using a water resource system of a single reservoir and a single demand zone. The System Editor, System Listing, Run Setup. Run Model, utility Plot and utility Merger will be used. The reservoir evaporation losses, the demand restrictions and different types of carriers will also be considered.

- **Worked Example 3**: Use of target storage curves in allocating water within a water resource system of two reservoirs and two demand zones.

- **Worked Example 4**: Illustration of above and below target zones and drawdown priority in allocating water within a water resource system of three reservoirs and two demand zones.

- **Worked Example 5**: Illustration of demand shortfall zones and shortfall priority in allocating water within a water resource system of a single reservoir and two demand zones.

- **Worked Example 6**: Water quality modelling.

- **Worked Example 7**: Modelling of irrigation demand restrictions.

- **Worked Example 8**: Modelling of a capacity shared water resource system. Several methods of capacity sharing modelling are considered.

All relevant input data files (ie. streamflow, demand, system and scenario files), which can be used in the worked examples are in the *c:\REALM\WorkedExamples* directory. The user can use these files (without creating them) to run REALM. However, the user is required to be in *c:\REALM\WorkedExamples* directory and necessary to load the relevant scenario file for the worked example under consideration using Run Setup of REALM.

Chapter 2

2 PROBLEM DEFINITIONS

2.1 WORKED EXAMPLE 1

2.1.1 PREPARATION OF STREAMFLOW AND DEMAND DATA FILES

Generally, streamflow and demand files are prepared initially using a spreadsheet package. They are then translated into a REALM format file. Alternatively, these files can be prepared through a standard editor such as Notepad in Windows or File Viewer (or editor) available in REALM. This tutorial is designed to illustrate the process of translating an MS EXCEL file into a REALM format file.

2.1.1.1 STREAMFLOW DATA FILE

An MS EXCEL spreadsheet containing streamflow data is given as a computer file named *stream1.xls* in the *c:\REALM\WorkedExamples* directory. The file contains only the numeric data in 5 columns. They are the month, the year and three columns of streamflow data for a 3-year period. Using this file, prepare a REALM format file with streamflow column names as

STREAM A
STREAM B
INFLOW 1

Follow the steps given below.

- Open the file *stream1.xls* using MS EXCEL.
- Save the file as a *space delimited formatted text file* (use any file name with any extension; default is *stream1.prn*).
- Edit the saved file (ie. *stream1.prn*) using Notepad in Windows, File Viewer in REALM or any other editor. Add the required header information, including the format statement.
- Save the file under the same name or any other name.

This is the REALM format streamflow file.

2.1.1.2 DEMAND FILE

A MS EXCEL spreadsheet containing demand data is given as a computer file named *demand1.xls* in the *c:\REALM\WorkedExamples* directory. The file contains only the numeric data in 3 columns. They are the month, the year and one column of demand data for a 3-year period. Using this file, prepare a REALM format file with demand column name as DEMAND 1.

Follow the steps in (a) above with appropriate header information for the demand file.

2.2 WORKED EXAMPLE 2

2.2.1 SINGLE RESERVOIR AND SINGLE DEMAND ZONE SYSTEM

This worked example is designed to illustrate the use of System Editor, System Listing, Run Setup. Run Model, utility Plot and utility Merger. Furthermore, the modelling of reservoir evaporation losses and urban demand restrictions are also considered. The use of different types of carriers are also considered, together with the effect of carrier capacity on supply to demand zones. (ie. demand shortfalls). Several sub-problems are considered to illustrate these concepts.

The streamflow files (*sf1.dat* and *sf2.dat*) and the demand file (*dem.dat*) corresponding to these examples are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

2.2.2 SUB-PROBLEMS

a) A water supply system consists of a single reservoir and a single urban demand centre. The reservoir minimum and maximum capacities are 0 and 12,000 ML respectively. The streamflow input to the reservoir is via the column name 'STREAM1' in the streamflow file (*sf1.dat*). The demand input is via the column name 'DEMAND 1' in the demand file (*dem.dat*). The reservoir and the demand centre are connected by a pipe (ie. 'Pipe' type carrier), which has a constant capacity of 12,000 ML/month. Spilled waer goes to the river. The reservoir evaporation and restrictions are not to be modelled in this case. Create the system file using the System Editor and save as *Ex2A.sys*. Look at *EX2A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor. Use System Listing to obtain a listing (with headings). Look at the contents of this file.

   The simulation period is from January 1982 to December 1984 and the initial storage volume is 9,000 ML. Use Run Setup for setting up the simulation with the simulation log file name of *EX2A.log.* Select the output options at least for reservoir storage volume and flow in the pipe. Save the scenario file as *scn2a.scn.* Use *scn2a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

   Use Run Model to perform the simulation. Look at the contents of the log file. Use utility Plot to plot the reservoir storage volume and flow in the pipe.

b) The system is same as in (a), but the reservoir evaporation is to be modelled. The evaporation is modelled through the column names 'PAN EVAP' and 'LOCAL RAIN' in the streamflow file *sf2.dat*. The coefficients A and B are 0.5 and 3 respectively. The volume-surface area relationship is given in Table 2.2-1.

   The demand file is *dem.dat.* The other details are same as in (a). Edit *EX2A.sys* using the System Editor and save as *Ex2B.sys* after changes. Look at *EX2B.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

   Use Run Setup to set up the simulation with the log file name as *EX2B.log*. Select the reservoir evaporation as an output option in addition to those of (a). Save the scenario file as *scn2b.scn*. Use *scn2b.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Compare the storage behaviour with and without modelling evaporation graphically using utility Plot. Create an ASCII (or text) file showing the storage volume for cases (a) and (b). Study how evaporation is modelled in REALM

Table 2.2-1 Volume-Surface Area Relationship for Reservoir

Volume (ML)	Surface Area (ha)
0	0
500	10
1000	30
4000	40
6000	50
8000	60
9000	70
10000	80
11000	90
12000	100

c) The system is same as in (a), except that the carrier connecting the reservoir and the demand centre has a constant capacity of 2,350 ML/month. This example is designed to illustrate the demand shortfalls. The other details (including streamflow and demand files) are same as in (a). Edit *Ex2A.sys* using the System Editor and save as *Ex2C.sys* after changes. Look at EX2C.*sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX2C.log*. Select the output options of unrestricted, shortfalls and actually supplied from the demand data compartment, and carrier capacity from the carrier data compartment when running Run Setup, apart from the output options of (a). Save the scenario file as *scn2c.scn*. Use *scn2c.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use utility Plot to investigate the effect of carrier capacity on supply to the demand zone.

d) The system is same as in (a), except that the capacity of the interconnecting carrier depends on the reservoir storage volume. This carrier is a variable capacity carrier. The volume-capacity relationship for the carrier is given in Table 2.2-2.

Table 2.2-2 Volume-Capacity Relationship for Carrier

Volume (ML)	Capacity (ML)
0	0
6,000	1,200
12,000	2,400

The other details (including streamflow and demand files) are same as in (a). Edit *EX2A.sys* using the System Editor and save as *EX2D.sys* after changes. Look at *EX2D.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX2D.log*. All scenario details are as in (c) when running Run Setup. Save the scenario file as *scn2d.scn*. Use *scn2d.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use utility Plot to investigate the effect of carrier capacity on supply to the demand zone.

e) The system is same as in (a), except that the restrictions are imposed when the storage volume falls below 6,500 ML. The upper rule curve and the lower rule curve are defined by the reservoir storage volumes of 6,500 and 3,500 ML respectively for each month, and the base demand is given as 500 ML/month. Four restriction zones are to be considered. The details of the restriction zones are given in Table 2.2-3.

The other details (including streamflow and demand files) are same as in (a). Edit *EX2A.sys* using the System Editor and save as *EX2E.sys* after changes. Look at *EX2E.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Table 2.2-3 Restriction Rule Curve Details

Level	Relative Position	Percentage Restriction
1	25	10
2	50	20
3	75	50
4	100	70

Use Run Setup to set up the simulation with the log file name as *Ex2E.log*. Select the output options as in (c) and two additional output options (ie. restricted demand and restriction levels), when running Run Setup. Save the scenario file as *scn2e.scn*. Use *scn2e.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Note the restriction details. Use System Listing and utility Plot to investigate the effect of the restrictions on supply to the demand zone. Create an ASCII (or text) file using utility Plot to show the above effect.

f) The system is same as in (e), except that the reservoir evaporation is to be modelled as in (b) and the capacity of the interconnecting carrier as in (c). The streamflow and demand files are *sf2.dat* and *dem.dat* respectively. Edit *EX2E.sys* using the System Editor and save as *EX2F.sys* after changes. Look at *EX2F.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX2F.log*. All scenario details are as in (e). Save the scenario file as *scn2f.scn*. Use *scn2f.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Use utility Merger to create an ASCII (or text) file with unrestricted and restricted demands, carrier flow and capacity, and demand shortfalls, and investigate the results.

g) The system is same as in (d), except that the capacity of the interconnecting carrier during a simulation time step depends on both start and end reservoir storage volume of that time step. The carrier is a variable capacity carrier. The volume–capacity relationship is given in Table 2.2-2. The volume in the volume-capacity relationship is computed from the following expression. This volume is used to compute the capacity of the carrier.

0.75*start storage + 0.5 * end storage – 5000

The other details are exactly same as in (d). Edit *EX2C.sys or EX2D.sys* using the System Editor, and change the carrier connecting the reservoir and the demand zone to a variable

capacity carrier. Save the file as *Ex2G.sys*. Look at *Ex2G.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *Ex2G.log*. All scenario details are as in (d), when running Run Setup. Save the scenario file as *scn2g.scn*. Use *scn2g.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup. Study the results and investigate how ‘Type 3’ carriers work.

Use utility Plot to investigate the effect of carrier capacity on supply to the demand zone.

2.3 WORKED EXAMPLE 3

2.3.1 TWO RESERVOIR AND TWO DEMAND ZONE SYSTEM

This worked example is designed to illustrate the use of target storage curves in allocating water within a water resource system. Again, several sub-problems are considered.

A streamflow file (*sf3.dat*) and a demand file (*dem2.dat*) corresponding to these examples are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

2.3.2 SUB-PROBLEMS

a) Two reservoirs supply water to two urban demand zones. The first reservoir which has a maximum capacity of 12,000 ML supplies the first demand zone; the second reservoir which has a maximum capacity of 24,000 ML supplies the second demand zone. Both reservoirs have minimum capacities of 0 ML. Water from either reservoir can go to the other reservoir. Spilled water goes down the river. The streamflow inputs to the first and the second reservoirs are via the column names 'STREAM1' and 'STREAM2' respectively in the streamflow file (*sf3.dat*). The demand input is via the column names 'DEMAND 1' and 'DEMAND 2' in the demand file (*dem2.dat*). The reservoir evaporation and restrictions are not to be modelled in this case.

   All four carriers are pipes. The monthly capacities of all carriers are constant over the year and given in Table 2.3-1. Use the linear target option.

Table 2.3-1 Monthly Capacities of Carriers

Description	Min Capacity (ML)	Max Capacity (ML)
First reservoir to first demand zone	0	12,000
First reservoir to second reservoir	0	24,000
Second reservoir to second demand zone	0	24,000
Second reservoir to first reservoir	0	24,000

   Create the system file using the System Editor and save as *EX3A.sys*. Look at *EX3A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor. The user can enter the number of above and below target zones for this case as 1. Why?

   The simulation period is from January 1982 to December 1984. The initial storage volumes are 9,000 and 8,000 ML respectively for the first and the second reservoirs. Use Run Setup to set up the simulation with the log file name as *EX3A.log*. Select the output options for at least reservoir storage volume, target storage volume and flow in the pipes. Save the scenario file as *scn3a.scn*. Use *scn3a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup. Investigate the output files. Why are the trajectories of reservoir storage volume and target storage volume the same?

b) The system is same as in (a), except that the non-linear (user-defined) targets are used. These targets are specified to achieve lower water levels in 12,000 ML reservoir. Ten target points (including maximum and minimum values) are to be considered, as given in Table 2.3-2.

Table 2.3-2 Non-Linear Targets

Total System Storage (ML)	First Reservoir Volume (ML)	Second Reservoir Volume (ML)
0	0	0
4,000	1,000	3,000
8,000	1,000	7,000
12,000	2,000	10,000
16,000	2,000	14,000
20,000	3,000	17,000
24,000	3,000	21,000
28,000	4,000	24,000
32,000	8,000	24,000
36,000	12,000	24,000

The other details are same as in (a). Edit *EX3A.sys* using the System Editor and save as *EX3B.sys* after changes. Look at *EX3B.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX3B.log*. All scenario details are as in (a). Save the scenario file as *scn3b.scn*. Use *scn3b.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Investigate the differences in results of (a) and (b).

c) The system is same as in (a), except that the carrier from the second reservoir to the first reservoir is taken off. Edit *EX3A.sys* using the System Editor and save as *EX3C.sys* after changes. Look at *EX3C.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX3C.log*. All scenario details are as in (a). Save the scenario file as *scn3c.scn*. Use *scn3c.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Study the results to find out how the targets control the flow in the network.

Use utility Plot to compare the total system storage and the total target storage. Why are they the same?

d) The system is same as in (c), except that the maximum capacity of the carrier connecting the first reservoir to the first demand zone is reduced to 2,000 ML/month. Also, a carrier with a minimum and maximum capacities of 0 and 24,000 ML/month is established between the second reservoir and the demand zone 1. The other details are same as in (c). Edit *Ex3C.sys* using the System Editor and save as *EX3D.sys* after changes. Look at *EX3D.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX3D.log*. All scenario details are as in (a). Save the scenario file as *scn3d.scn*. Use *scn3d.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Compare the individual storage and target storage volumes of the reservoirs. Investigate why the targets and storage volumes are different only for 5/1984. Also study the carrier flows.

2.4 WORKED EXAMPLE 4

2.4.1 ILLUSTRATION OF ABOVE AND BELOW TARGET ZONES AND DRAWDOWN PRIORITY

This worked example is designed to illustrate the use of above/below target zones and drawdown priority of reservoirs in allocating water within the water resource system. This tutorial uses three reservoirs and two demand centres.

Why is it necessary to have at least three reservoirs to illustrate these concepts?

A streamflow file (*sf3.dat*) and a demand file (*dem2.dat*) are given in the *c:\REALM\WorkedExamples* directory for use in this worked example. The user is advised to study the contents and formats of these files.

2.4.2 SUB-PROBLEMS

a) Three reservoirs supply water to two urban demand zones. The first and the second reservoirs have maximum capacities of 12,000 ML and 20,000 ML respectively, and supply the first demand zone. The third reservoir with a maximum capacity of 10,000 ML supply the second demand zone. All three reservoirs have minimum capacities of 0 ML. A pipe is used for inter-reservoir transfer from the second reservoir to the third reservoir. Spill water goes down the river. The streamflow inputs to the first, second and third reservoirs are via the column names 'STREAM1', 'STREAM2' and 'STREAM1' respectively in the streamflow file (*sf3.dat*). The demand inputs are via the column names 'DEMAND 1' and 'DEMAND 2' in the demand file (*dem2.dat*). The reservoir evaporation and restrictions are not to be modelled in this case.

   All four carriers are pipes. The monthly capacities of all carriers are constant and the minimum and maximum values for each carrier are 0 and 99,999,999 ML respectively. (99,999,999 is the unlimited capacity of carriers in REALM). Use the number of above and below target zones for each reservoir as 1. Drawdown priorities for the first, second and third reservoirs are 1, 2 and 3 respectively. Use the linear targets option.

   Create the system file using the System Editor and save as *EX4A.sys*. Look at *EX4A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

   The simulation period is from January 1982 to December 1984. The initial storage volumes are 8,000, 10,000 and 8,000 ML respectively for first, second and third reservoirs. Use Run Setup to set up the simulation with the log file name as *EX4A.log* and select the output options at least for reservoir storage volume, target storage volume, demand shortfalls, and flow and capacity in the pipes. Save the scenario file as *scn4a.scn*. Use *scn4a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

b) The system is same as in (a), except that the number of below target zones for the first reservoir, which is to be arbitrarily set at 25, to illustrate the concepts in this worked example. (In this case, it is possible only to illustrate the storage going below target. Why?) The other details are same as in (a). Edit *EX4A.sys* using the System Editor and save as *Ex4B.sys* after changes. Look at *Ex4B.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

   Use Run Setup to set up the simulation with the log file name as *EX4B.log*. All scenario details are as in (a). Save the scenario file as *scn4b.scn*. Use *scn4b.scn* in the

c:\REALM\WorkedExamples directory in case of difficulty in using Run Setup.

Use utility Plot to plot the individual reservoir storage and target storage volumes for the cases (a) and (b). Perform manual calculations to investigate the difference in storage volumes in cases (a) and (b), and to study how the below target zones and drawdown priority control the storage levels. Consider January 1982 for manual calculations.

Why are the reservoir target storage volumes same for cases (a) and (b)?

Use utility Merger to create an ASCII (or text) file for reservoir storage volume and target storage volume for all reservoirs.

2.5 WORKED EXAMPLE 5

2.5.1 ILLUSTRATION OF DEMAND SHORTFALL ZONES AND SHORTFALL PRIORITY

This worked example is designed to illustrate the use of demand shortfall zones (or bypass zones) and shortfall priority in allocating water within the water resource system. The example involves one reservoir and two demand centres.

Why is it necessary to have at least two demand zones to illustrate these concepts?

A streamflow file (*sf3.dat*) and a demand file (*dem2.dat*) are given in the *c:\REALM\WorkedExamples* directory for use in this example. The user is advised to study the contents and formats of the files.

2.5.2 SUB-PROBLEMS

a) A reservoir with minimum and maximum capacities of 0 and 12,000 ML respectively supplies water to two urban demand zones. The streamflow input to the reservoir is via the column name 'STREAM1' in the streamflow file (*sf3.dat*). The demand inputs are via the column names 'DEMAND 1' and 'DEMAND 2' in the demand file (*dem2.dat*). Spill water goes down the river. Use the number of demand shortfall zones for DEMAND 1 and DEMAND 2 as 1, and the shortfall priority for DEMAND 1 and DEMAND 2 as 1 and 2 respectively. The reservoir evaporation and restrictions are not to be modelled in this example.

   Both carriers are pipes and the monthly capacities of the carriers are constant. The minimum and maximum capacities of both carriers are 0 and 99,999,999 ML respectively.

   Create the system file using the System Editor and save as *EX5A.sys*. Look at *EX5A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

   Use System Listing to get a listing of the system file with captions. Note that the number of shortfall zones in this file is given as ' No Bypass'.

   The simulation period is from January 1982 to December 1984 and the initial storage volume is 8,000 ML. Use Run Setup to set up the simulation with the log file name as *EX5A.log* and select the output options at least for reservoir storage volume, unrestricted demand, demand shortfalls and flow in the pipes. Save the scenario file as *scn5a.scn*. Use *scn5a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

b) The system is same as in (a), except that the number of demand shortfall zones for DEMAND 1 and DEMAND 2 are 2 and 4 respectively. Edit *EX5A.sys* using the System Editor and save as *EX5B.sys* after changes. Look at *EX5B.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

   Use Run Setup to set up the simulation with the log file name as *EX5B.log*. All scenario details are as in (a). Save the scenario file as *scn5b.scn*. Use *scn5b.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

   Use utility Plot to plot the demand shortfalls for cases (a) and (b). Investigate the output files.

   Perform manual calculations to investigate how the demand shortfall zones and shortfall priority work in supplying the required demand. Consider March 1982.

2.6 WORKED EXAMPLE 6

2.6.1 WATER QUALITY MODELLING

This worked example is designed to illustrate the water quality modelling capabilities of REALM. Water quality modelling in REALM is based on pure mixing. The rejection of flows in certain flow paths based on water quality and the effect of evaporation losses on the water quality of reservoirs are demonstrated.

It is important to note that in this example the water quality constituents are considered to have constant concentrations during the month, which may not be the case in a real application. However, the fixed monthly concentrations are used to illustrate the features of water quality modelling with the same streamflow and demand files used in the other worked examples. The water quality should be modelled with a daily REALM model, where daily variations are considered necessary.

The streamflow files (*sf4.dat* and *sf5.dat*) and the demand file (*dem.dat*) corresponding to these examples are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

2.6.2 SUB-PROBLEMS

a) A reservoir with minimum and maximum capacities of 0 and 20,000 ML respectively supplies water to an urban demand centre via a pipe. When the reservoir is full, the excess water is spilled to a natural water course. Water is not used by the demand centre, if the EC of water is greater than 400 EC units. This flow rejection is to be modelled with two pipes. Note that this can be modelled with one variable capacity pipe. However, this network is used in subproblem (b) to illustrate additional water quality modelling capabilities. The first pipe is from the reservoir to a pipe junction with unlimited capacity and the second pipe is from the pipe junction to the demand centre, which depends on the EC concentration of reservoir. Two water quality parameters, EC and turbidity, are to be considered.

   The streamflow inputs to the reservoir is via the column name ‘STREAM1’ in the streamflow file (*sf4.dat*), while EC values corresponding to these flows are given by the column name EC_VALUES in the same file. The turbidity concentration of reservoir is a fixed concentration of 1,000 turbidity units. The demand input is via the column name ‘DEMAND 1’ in the demand file (*dem.dat*). The reservoir evaporation and restrictions are not to be modelled in this example.

   Create the system file using the System Editor and save as *EX6A.sys*. Look at *EX6A.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

   The simulation period is from January 1982 to December 1984 and the initial storage volume is 10,000 ML. The initial concentration of EC and turbidity are 200 EC units and 1000 turbidity units respectively. Use Run Setup to set up the simulation with the log file name as *EX6A.log* and select the output options at least for reservoir storage volume, water quality of reservoirs, and flow and capacity of carriers. Save the scenario file as *scn6a.scn*. Use *scn6a.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

   Use the utility Merger to create an ASCII (or text) file with reservoir EC, and flow and capacity of the variable capacity carrier. Note that the reservoir EC given in REALM output time series file is the concentration at the end of the simulation time step.

(b) The system is same as in (a), except that the reservoir evaporation is to be modelled. The evaporation is modelled through the column names 'PAN EVAP' and 'LOCAL RAIN' in the streamflow file *sf5.dat*. The coefficients A and B are 0.5 and 3 respectively. The volume-surface area relationship is given in Table 2.2-1. The demand file is *dem.dat.* The other details are same as in (a).

Edit *EX6A.sys* using the System Editor and save as *EX6B.sys* after changes. Look at *ex6b.sys* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using the System Editor.

Use Run Setup to set up the simulation with the log file name as *EX6B.log*. Select the reservoir evaporation as an output option in addition to those of (a), and other scenario details are same as in (a). Save the scenario file as *scn6b.scn*. Use *scn6b.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Compare the water quality in the reservoir with and without modelling evaporation graphically using utility Plot. Use utility Plot to create an ASCII (or text) file showing the water quality for cases (a) and (b). Do manual calculations to investigate how REALM water quality module works.

2.7 WORKED EXAMPLE 7

2.7.1 MODELLING OF IRRIGATION DEMAND RESTRICTIONS

Modelling of irrigation demand restrictions is considered in this worked example. The system used for this example is a component of the Werribee system model, which was developed in 1997.

The system is fairly complex and all data relevant to the example are not explained here. Therefore, the user is not required to create the system file. Instead, the user should look at the contents of the system data file for node, carrier and demand restriction details, using the System Editor. In addition, the user should use System Listing to study the contents of the system file. The system data file used in this example is *WERRIRRG.sys* and is given in the *c:\REALM\WorkedExamples* directory.

The streamflow file *WERRFLOW.SF* and the demand file *WERRIRR.DEM* are used in this example and are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

Some details are given below to describe the system. Water is supplied to the system from a number of weirs and Pykes Creek reservoir (which has minimum and maximum capacities of 1,190 and 23,920 ML respectively). The demands to be supplied from this system are:

Bacchus Marsh (BM) irrigation district
CSR industrial demand
Lerderderg private diverters

The environmental releases are to be provided in certain carriers and they are modelled through ‘minimum capacities’ in carriers.

The demand restriction policy, which has been modelled in this example, is:

- CSR industrial demand and Lerderderg private diverters are not to be restricted at any time, provided water is available.
- The irrigation demands in the BM irrigation district (defined by DC2 nodes of BM IRRIGATION and BM OUTSIDE SALES) are considered to form one demand group. This demand group is restricted based on the available water for release.

The simulation period is from July 1920 to June 1990 and the initial storage volume of the Pykes Creek reservoir is 20,000 ML. Use Run Setup to set up the simulation with the log file name as *IRRG.log* and select the output options at least for reservoir storage volume, reservoir evaporation, unrestricted, restricted and supplied demands, restriction levels, and flow and capacity of carriers. Select the following (important) carriers.

PYKES DIV2
WERRIBEE D/S PYKES
TO BM IRRIGATION
TO CSR FACTORY
BM-OFFTAKE

WERRIBEE U/S BM WEIR
TO BM OUTSIDE SALES
WERRIBEE D/S BM
FROM INFL U/S MELTON
LERD DIS GOOD.
LOWER LERD
FROM PARWON CK
BM OPERATIONAL SPILL
END SECTION 1
END SECTION 2

Save the scenario file as *scn7.scn*. Use *scn7.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup. Study the log file and the other output files. Note that only the System Listing output file and log files are given in the Solutions section, since the streamflow and demand input files, and the output files generated from REALM are too long (i.e. planning period is 70 years). Note that under 'Demand data' of the log file, the LEADERBERG DV irrigation demand has the maximum restriction level as 1,000, which indicates no restrictions.

Create an ASCII (or text) file using utility Plot with the following details and study how the irrigation restriction policy works.

- unrestricted, restricted and supplied demands of two irrigation demand zones (i.e. BM IRRIGATION and BM OUTSIDE SALES)
- demand restriction levels of these irrigation demand zones, and
- storage volume of the reservoir.

Study whether the minimum flows are met at all times.

2.8 WORKED EXAMPLE 8

2.8.1 MODELLING OF CAPACITY SHARED SYSTEMS

Two techniques in modelling capacity shared systems are considered in this worked example. They are:

'Explicit' capacity sharing, and
'Implicit' capacity sharing.

Explicit capacity sharing uses separate notional storages and carriers for each capacity sharing group and the 'actual' storages and carriers are modelled indirectly (by summing up the notional storages and the carriers respectively). Implicit capacity sharing, on the other hand, models the 'actual' storages and carriers directly, and capacity sharing features are modelled through an accounting network. Although the modelling techniques are different, they should yield the same (more or less) result.

In this example, the capacity sharing of reservoirs, carriers, losses (both reservoir evaporation and carrier losses) and internal spills between notional storages are considered.

The system used for this example is a component of the Werribee system model, which was developed in 1997. Two system files are considered, one for explicit modelling and the other for implicit modelling. The system files are fairly complex, and all data relevant to the creation of these system files are not explained here. Therefore, the user is not required to create the system files. Instead, the user should look at the contents of the system data files for node, carrier and demand restriction details, using the System Editor. In addition, the user should use System Listing to study the contents of the system file.

The streamflow file *WERRCAPC.SF* and the demand file *WERRIRR.DEM* are used in this example, and are given in the *c:\REALM\WorkedExamples* directory. The user is advised to study the contents and formats of these files.

Some details are given below to describe the system. The system consists of the Merrimu and Djerriwarrh reservoirs, and Melton and Bacchus Marsh townships as urban demand centres. Merrimu also supplements the irrigation requirements of the Werribee irrigation district. This irrigation demand is modelled through a volume dependent carrier with a high negative penalty. In addition, the system supplies the required environmental releases. The system has (currently) unused storage capacity, which is to be reserved for future requirements. The system is planned to operate as a capacity shared system. The Merrimu reservoir has a minimum and maximum capacity of 300 and 35,000 ML respectively.

The capacity sharing details are given as follows. Three user groups are considered namely:

Urban group
Irrigation group
Unallocated resource group

The resources of the Merrimu reservoir are to be shared between the user groups. The maximum storage capacity reserved for capacity sharing purposes for urban, irrigation and unallocated are 21,000 (60%), 7,500 (21.4%) and 6,500 (18.6%) ML respectively. The rain on to the reservoir and the evaporation from the reservoir are to be shared in the proportion of 60%, 30% and 10% respectively. Similarly, the inflows that can be physically shared between all three groups (i.e. inflows at the Merrimu reservoir and other inflows that are accessible to all user groups) are to be shared according to the same proportion. When the environmental flows are to be supplied from the resources of all three user groups, they are also shared according to the same proportion.

The internal spills from one user group are shared between the other two user groups based on user-specified ratios. The internal spills are handled by 'internal spill' carriers, which are capacity shared. When all three notional storages spill, external spills will occur.

The urban demands are represented by Melton and Bacchus Marsh township demands, while the unallocated reservoir share supplies a notional urban demand. The demand restriction policy, which has been modelled in this example, is:

- Bacchus March township demand is not to be restricted at any time, provided water is available.
- A single demand group is to be considered for demand restrictions. The restrictions are based on the storage volumes of Merrimu and Djerriwarrh reservoirs. This demand group consists of the Melton township demand and the notional demand. A four-level urban restriction demand policy is considered for this demand group.

2.8.2 EXPLICIT CAPACITY SHARING

The system data file used for explicit capacity sharing is *WERREXPl.sys* and is given in the *c:\REALM\WorkedExamples* directory.

The simulation period is from July 1920 to June 1990, and the initial storage volumes of the Merrimu reservoir shares and Djerriwarrh reservoir are as given in the Table 2.8-1.

Table 2.8-1 Initial Storage Volumes of Reservoirs

Merrimu urban	16,314 ML
Merrimu irrigation	5,123 ML
Merrimu unallocated	5,123 ML
Djerriwarrh	500 ML

Use Run Setup to set up the simulation with the log file name as *EXPL.log* and select the output options at least for reservoir storage volume, unrestricted, restricted and supplied demands, restriction levels, and flow and capacity of carriers. Save the scenario file as *scn8e.scn*. Use *scn8e.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Study the log file and the other output files. Note that only the System Listing output file and the log file are given in the Solutions section, since the streamflow and demand input files, and the output files generated from REALM are too long (i.e. planning period is 70 years).

Create an ASCII (or text) file using utility Plot with appropriate columns to study how explicit modelling of capacity sharing works.

2.8.3 IMPLICIT CAPACITY SHARING

The system data file used for implicit capacity sharing is *WERRIMPL.sys* and is given in the *c:\REALM\WorkedExamples* directory.

The simulation period is from July 1920 to June 1990, and the initial storage volumes of the Merrimu reservoir shares and Djerriwarrh reservoir are as given in the Table 2.8-2.

Table 2.8-2 Initial Storage Volumes of Reservoirs

Merrimu urban	16,314 ML
Merrimu irrigation	5,123 ML
Merrimu unallocated	5,123 ML
Djerriwarrh	500 ML

Use Run Setup to set up the simulation with the log file name as *IMPL.log* and select the output options at least for reservoir storage volume, unrestricted, restricted and supplied demands, restriction levels, and flow and capacity of carriers. Save the scenario file as *scn8i.scn*. Use *scn8i.scn* in the *c:\REALM\WorkedExamples* directory in case of difficulty in using Run Setup.

Study the log file and the other output files. Note that only the System Listing output file and the log file are given in the Solutions section, since the streamflow and demand input files, and the output files generated from REALM are too long (i.e. planning period is 70 years).

Create an ASCII (or text) file using utility Plot with appropriate columns to study how implicit modelling of capacity sharing works.

Compare the results from explicit and implicit capacity sharing modelling.

Chapter 3

3 SOLUTIONS

3.1 WORKED EXAMPLE 1

PREPARATION OF STREAMFLOW AND DEMAND FILES

WORKED EXAMPLE 1 – STREAMFLOW FILE

```
####2
STREAMFLOW DATA FILER
EALM WORKED EXAMPLES - TUTORIAL 1
TEST DATA
DATE: 20 JULY 1997
(I8,I11,2I12,I7)
5
SEASON
YEAR
STREAM A
STREAM B
INFLOW 1
       1       1982         416         400   4988
       2       1982         288         600   2249
       3       1982        1025        1200   1234
       4       1982         450          90   2273
       5       1982        4988         120   2160
       6       1982        2249         700   1216
       7       1982        1234          10   1338
       8       1982        2273        1200   1200
       9       1982        2160        2000     90
      10       1982        1216         450    120
      11       1982        1338         900    700
      12       1982        1269        3000     10
       1       1983         172         500   1200
       2       1983         160         900   2000
       3       1983         566         200    450
       4       1983        3848         100    900
       5       1983        3220          50   2360
       6       1983        1500         700   2023
       7       1983        4640         900   2967
       8       1983        3900        1500   4426
       9       1983        4600        2500    246
      10       1983        2360        1500   2526
      11       1983        2023         600   1513
      12       1983        2967         650   1500
       1       1984        4426         950   4640
       2       1984         246         200   3900
       3       1984        2526         350   4600
       4       1984        1513         200   2360
       5       1984         525        7000   2023
       6       1984        2833        2500   2967
       7       1984         908         900   4426
       8       1984        2029         500    246
       9       1984        4600         450    350
      10       1984        5910        1000    200
      11       1984         249        1100   7000
      12       1984         353         670   2500
```

WORKED EXAMPLE 1 – DEMAND FILE

```
####3
DEMAND DATA FILE
REALM WORKED EXAMPLES – TUTORIAL 1
TEST DATA
DATE: 20 JUL 1997
(3F12.2)
3
SEASON
YEAR
DEMAND 1
       1.00     1982.00     2700.00
       2.00     1982.00     1300.00
       3.00     1982.00     2100.00
       4.00     1982.00     1500.00
       5.00     1982.00     1600.00
       6.00     1982.00      700.00
       7.00     1982.00     1200.00
       8.00     1982.00     1800.00
       9.00     1982.00     2200.00
      10.00     1982.00     1300.00
      11.00     1982.00     1400.00
      12.00     1982.00     1400.00
       1.00     1983.00     1900.00
       2.00     1983.00     1100.00
       3.00     1983.00     1300.00
       4.00     1983.00      800.00
       5.00     1983.00      500.00
       6.00     1983.00      600.00
       7.00     1983.00      900.00
       8.00     1983.00      300.00
       9.00     1983.00      600.00
      10.00     1983.00     1400.00
      11.00     1983.00     2100.00
      12.00     1983.00     2100.00
       1.00     1984.00     1100.00
       2.00     1984.00     2300.00
       3.00     1984.00     2800.00
       4.00     1984.00     1900.00
       5.00     1984.00      300.00
       6.00     1984.00      600.00
       7.00     1984.00      600.00
       8.00     1984.00      100.00
       9.00     1984.00     1600.00
      10.00     1984.00     1300.00
      11.00     1984.00     2400.00
      12.00     1984.00     2100.00
```

3.2 WORKED EXAMPLE 2

SINGLE RESERVOIR AND SINGLE DEMAND ZONE SYSTEM

DATA FILE: SF1.DAT

```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 3F12.2)
3
SEASON
YEAR
STREAM1
        1.00     1982.00      416.00
        2.00     1982.00      288.00
        3.00     1982.00     1025.00
        4.00     1982.00      450.00
        5.00     1982.00     4988.00
        6.00     1982.00     2249.00
        7.00     1982.00     1234.00
        8.00     1982.00     2273.00
        9.00     1982.00     2160.00
       10.00     1982.00     1216.00
       11.00     1982.00     1338.00
       12.00     1982.00     1269.00
        1.00     1983.00      172.00
        2.00     1983.00      160.00
        3.00     1983.00      566.00
        4.00     1983.00     3848.00
        5.00     1983.00     3220.00
        6.00     1983.00     1500.00
        7.00     1983.00     4640.00
        8.00     1983.00     3900.00
        9.00     1983.00     4600.00
       10.00     1983.00     2360.00
       11.00     1983.00     2023.00
       12.00     1983.00     2967.00
        1.00     1984.00     4426.00
        2.00     1984.00      246.00
        3.00     1984.00     2526.00
        4.00     1984.00     1513.00
        5.00     1984.00      525.00
        6.00     1984.00     2833.00
        7.00     1984.00      908.00
        8.00     1984.00     2029.00
        9.00     1984.00     4600.00
       10.00     1984.00     5910.00
       11.00     1984.00      249.00
       12.00     1984.00      353.00
```

DATA FILE: SF2.DAT

```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 5F12.2)
5
SEASON
YEAR
STREAM1
PAN EVAP
LOCAL RAIN
        1.00     1982.00      416.00       32.10       33.80
        2.00     1982.00      288.00       32.40       32.40
        3.00     1982.00     1025.00       27.60       29.10
        4.00     1982.00      450.00       21.40      123.90
        5.00     1982.00     4988.00       16.00      119.60
        6.00     1982.00     2249.00       12.30      214.60
        7.00     1982.00     1234.00       11.90      315.50
        8.00     1982.00     2273.00       17.10      121.40
        9.00     1982.00     2160.00       17.00       20.60
       10.00     1982.00     1216.00       22.40       24.00
       11.00     1982.00     1338.00       30.00       31.50
       12.00     1982.00     1269.00       30.20       31.40
        1.00     1983.00      172.00       30.80       31.30
        2.00     1983.00      160.00       34.40       35.20
        3.00     1983.00      566.00       28.50      128.90
        4.00     1983.00     3848.00       19.70      221.10
        5.00     1983.00     3220.00       16.40      319.40
        6.00     1983.00     1500.00       11.30      216.00
        7.00     1983.00     4640.00       11.70      114.80
        8.00     1983.00     3900.00       13.70       17.50
        9.00     1983.00     4600.00       16.60       20.30
       10.00     1983.00     2360.00       20.10      123.20
       11.00     1983.00     2023.00       22.80       26.80
       12.00     1983.00     2967.00       29.00       30.80
        1.00     1984.00     4426.00       27.30       29.00
        2.00     1984.00      246.00       28.50       32.10
        3.00     1984.00     2526.00       24.10       26.70
        4.00     1984.00     1513.00       21.30       22.70
        5.00     1984.00      525.00       16.80       20.10
        6.00     1984.00     2833.00       14.60      117.30
        7.00     1984.00      908.00       11.60      214.40
        8.00     1984.00     2029.00       14.00      116.90
        9.00     1984.00     4600.00       15.40       17.80
       10.00     1984.00     5910.00       20.50       23.90
       11.00     1984.00      249.00       25.80       27.50
       12.00     1984.00      353.00       26.50      230.10
```

DATA FILE: DEM.DAT

```
####3
DEMANDS DATAFILE
HISTORICAL DATA
DATA ASSEMBLED AND REFORMATED ON
DATE : 9 JUL 1990
(3F12.2)
3
SEASON
YEAR
DEMAND 1
        1.00     1982.00     2700.00
        2.00     1982.00     1300.00
        3.00     1982.00     2100.00
        4.00     1982.00     1500.00
        5.00     1982.00     1600.00
        6.00     1982.00      700.00
        7.00     1982.00     1200.00
        8.00     1982.00     1800.00
        9.00     1982.00     2200.00
       10.00     1982.00     1300.00
       11.00     1982.00     1400.00
       12.00     1982.00     1400.00
        1.00     1983.00     1900.00
        2.00     1983.00     1100.00
        3.00     1983.00     1300.00
        4.00     1983.00      800.00
        5.00     1983.00        0.00
        6.00     1983.00      600.00
        7.00     1983.00      900.00
        8.00     1983.00      300.00
        9.00     1983.00      600.00
       10.00     1983.00     1400.00
       11.00     1983.00     2100.00
       12.00     1983.00     2100.00
        1.00     1984.00     1100.00
        2.00     1984.00     2300.00
        3.00     1984.00     2800.00
        4.00     1984.00     1900.00
        5.00     1984.00      300.00
        6.00     1984.00      600.00
        7.00     1984.00      600.00
        8.00     1984.00      100.00
        9.00     1984.00     1600.00
       10.00     1984.00     1300.00
       11.00     1984.00     2400.00
       12.00     1984.00     2100.00
```

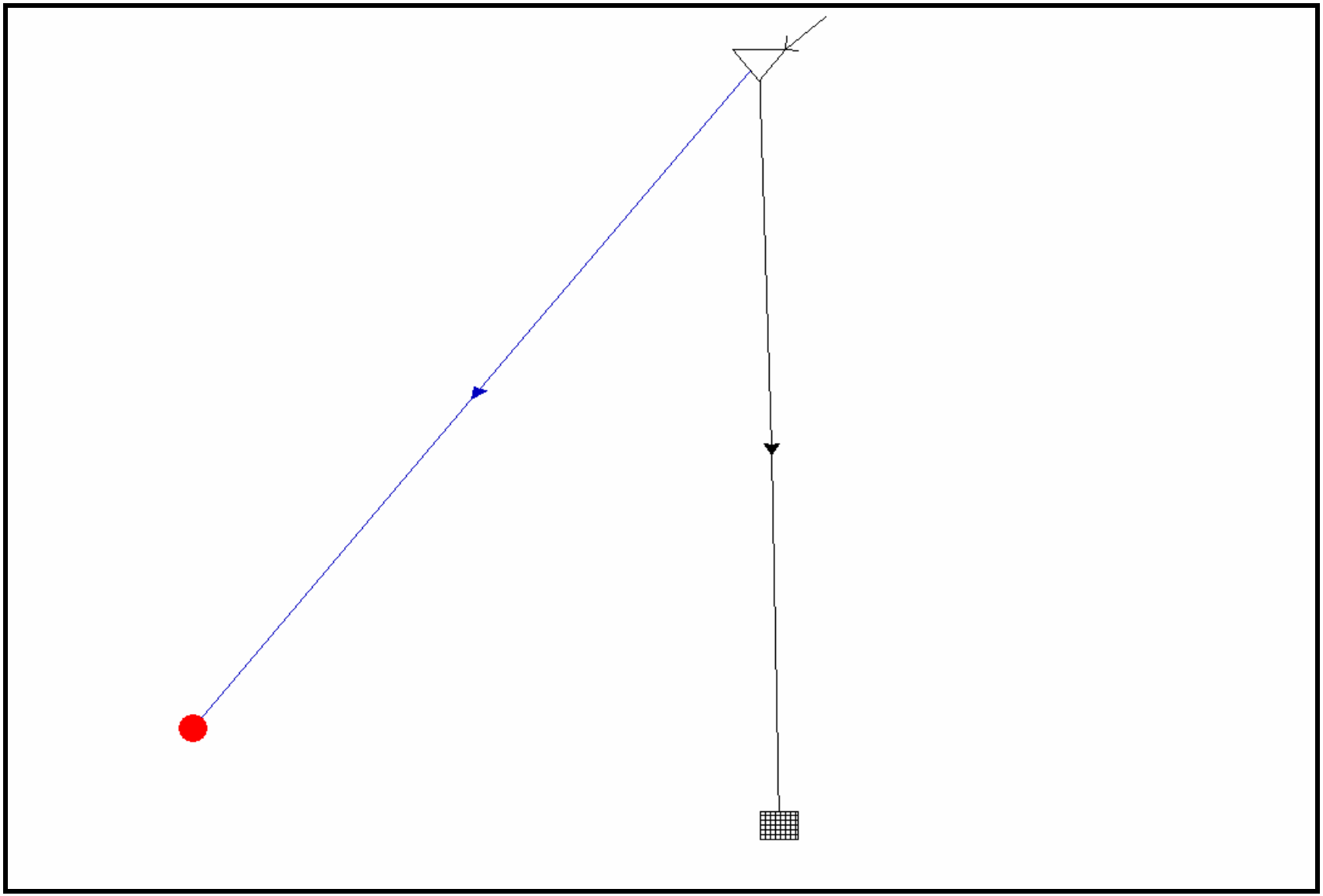

Figure 3.2-1 Worked Example 2(a) – System Plot (*EX2A.sys*)

WORKED EXAMPLE 2(a) – SYSTEM LISTING

```
_____________________________________________________________

              R      E      A      L      M
_____________________________________________________________

            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX2A.sys

 Simulation label:
     Tutorial 2 - Sub-Problem (a)



 Date: 14:45:30 12/04/01


--------------------------------
|  NODE INFORMATION            |
--------------------------------

-------------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input           No
-------------------------------------------------------------------------------------------------------------
   1 RESERVOIR 1          Reservoir          48.63     93.12     0.00     1.00 STREAM1                 1
   2 DEMAND 1             Demand             49.84      7.46     0.00     1.00                         2
   3 Stream Terminator    Strm terminator    14.44     18.32     0.00     1.00                         3


Reservoir data:

      No       Name               Min     Max    No   No     Spill
                                  Cap     Cap  Above Below    Type
     ------------------------------------------------------------------
        1 RESERVOIR 1                0    12000  1    1     Downstream

     No       Name                            Levels/volume relationships
                                    pt1     pt2     pt3     pt4     pt5     pt6    pt7    pt8     pt9     pt10     pt11   pt12    pt13   pt14    pt15
     ------------------------------------------------------------------------------------------------------------------
        1 RESERVOIR 1         Vol        0       0       0       0       0       0       0       0       0       0       0       0       0       0       0
                              Lvl     0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	PIPE 1	Pipe	1	2	0	0	0fix	0		0%	1
2	River 1	River	1	3	1000	0	0fix	0		0%	2

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	PIPE 1	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
2	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

WORKED EXAMPLE 2(a) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX2A.log

 Scenario file: scn2a.scn

 Simulation label:
     Tutorial 2 Sub-Problem (a)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf1.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 14:47:49 12/04/01
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX2A.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX2A.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     3579.     9427.        0.      736.        0.     8102.
-------------------------------------------------------------------------------------------------------------
                              9000.     2083.        0.     9427.        0.      736.        0.     8102.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	0.	1372.
		1372.	1372.	1372.	0.	1372.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	PIPE 1	1372.2	12000.0	0.0	2800.0	0.0
2	River 1	735.5	99999999.0	0.0	4610.0	0.0
						0.

End run

WORKED EXAMPLE 2(a) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX2A.log                    Time :00:02:20 Date :07/21/97
Tutorial 2(a)


(F4.0,2F6.0,  1f12.2              )
4
SEASON
YEAR
REPLICATE
RESERVOIR 1     ESTO
  1. 1982.    1.     6716.00
  2. 1982.    1.     5704.00
  3. 1982.    1.     4629.00
  4. 1982.    1.     3579.00
  5. 1982.    1.     6967.00
  6. 1982.    1.     8516.00
  7. 1982.    1.     8550.00
  8. 1982.    1.     9023.00
  9. 1982.    1.     8983.00
 10. 1982.    1.     8899.00
 11. 1982.    1.     8837.00
 12. 1982.    1.     8706.00
  1. 1983.    1.     6978.00
  2. 1983.    1.     6038.00
  3. 1983.    1.     5304.00
  4. 1983.    1.     8352.00
  5. 1983.    1.    11572.00
  6. 1983.    1.    12000.00
  7. 1983.    1.    12000.00
  8. 1983.    1.    12000.00
  9. 1983.    1.    12000.00
 10. 1983.    1.    12000.00
 11. 1983.    1.    11923.00
 12. 1983.    1.    12000.00
  1. 1984.    1.    12000.00
  2. 1984.    1.     9946.00
  3. 1984.    1.     9672.00
  4. 1984.    1.     9285.00
  5. 1984.    1.     9510.00
  6. 1984.    1.    11743.00
  7. 1984.    1.    12000.00
  8. 1984.    1.    12000.00
  9. 1984.    1.    12000.00
 10. 1984.    1.    12000.00
 11. 1984.    1.     9849.00
 12. 1984.    1.     8102.00
```

WORKED EXAMPLE 2(a) – CARRIER FLOW

```
CARRIER FLOWS
EX2A.log                          Time :14:47:49 Date :12/04/01
Tutorial 2 Sub-Problem (a)


(F4.0,2F6.0,  2f12.2               )
  5
SEASON
YEAR
REPLICATE
PIPE 1          FLOW
River 1         FLOW
  1. 1982.    1.     2700.00        0.00
  2. 1982.    1.     1300.00        0.00
  3. 1982.    1.     2100.00        0.00
  4. 1982.    1.     1500.00        0.00
  5. 1982.    1.     1600.00        0.00
  6. 1982.    1.      700.00        0.00
  7. 1982.    1.     1200.00        0.00
  8. 1982.    1.     1800.00        0.00
  9. 1982.    1.     2200.00        0.00
 10. 1982.    1.     1300.00        0.00
 11. 1982.    1.     1400.00        0.00
 12. 1982.    1.     1400.00        0.00
  1. 1983.    1.     1900.00        0.00
  2. 1983.    1.     1100.00        0.00
  3. 1983.    1.     1300.00        0.00
  4. 1983.    1.      800.00        0.00
  5. 1983.    1.        0.00        0.00
  6. 1983.    1.      600.00      472.00
  7. 1983.    1.      900.00     3740.00
  8. 1983.    1.      300.00     3600.00
  9. 1983.    1.      600.00     4000.00
 10. 1983.    1.     1400.00      960.00
 11. 1983.    1.     2100.00        0.00
 12. 1983.    1.     2100.00      790.00
  1. 1984.    1.     1100.00     3326.00
  2. 1984.    1.     2300.00        0.00
  3. 1984.    1.     2800.00        0.00
  4. 1984.    1.     1900.00        0.00
  5. 1984.    1.      300.00        0.00
  6. 1984.    1.      600.00        0.00
  7. 1984.    1.      600.00       51.00
  8. 1984.    1.      100.00     1929.00
  9. 1984.    1.     1600.00     3000.00
 10. 1984.    1.     1300.00     4610.00
 11. 1984.    1.     2400.00        0.00
 12. 1984.    1.     2100.00        0.00
```

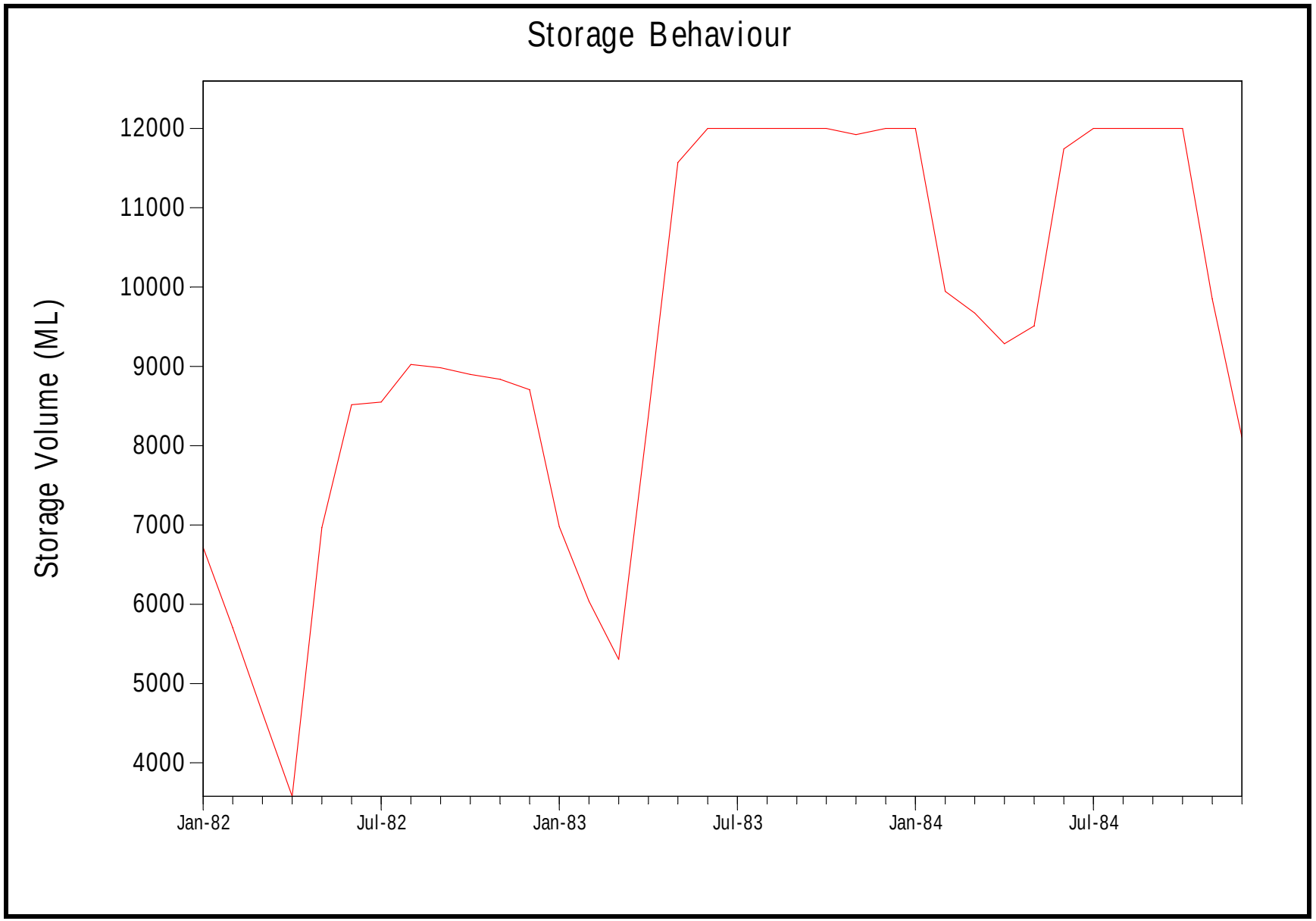

Figure 3.2-2 Worked Example 2(a) – Time Series Plot of Storage Behaviour

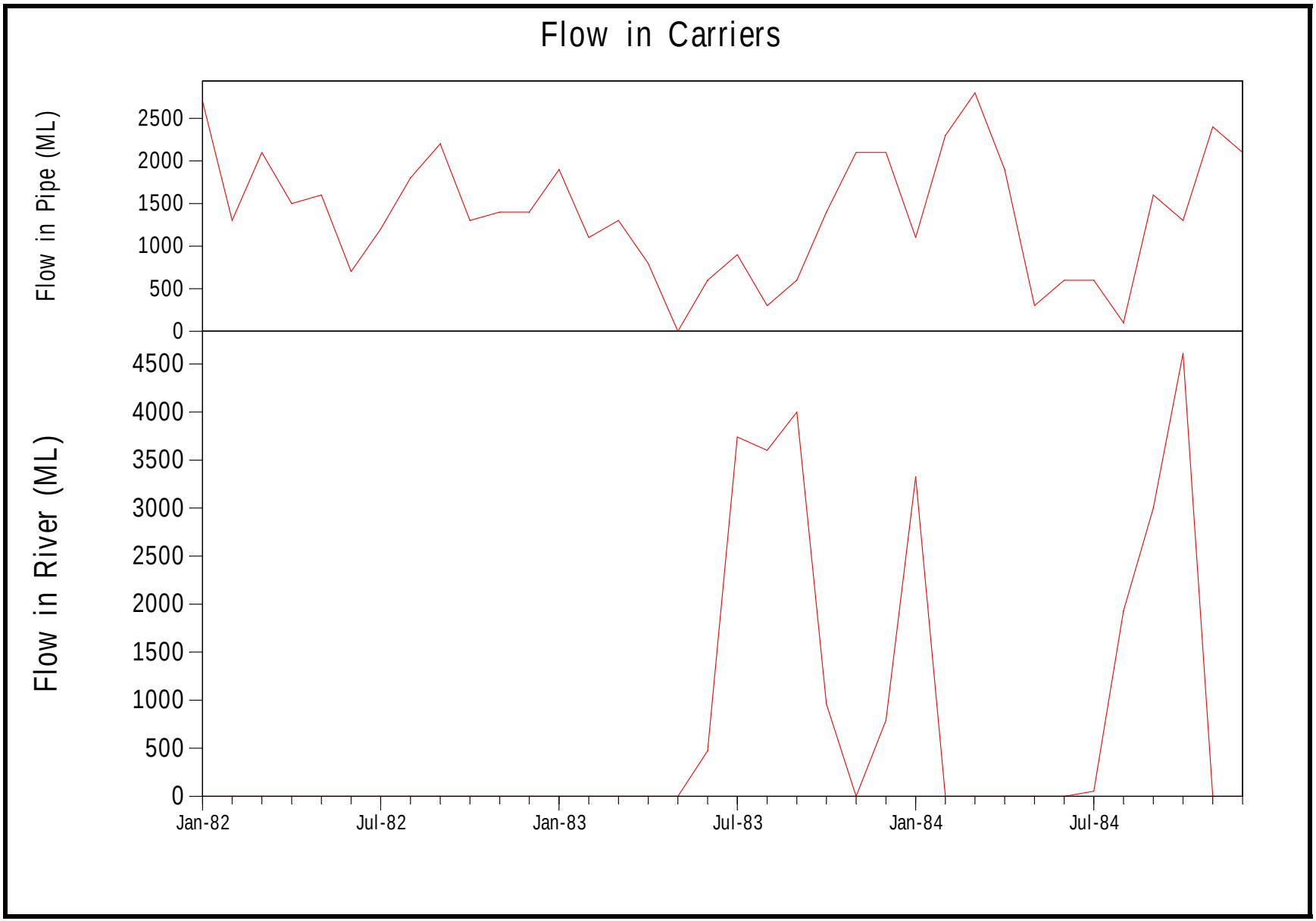

Figure 3.2-3 Worked Example 2(a) – Time Series Plot of Flow in Carriers

WORKED EXAMPLE 2(b) - SYSTEM LISTING

```
_____________________________________________________________

              R      E      A      L      M
_____________________________________________________________


            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX2B.sys

 Simulation label:
     Tutorial 2 - Sub-Problem (b)



 Date: 14:53:10 12/04/01



-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input          No
-------------------------------------------------------------------------------------------------------------
   1 RESERVOIR 1          Reservoir          48.63    93.12     0.00     1.00 STREAM1                1
   2 DEMAND 1             Demand             49.84     7.46     0.00     1.00                        2
   3 Stream Terminator    Strm terminator    14.44    18.32     0.00     1.00                        3


 Reservoir data:

      No       Name               Min      Max    No   No     Spill
                                  Cap      Cap  Above Below    Type
    ------------------------------------------------------------------
       1 RESERVOIR 1                0    12000  1    1     Downstream
```

Reservoir evaps: (if A=B=0 evaps not calculated!)

No	Name	NET EVAP =	(A	+	B	*	EVAPORATION)	-	RAINFALL
1	RESERVOIR 1		0.500		3.000		PAN EVAP		LOCAL RAIN

No	Name		Surface area/volume relationships									
			pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10
1	RESERVOIR 1	Vol	0	500	1000	4000	6000	8000	9000	10000	11000	12000
		Area	0	10	30	40	50	60	70	80	90	100

No	Name		Levels/volume relationships														
			pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR 1	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No	S/F		Monthly Factors											
		Bypass	Priority		Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	PIPE 1	Pipe	1	2	0	0	0fix	0		0%	1
2	River 1	River	1	3	1000	0	0fix	0		0%	2

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	PIPE 1	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
2	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

WORKED EXAMPLE 2(b) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX2B.log

 Scenario file: scn2b.scn

 Simulation label:
     Tutorial 2 Sub-Problem (b)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf2.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 14:51:53 12/04/01
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX2B.sys
 --------------------------------

 Total number of seasons:-   36









 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX2B.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     3501.     9460.      -17.      750.        0.     8166.
-------------------------------------------------------------------------------------------------------------
                              9000.     2083.        0.     9460.      -17.      750.        0.     8166.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	0.	1372.
		1372.	1372.	1372.	0.	1372.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	PIPE 1	1372.2	12000.0	0.0	2800.0	0.0
2	River 1	750.3	99999999.0	0.0	4571.0	0.0
						0.

End run

WORKED EXAMPLE 2(b) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX2B.log                          Time :12:02:35 Date :12/04/01
Tutorial 2 Sub-Problem (b)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
RESERVOIR 1     ESTO
  1. 1982.    1.     6673.00
  2. 1982.    1.     5627.00
  3. 1982.    1.     4526.00
  4. 1982.    1.     3501.00
  5. 1982.    1.     6916.00
  6. 1982.    1.     8561.00
  7. 1982.    1.     8776.00
  8. 1982.    1.     9295.00
  9. 1982.    1.     9234.00
 10. 1982.    1.     9120.00
 11. 1982.    1.     9017.00
 12. 1982.    1.     8845.00
  1. 1983.    1.     7075.00
  2. 1983.    1.     6098.00
  3. 1983.    1.     5384.00
  4. 1983.    1.     8505.00
  5. 1983.    1.    11900.00
  6. 1983.    1.    12000.00
  7. 1983.    1.    12000.00
  8. 1983.    1.    12000.00
  9. 1983.    1.    12000.00
 10. 1983.    1.    12000.00
 11. 1983.    1.    11881.00
 12. 1983.    1.    12000.00
  1. 1984.    1.    12000.00
  2. 1984.    1.     9891.00
  3. 1984.    1.     9582.00
  4. 1984.    1.     9165.00
  5. 1984.    1.     9368.00
  6. 1984.    1.    11653.00
  7. 1984.    1.    12000.00
  8. 1984.    1.    12000.00
  9. 1984.    1.    12000.00
 10. 1984.    1.    12000.00
 11. 1984.    1.     9799.00
 12. 1984.    1.     8166.00
```

WORKED EXAMPLE 2(b) – RESERVOIR EVAPORATION

```
RESERVOIR EVAPS
EX2B.log                          Time :12:02:35 Date :12/04/01
Tutorial 2 Sub-Problem (b)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
RESERVOIR 1     EVAP
  1. 1982.    1.       43.00
  2. 1982.    1.       34.00
  3. 1982.    1.       26.00
  4. 1982.    1.      -25.00
  5. 1982.    1.      -27.00
  6. 1982.    1.      -96.00
  7. 1982.    1.     -181.00
  8. 1982.    1.      -46.00
  9. 1982.    1.       21.00
 10. 1982.    1.       30.00
 11. 1982.    1.       41.00
 12. 1982.    1.       41.00
  1. 1983.    1.       42.00
  2. 1983.    1.       37.00
  3. 1983.    1.      -20.00
  4. 1983.    1.      -73.00
  5. 1983.    1.     -175.00
  6. 1983.    1.     -180.00
  7. 1983.    1.      -78.00
  8. 1983.    1.       24.00
  9. 1983.    1.       31.00
 10. 1983.    1.      -62.00
 11. 1983.    1.       42.00
 12. 1983.    1.       55.00
  1. 1984.    1.       52.00
  2. 1984.    1.       55.00
  3. 1984.    1.       35.00
  4. 1984.    1.       30.00
  5. 1984.    1.       22.00
  6. 1984.    1.      -52.00
  7. 1984.    1.     -170.00
  8. 1984.    1.      -74.00
  9. 1984.    1.       27.00
 10. 1984.    1.       39.00
 11. 1984.    1.       50.00
 12. 1984.    1.     -114.00
```

WORKED EXAMPLE 2(b) – CARRIER FLOW

```
CARRIER FLOWS
EX2B.log                          Time :12:02:35 Date :12/04/01
Tutorial 2 Sub-Problem (b)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
PIPE 1          FLOW
  1. 1982.    1.     2700.00
  2. 1982.    1.     1300.00
  3. 1982.    1.     2100.00
  4. 1982.    1.     1500.00
  5. 1982.    1.     1600.00
  6. 1982.    1.      700.00
  7. 1982.    1.     1200.00
  8. 1982.    1.     1800.00
  9. 1982.    1.     2200.00
 10. 1982.    1.     1300.00
 11. 1982.    1.     1400.00
 12. 1982.    1.     1400.00
  1. 1983.    1.     1900.00
  2. 1983.    1.     1100.00
  3. 1983.    1.     1300.00
  4. 1983.    1.      800.00
  5. 1983.    1.        0.00
  6. 1983.    1.      600.00
  7. 1983.    1.      900.00
  8. 1983.    1.      300.00
  9. 1983.    1.      600.00
 10. 1983.    1.     1400.00
 11. 1983.    1.     2100.00
 12. 1983.    1.     2100.00
  1. 1984.    1.     1100.00
  2. 1984.    1.     2300.00
  3. 1984.    1.     2800.00
  4. 1984.    1.     1900.00
  5. 1984.    1.      300.00
  6. 1984.    1.      600.00
  7. 1984.    1.      600.00
  8. 1984.    1.      100.00
  9. 1984.    1.     1600.00
 10. 1984.    1.     1300.00
 11. 1984.    1.     2400.00
 12. 1984.    1.     2100.00
```

WORKED EXAMPLE 2(b) - COMPARISON OF STORAGE VOLUME

```
####4
EX2A.log + EX2B.log                          Time :11:24:06 Date
:12/04/01
Tutorial 2 Sub-Problem (a) and (b)


(  4f12.2               )
   4
SEASON
YEAR
RESERVOIR 1     ESTO (without evap)
RESERVOIR 1     ESTO (with evap)
        1.00     1982.00     6716.00     6673.00
        2.00     1982.00     5704.00     5627.00
        3.00     1982.00     4629.00     4526.00
        4.00     1982.00     3579.00     3501.00
        5.00     1982.00     6967.00     6916.00
        6.00     1982.00     8516.00     8561.00
        7.00     1982.00     8550.00     8776.00
        8.00     1982.00     9023.00     9295.00
        9.00     1982.00     8983.00     9234.00
       10.00     1982.00     8899.00     9120.00
       11.00     1982.00     8837.00     9017.00
       12.00     1982.00     8706.00     8845.00
        1.00     1983.00     6978.00     7075.00
        2.00     1983.00     6038.00     6098.00
        3.00     1983.00     5304.00     5384.00
        4.00     1983.00     8352.00     8505.00
        5.00     1983.00    11572.00    11900.00
        6.00     1983.00    12000.00    12000.00
        7.00     1983.00    12000.00    12000.00
        8.00     1983.00    12000.00    12000.00
        9.00     1983.00    12000.00    12000.00
       10.00     1983.00    12000.00    12000.00
       11.00     1983.00    11923.00    11881.00
       12.00     1983.00    12000.00    12000.00
        1.00     1984.00    12000.00    12000.00
        2.00     1984.00     9946.00     9891.00
        3.00     1984.00     9672.00     9582.00
        4.00     1984.00     9285.00     9165.00
        5.00     1984.00     9510.00     9368.00
        6.00     1984.00    11743.00    11653.00
        7.00     1984.00    12000.00    12000.00
        8.00     1984.00    12000.00    12000.00
        9.00     1984.00    12000.00    12000.00
       10.00     1984.00    12000.00    12000.00
       11.00     1984.00     9849.00     9799.00
       12.00     1984.00     8102.00     8166.00
```

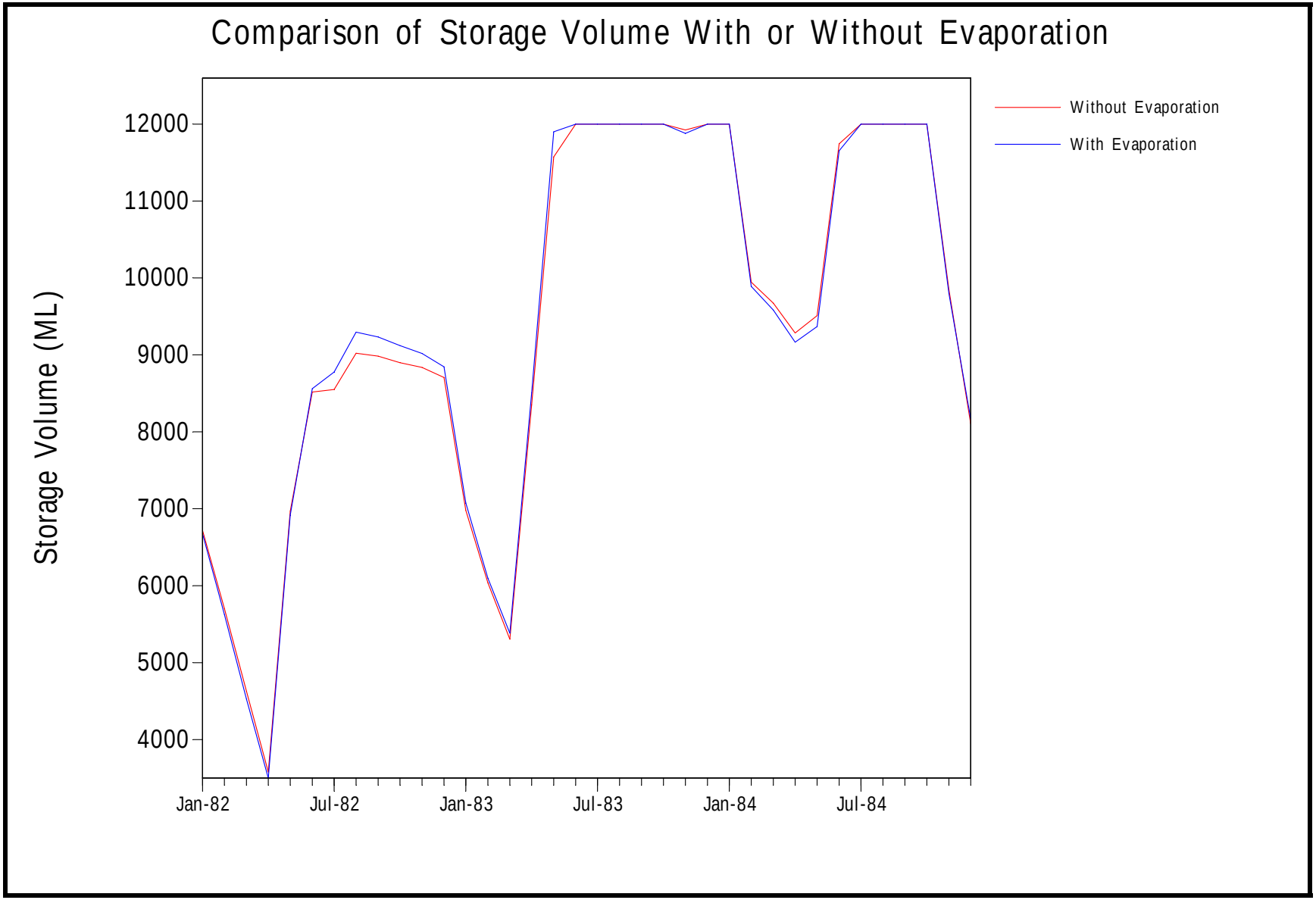

Figure 3.2-4 Worked Example 2(b) – Time Series Plot of Storage Behavior With and Without Evaporation

WORKED EXAMPLE 2(c)- SYSTEM LISTING

R E A L M

****
* SYSTEM FILE LISTING *
****

File: C:\REALM\WorkedExamples\EX2C.sys

Simulation label:
Tutorial 2 - Sub-Problem (c)

Date: 14:57:29 12/04/01

| NODE INFORMATION |

| NODE INFORMATION |

No	Name	Type	X	Y	Z	Size	Aux Input	No
1	RESERVOIR 1	Reservoir	48.63	93.12	0.00	1.00	STREAM1	1
2	DEMAND 1	Demand	49.84	7.46	0.00	1.00		2
3	Stream Terminator	Strm terminator	14.44	18.32	0.00	1.00		3

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
1	RESERVOIR 1	0	12000	1	1	Downstream

No	Name		Levels/volume relationships pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR 1	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	PIPE 1	Pipe	1	2	0	0	0fix	0		0%	1
2	River 1	River	1	3	1000	0	0fix	0		0%	2

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	PIPE 1	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350
2	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

WORKED EXAMPLE 2(c)- LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX2C.log

 Scenario file: scn2c.scn

 Simulation label:
     Tutorial 2 Sub-Problem (c)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf1.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 14:59:17 12/04/01
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX2C.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX2C.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     3929.     9640.        0.      758.        0.     8152.
-------------------------------------------------------------------------------------------------------------
                              9000.     2083.        0.     9640.        0.      758.        0.     8152.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	24.	1349.
		1372.	1372.	1372.	24.	1349.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	3.0	10.0	16.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	PIPE 1	1348.6	2350.0	0.0	2350.0	0.0
2	River 1	757.7	99999999.0	0.0	4610.0	0.0
						0.

End run

WORKED EXAMPLE 2(c) - RESERVOIR VOLUME

RESERVOIR STORAGE
EX2C.log Time :14:59:17 Date :12/04/01
Tutorial 2 Sub-Problem (c)

(F4.0,2F6.0, 1f12.2)
4
SEASON
YEAR
REPLICATE
RESERVOIR 1 ESTO

1.	1982.	1.	7066.00
2.	1982.	1.	6054.00
3.	1982.	1.	4979.00
4.	1982.	1.	3929.00
5.	1982.	1.	7317.00
6.	1982.	1.	8866.00
7.	1982.	1.	8900.00
8.	1982.	1.	9373.00
9.	1982.	1.	9333.00
10.	1982.	1.	9249.00
11.	1982.	1.	9187.00
12.	1982.	1.	9056.00
1.	1983.	1.	7328.00
2.	1983.	1.	6388.00
3.	1983.	1.	5654.00
4.	1983.	1.	8702.00
5.	1983.	1.	11922.00
6.	1983.	1.	12000.00
7.	1983.	1.	12000.00
8.	1983.	1.	12000.00
9.	1983.	1.	12000.00
10.	1983.	1.	12000.00
11.	1983.	1.	11923.00
12.	1983.	1.	12000.00
1.	1984.	1.	12000.00
2.	1984.	1.	9946.00
3.	1984.	1.	10122.00
4.	1984.	1.	9735.00
5.	1984.	1.	9960.00
6.	1984.	1.	12000.00
7.	1984.	1.	12000.00
8.	1984.	1.	12000.00
9.	1984.	1.	12000.00
10.	1984.	1.	12000.00
11.	1984.	1.	9899.00
12.	1984.	1.	8152.00

WORKED EXAMPLE 2(c) - DEMAND SHORTFALLS

DEMAND SHORTFALL
EX2C.log Time :14:59:17 Date :12/04/01
Tutorial 2 Sub-Problem (c)

(F4.0,2F6.0, 1f12.2)
4
SEASON
YEAR
REPLICATE
DEMAND 1 SHRT

1.	1982.	1.	350.00
2.	1982.	1.	0.00
3.	1982.	1.	0.00
4.	1982.	1.	0.00
5.	1982.	1.	0.00
6.	1982.	1.	0.00
7.	1982.	1.	0.00
8.	1982.	1.	0.00
9.	1982.	1.	0.00
10.	1982.	1.	0.00
11.	1982.	1.	0.00
12.	1982.	1.	0.00
1.	1983.	1.	0.00
2.	1983.	1.	0.00
3.	1983.	1.	0.00
4.	1983.	1.	0.00
5.	1983.	1.	0.00
6.	1983.	1.	0.00
7.	1983.	1.	0.00
8.	1983.	1.	0.00
9.	1983.	1.	0.00
10.	1983.	1.	0.00
11.	1983.	1.	0.00
12.	1983.	1.	0.00
1.	1984.	1.	0.00
2.	1984.	1.	0.00
3.	1984.	1.	450.00
4.	1984.	1.	0.00
5.	1984.	1.	0.00
6.	1984.	1.	0.00
7.	1984.	1.	0.00
8.	1984.	1.	0.00
9.	1984.	1.	0.00
10.	1984.	1.	0.00
11.	1984.	1.	50.00
12.	1984.	1.	0.00

WORKED EXAMPLE 2(c) - CARRIER FLOW

```
CARRIER FLOWS
EX2C.log                          Time :11:16:34 Date :12/05/01
Tutorial 2 Sub-Problem (c)


(F4.0,2F6.0,  1f12.2               )
  4
SEASON
YEAR
REPLICATE
PIPE 1          FLOW
  1. 1982.    1.     2350.00
  2. 1982.    1.     1300.00
  3. 1982.    1.     2100.00
  4. 1982.    1.     1500.00
  5. 1982.    1.     1600.00
  6. 1982.    1.      700.00
  7. 1982.    1.     1200.00
  8. 1982.    1.     1800.00
  9. 1982.    1.     2200.00
 10. 1982.    1.     1300.00
 11. 1982.    1.     1400.00
 12. 1982.    1.     1400.00
  1. 1983.    1.     1900.00
  2. 1983.    1.     1100.00
  3. 1983.    1.     1300.00
  4. 1983.    1.      800.00
  5. 1983.    1.        0.00
  6. 1983.    1.      600.00
  7. 1983.    1.      900.00
  8. 1983.    1.      300.00
  9. 1983.    1.      600.00
 10. 1983.    1.     1400.00
 11. 1983.    1.     2100.00
 12. 1983.    1.     2100.00
  1. 1984.    1.     1100.00
  2. 1984.    1.     2300.00
  3. 1984.    1.     2350.00
  4. 1984.    1.     1900.00
  5. 1984.    1.      300.00
  6. 1984.    1.      600.00
  7. 1984.    1.      600.00
  8. 1984.    1.      100.00
  9. 1984.    1.     1600.00
 10. 1984.    1.     1300.00
 11. 1984.    1.     2350.00
 12. 1984.    1.     2100.00
```

WORKED EXAMPLE 2(c) - COMPARISON OF DEMAND, FLOW IN PIPE AND DEMAND SHORTFALLS

```
####4
EX2C.log                          Time :09:49:34 Date :01/11/02
Tutorial 2 Sub-Problem (c)


(  6f12.2              )
   6
SEASON
YEAR
PIPE 1          FLOW
PIPE 1          CAPC
DEMAND 1        SHRT
DEMAND 1        UNRS
        1.00     1982.00     2350.00     2350.00      350.00     2700.00
        2.00     1982.00     1300.00     2350.00        0.00     1300.00
        3.00     1982.00     2100.00     2350.00        0.00     2100.00
        4.00     1982.00     1500.00     2350.00        0.00     1500.00
        5.00     1982.00     1600.00     2350.00        0.00     1600.00
        6.00     1982.00      700.00     2350.00        0.00      700.00
        7.00     1982.00     1200.00     2350.00        0.00     1200.00
        8.00     1982.00     1800.00     2350.00        0.00     1800.00
        9.00     1982.00     2200.00     2350.00        0.00     2200.00
       10.00     1982.00     1300.00     2350.00        0.00     1300.00
       11.00     1982.00     1400.00     2350.00        0.00     1400.00
       12.00     1982.00     1400.00     2350.00        0.00     1400.00
        1.00     1983.00     1900.00     2350.00        0.00     1900.00
        2.00     1983.00     1100.00     2350.00        0.00     1100.00
        3.00     1983.00     1300.00     2350.00        0.00     1300.00
        4.00     1983.00      800.00     2350.00        0.00      800.00
        5.00     1983.00        0.00     2350.00        0.00        0.00
        6.00     1983.00      600.00     2350.00        0.00      600.00
        7.00     1983.00      900.00     2350.00        0.00      900.00
        8.00     1983.00      300.00     2350.00        0.00      300.00
        9.00     1983.00      600.00     2350.00        0.00      600.00
       10.00     1983.00     1400.00     2350.00        0.00     1400.00
       11.00     1983.00     2100.00     2350.00        0.00     2100.00
       12.00     1983.00     2100.00     2350.00        0.00     2100.00
        1.00     1984.00     1100.00     2350.00        0.00     1100.00
        2.00     1984.00     2300.00     2350.00        0.00     2300.00
        3.00     1984.00     2350.00     2350.00      450.00     2800.00
        4.00     1984.00     1900.00     2350.00        0.00     1900.00
        5.00     1984.00      300.00     2350.00        0.00      300.00
        6.00     1984.00      600.00     2350.00        0.00      600.00
        7.00     1984.00      600.00     2350.00        0.00      600.00
        8.00     1984.00      100.00     2350.00        0.00      100.00
        9.00     1984.00     1600.00     2350.00        0.00     1600.00
       10.00     1984.00     1300.00     2350.00        0.00     1300.00
       11.00     1984.00     2350.00     2350.00       50.00     2400.00
       12.00     1984.00     2100.00     2350.00        0.00     2100.00
```

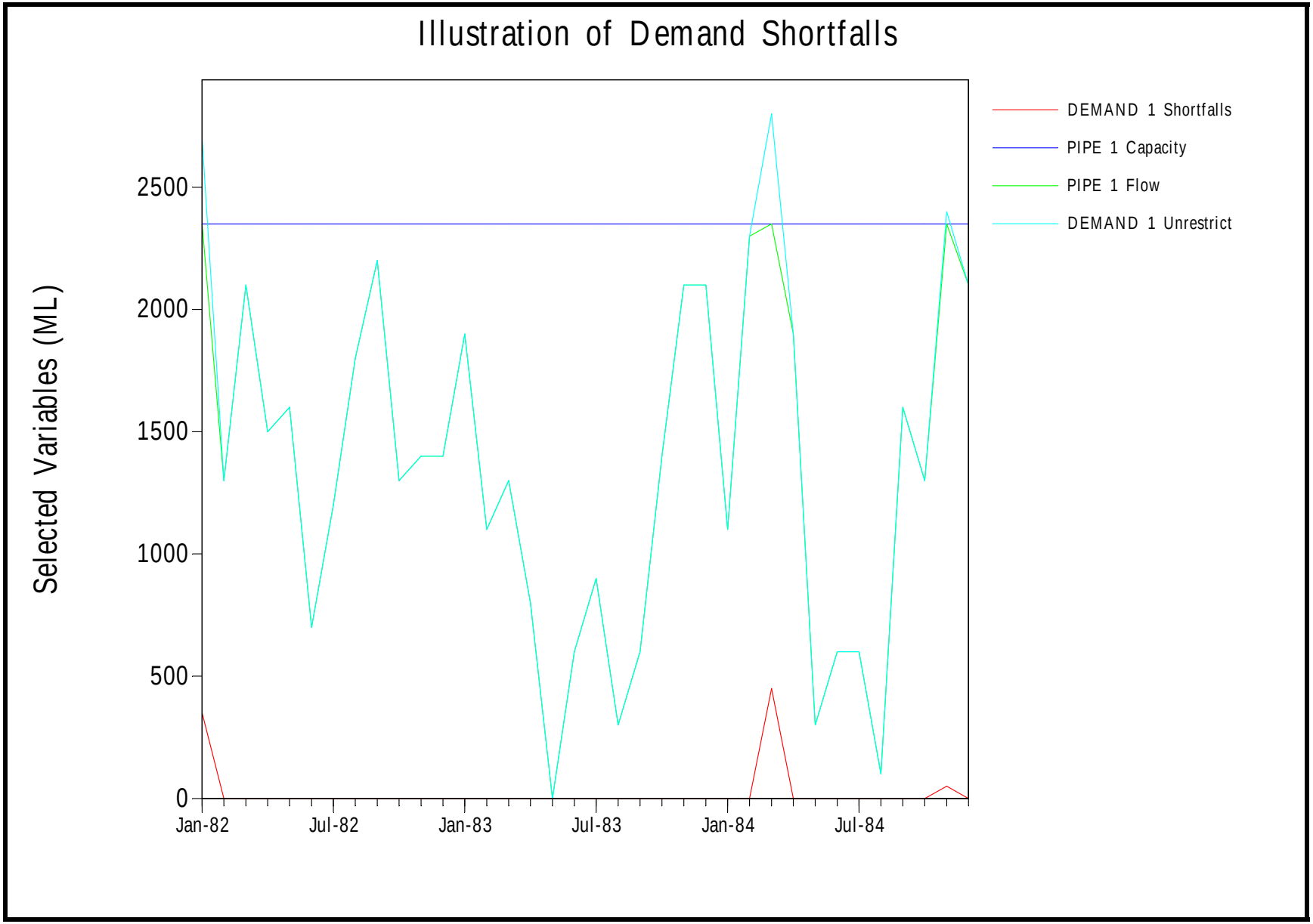

Figure 3.2-5 Worked Example 2(c) – Illustration of Demand Shortfalls

WORKED EXAMPLE 2(d) - SYSTEM LISTING

R E A L M

****
* SYSTEM FILE LISTING *
****

File: C:\REALM\WorkedExamples\EX2D.sys

Simulation label:
Tutorial 2 - Sub-Problem (d)

Date: 07:05 20/03/2005

| NODE INFORMATION |

No	Name	Type	X	Y	Z	Size	Aux Input	No
1	RESERVOIR 1	Reservoir	48.63	93.12	0.00	1.00	STREAM1	1
2	DEMAND 1	Demand	49.84	7.46	0.00	1.00		2
3	Stream Terminator	Strm terminator	14.44	18.32	0.00	1.00		3

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
1	RESERVOIR 1	0	12000	1	1	Downstream

No	Name		Levels/volume relationships													
			pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR 1	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	PIPE 1	Pipe	1	2	0	0	0fix	0		0%	1
2	River 1	River	1	3	1000	0	0fix	0		0%	2

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

Functional Capacities

No	Name		pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12
1	PIPE 1	V	0	6000	12000	0	0	0	0	0	0	0	0	0
	Fn Name:	C	0	1200	2400	0	0	0	0	0	0	0	0	0

Equation used: '1
' 1 = RESERVOIR 1 Type: STOR
Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2

WORKED EXAMPLE 2(d) - LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H          HHHHHHHHHH
      H   H     H           H    H    H          H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH        HHH  H   H
      HHH    H  HHH        HHH    H   HHH        HHH  H   H
      HHH    H  HHH        HHH    H   HHH        HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH   HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX2D.log

 Scenario file: scn2d.scn

 Simulation label:
     Tutorial 2 Sub-Problem (d)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf1.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 12:20:18 01/11/02
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX2D.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX2D.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     5496.    10473.        0.      825.        0.     8232.
-------------------------------------------------------------------------------------------------------------
                              9000.     2083.        0.    10473.        0.      825.        0.     8232.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	93.	1279.
		1372.	1372.	1372.	93.	1279.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	6.0	25.0	37.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	PIPE 1	1278.9	2098.9	0.0	2400.0	0.0
2	River 1	825.2	99999999.0	0.0	4610.0	0.0
						0.

End run

WORKED EXAMPLE 2(d) - RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX2D.log                          Time :15:17:50 Date :12/04/01
Tutorial 2 Sub-Problem (d)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
RESERVOIR 1     ESTO
  1. 1982.    1.     7616.00
  2. 1982.    1.     6604.00
  3. 1982.    1.     6308.00
  4. 1982.    1.     5496.00
  5. 1982.    1.     9385.00
  6. 1982.    1.    10934.00
  7. 1982.    1.    10968.00
  8. 1982.    1.    11441.00
  9. 1982.    1.    11401.00
 10. 1982.    1.    11317.00
 11. 1982.    1.    11255.00
 12. 1982.    1.    11124.00
  1. 1983.    1.     9396.00
  2. 1983.    1.     8456.00
  3. 1983.    1.     7722.00
  4. 1983.    1.    10770.00
  5. 1983.    1.    12000.00
  6. 1983.    1.    12000.00
  7. 1983.    1.    12000.00
  8. 1983.    1.    12000.00
  9. 1983.    1.    12000.00
 10. 1983.    1.    12000.00
 11. 1983.    1.    11923.00
 12. 1983.    1.    12000.00
  1. 1984.    1.    12000.00
  2. 1984.    1.     9946.00
  3. 1984.    1.    10483.00
  4. 1984.    1.    10096.00
  5. 1984.    1.    10321.00
  6. 1984.    1.    12000.00
  7. 1984.    1.    12000.00
  8. 1984.    1.    12000.00
  9. 1984.    1.    12000.00
 10. 1984.    1.    12000.00
 11. 1984.    1.     9849.00
 12. 1984.    1.     8232.00
```

WORKED EXAMPLE 2(d) - CARRIER CAPACITY

```
ARC CAPACITIES
EX2D.log                          Time :12:20:18 Date :01/11/02
Tutorial 2 Sub-Problem (d)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
PIPE 1          CAPC
  1. 1982.    1.     1800.00
  2. 1982.    1.     1523.00
  3. 1982.    1.     1321.00
  4. 1982.    1.     1262.00
  5. 1982.    1.     1099.00
  6. 1982.    1.     1877.00
  7. 1982.    1.     2187.00
  8. 1982.    1.     2194.00
  9. 1982.    1.     2288.00
 10. 1982.    1.     2280.00
 11. 1982.    1.     2263.00
 12. 1982.    1.     2251.00
  1. 1983.    1.     2225.00
  2. 1983.    1.     1879.00
  3. 1983.    1.     1691.00
  4. 1983.    1.     1544.00
  5. 1983.    1.     2154.00
  6. 1983.    1.     2400.00
  7. 1983.    1.     2400.00
  8. 1983.    1.     2400.00
  9. 1983.    1.     2400.00
 10. 1983.    1.     2400.00
 11. 1983.    1.     2400.00
 12. 1983.    1.     2385.00
  1. 1984.    1.     2400.00
  2. 1984.    1.     2400.00
  3. 1984.    1.     1989.00
  4. 1984.    1.     2097.00
  5. 1984.    1.     2019.00
  6. 1984.    1.     2064.00
  7. 1984.    1.     2400.00
  8. 1984.    1.     2400.00
  9. 1984.    1.     2400.00
 10. 1984.    1.     2400.00
 11. 1984.    1.     2400.00
 12. 1984.    1.     1970.00
```

WORKED EXAMPLE 2(d) - DEMAND SHORTFALLS

```
DEMAND SHORTFALL
EX2D.log                          Time :15:17:50 Date :12/04/01
Tutorial 2 Sub-Problem (d)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
DEMAND 1        SHRT
  1. 1982.    1.      900.00
  2. 1982.    1.        0.00
  3. 1982.    1.      779.00
  4. 1982.    1.      238.00
  5. 1982.    1.      501.00
  6. 1982.    1.        0.00
  7. 1982.    1.        0.00
  8. 1982.    1.        0.00
  9. 1982.    1.        0.00
 10. 1982.    1.        0.00
 11. 1982.    1.        0.00
 12. 1982.    1.        0.00
  1. 1983.    1.        0.00
  2. 1983.    1.        0.00
  3. 1983.    1.        0.00
  4. 1983.    1.        0.00
  5. 1983.    1.        0.00
  6. 1983.    1.        0.00
  7. 1983.    1.        0.00
  8. 1983.    1.        0.00
  9. 1983.    1.        0.00
 10. 1983.    1.        0.00
 11. 1983.    1.        0.00
 12. 1983.    1.        0.00
  1. 1984.    1.        0.00
  2. 1984.    1.        0.00
  3. 1984.    1.      811.00
  4. 1984.    1.        0.00
  5. 1984.    1.        0.00
  6. 1984.    1.        0.00
  7. 1984.    1.        0.00
  8. 1984.    1.        0.00
  9. 1984.    1.        0.00
 10. 1984.    1.        0.00
 11. 1984.    1.        0.00
 12. 1984.    1.      130.00
```

WORKED EXAMPLE 2(d) – COMPARISON OF DEMAND, FLOW AND CAPACITY OF PIPE 1 AND SHORTFALLS

```
####4
EX2D.log                          Time :12:20:18 Date :01/11/02
Tutorial 2 Sub-Problem (d)


(  6f12.2              )
   6
SEASON
YEAR
PIPE 1          FLOW
PIPE 1          CAPC
DEMAND 1        SHRT
DEMAND 1        UNRS
       1.00     1982.00     1800.00     1800.00      900.00     2700.00
       2.00     1982.00     1300.00     1523.00        0.00     1300.00
       3.00     1982.00     1321.00     1321.00      779.00     2100.00
       4.00     1982.00     1262.00     1262.00      238.00     1500.00
       5.00     1982.00     1099.00     1099.00      501.00     1600.00
       6.00     1982.00      700.00     1877.00        0.00      700.00
       7.00     1982.00     1200.00     2187.00        0.00     1200.00
       8.00     1982.00     1800.00     2194.00        0.00     1800.00
       9.00     1982.00     2200.00     2288.00        0.00     2200.00
      10.00     1982.00     1300.00     2280.00        0.00     1300.00
      11.00     1982.00     1400.00     2263.00        0.00     1400.00
      12.00     1982.00     1400.00     2251.00        0.00     1400.00
       1.00     1983.00     1900.00     2225.00        0.00     1900.00
       2.00     1983.00     1100.00     1879.00        0.00     1100.00
       3.00     1983.00     1300.00     1691.00        0.00     1300.00
       4.00     1983.00      800.00     1544.00        0.00      800.00
       5.00     1983.00        0.00     2154.00        0.00        0.00
       6.00     1983.00      600.00     2400.00        0.00      600.00
       7.00     1983.00      900.00     2400.00        0.00      900.00
       8.00     1983.00      300.00     2400.00        0.00      300.00
       9.00     1983.00      600.00     2400.00        0.00      600.00
      10.00     1983.00     1400.00     2400.00        0.00     1400.00
      11.00     1983.00     2100.00     2400.00        0.00     2100.00
      12.00     1983.00     2100.00     2385.00        0.00     2100.00
       1.00     1984.00     1100.00     2400.00        0.00     1100.00
       2.00     1984.00     2300.00     2400.00        0.00     2300.00
       3.00     1984.00     1989.00     1989.00      811.00     2800.00
       4.00     1984.00     1900.00     2097.00        0.00     1900.00
       5.00     1984.00      300.00     2019.00        0.00      300.00
       6.00     1984.00      600.00     2064.00        0.00      600.00
       7.00     1984.00      600.00     2400.00        0.00      600.00
       8.00     1984.00      100.00     2400.00        0.00      100.00
       9.00     1984.00     1600.00     2400.00        0.00     1600.00
      10.00     1984.00     1300.00     2400.00        0.00     1300.00
      11.00     1984.00     2400.00     2400.00        0.00     2400.00
      12.00     1984.00     1970.00     1970.00      130.00     2100.00
```

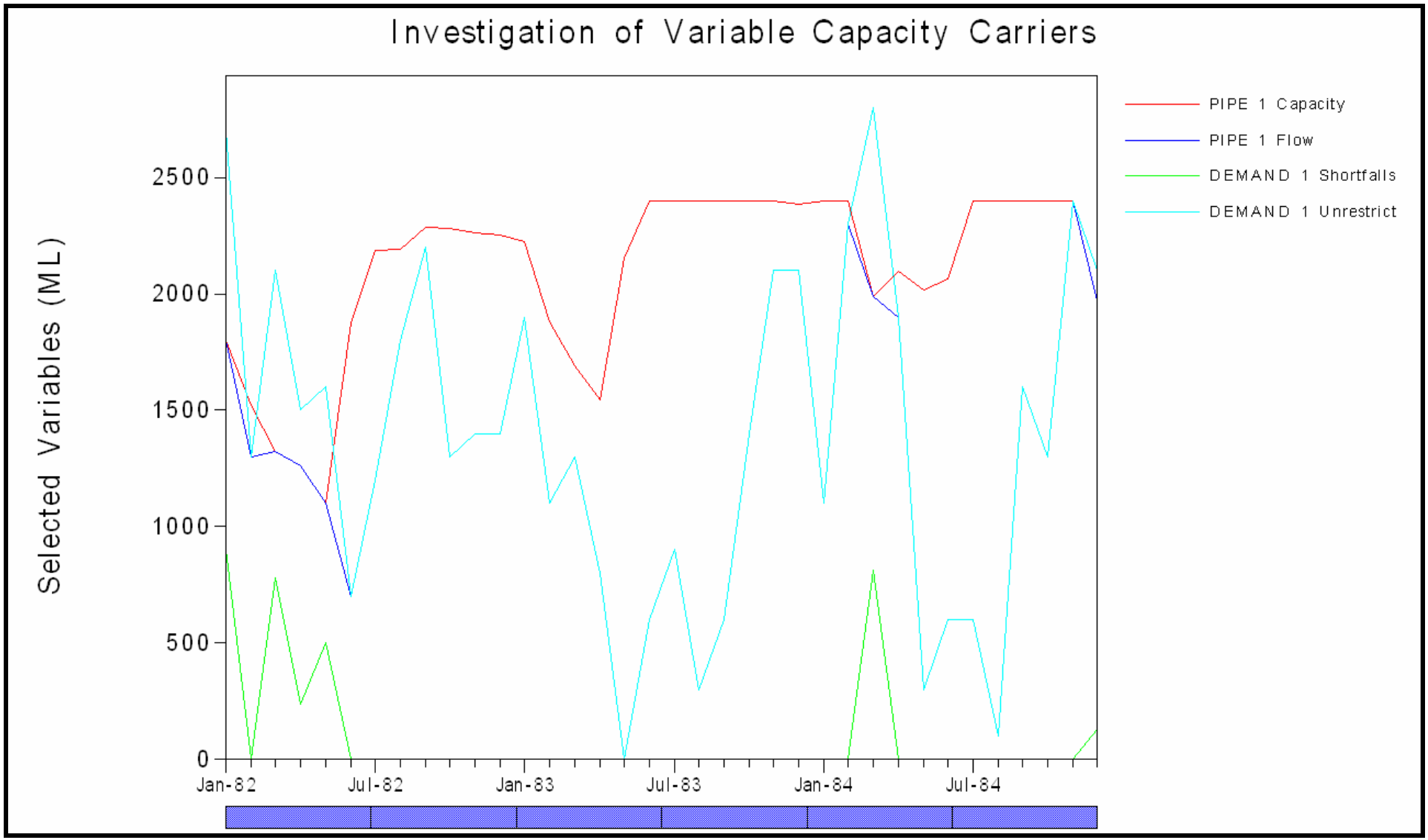

Figure 3.2-6 Worked Example 2(d) – Investigation of Variable Capacity Carriers

WORKED EXAMPLE 2(e) – SYSTEM LISTING

```
                R      E      A      L      M
```

```
             ****************************
             *   SYSTEM FILE LISTING    *
             ****************************

 File: C:\REALM\WorkedExamples\EX2E.sys

 Simulation label:
     Tutorial 2 - Sub-Problem (e)



 Date: 15:42:44 12/04/01
```

```
-------------------------------
|  NODE INFORMATION           |
-------------------------------
```


```
-------------------------------
|  NODE INFORMATION           |
-------------------------------
```


No	Name	Type	X	Y	Z	Size	Aux Input	No
1	RESERVOIR 1	Reservoir	48.63	93.12	0.00	1.00	STREAM1	1
2	DEMAND 1	Demand	49.84	7.46	0.00	1.00		2
3	Stream Terminator	Strm terminator	14.44	18.32	0.00	1.00		3

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
1	RESERVOIR 1	0	12000	1	1	Downstream

No	Name		Levels/volume relationships pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR 1	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	PIPE 1	Pipe	1	2	0	0	0fix	0		0%	1
2	River 1	River	1	3	1000	0	0fix	0		0%	2

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	PIPE 1	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
2	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

RESTRICTION INFORMATION

Number of restriction groups: 1

NB. Each restriction group is treated separately
with its own rule curve definitions;
for irrigation demand groups by its allocations functions.

Restriction Group: 1 Type: Urban/industrial demand centers

Reservoirs/ arcs in Group	Demands in Group
RESERVOIR 1	DEMAND 1

Restriction Level	Relative Position	% of Restrictable Demand Restricted	Storage as % of Average Annual Demand Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0.0	0.0	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00
1	25.0	10.0	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00
2	50.0	20.0	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00
3	75.0	50.0	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00
4	100.0	70.0	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00
Base levels (% AAD)			-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00

NB. Negative values will be interpreted as absolute values

WORKED EXAMPLE 2(e) - LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX2E.log

 Scenario file: scn2e.scn

 Simulation label:
     Tutorial 2 Sub-Problem (e)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf1.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem.dat

 Restrictions are ON

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 15:51:35 12/04/01
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX2E.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX2E.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     4399.     9928.        0.      774.        0.     8102.
-------------------------------------------------------------------------------------------------------------
                              9000.     2083.        0.     9928.        0.      774.        0.     8102.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1334.	1334.	0.	1334.
		1372.	1334.	1334.	0.	1334.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	3.0	2.7	3.0	0.0	0.0	0.0	0.0	0.0	0.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	PIPE 1	1334.2	12000.0	0.0	2800.0	0.0
2	River 1	773.6	99999999.0	0.0	4610.0	0.0
						0.

End run

WORKED EXAMPLE 2(e) - RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX2E.log                          Time :15:51:35 Date
:12/04/01
Tutorial 2 Sub-Problem (e)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
RESERVOIR 1     ESTO
  1. 1982.    1.     6716.00
  2. 1982.    1.     5704.00
  3. 1982.    1.     4949.00
  4. 1982.    1.     4399.00
  5. 1982.    1.     8337.00
  6. 1982.    1.     9886.00
  7. 1982.    1.     9920.00
  8. 1982.    1.    10393.00
  9. 1982.    1.    10353.00
 10. 1982.    1.    10269.00
 11. 1982.    1.    10207.00
 12. 1982.    1.    10076.00
  1. 1983.    1.     8348.00
  2. 1983.    1.     7408.00
  3. 1983.    1.     6674.00
  4. 1983.    1.     9722.00
  5. 1983.    1.    12000.00
  6. 1983.    1.    12000.00
  7. 1983.    1.    12000.00
  8. 1983.    1.    12000.00
  9. 1983.    1.    12000.00
 10. 1983.    1.    12000.00
 11. 1983.    1.    11923.00
 12. 1983.    1.    12000.00
  1. 1984.    1.    12000.00
  2. 1984.    1.     9946.00
  3. 1984.    1.     9672.00
  4. 1984.    1.     9285.00
  5. 1984.    1.     9510.00
  6. 1984.    1.    11743.00
  7. 1984.    1.    12000.00
  8. 1984.    1.    12000.00
  9. 1984.    1.    12000.00
 10. 1984.    1.    12000.00
 11. 1984.    1.     9849.00
 12. 1984.    1.     8102.00
```

WORKED EXAMPLE 2(e) - RESTRICTION LEVELS

```
DEMAND RESTN LVLS
EX2E.log                          Time :15:51:35 Date :12/04/01
Tutorial 2 Sub-Problem (e)


(F4.0,2F6.0,  1F4.0)
  4
SEASON
YEAR
REPLICATE
DEMAND 1        RLVS
  1. 1982.    1.  0.
  2. 1982.    1.  0.
  3. 1982.    1.  2.
  4. 1982.    1.  3.
  5. 1982.    1.  3.
  6. 1982.    1.  0.
  7. 1982.    1.  0.
  8. 1982.    1.  0.
  9. 1982.    1.  0.
 10. 1982.    1.  0.
 11. 1982.    1.  0.
 12. 1982.    1.  0.
  1. 1983.    1.  0.
  2. 1983.    1.  0.
  3. 1983.    1.  0.
  4. 1983.    1.  0.
  5. 1983.    1.  0.
  6. 1983.    1.  0.
  7. 1983.    1.  0.
  8. 1983.    1.  0.
  9. 1983.    1.  0.
 10. 1983.    1.  0.
 11. 1983.    1.  0.
 12. 1983.    1.  0.
  1. 1984.    1.  0.
  2. 1984.    1.  0.
  3. 1984.    1.  0.
  4. 1984.    1.  0.
  5. 1984.    1.  0.
  6. 1984.    1.  0.
  7. 1984.    1.  0.
  8. 1984.    1.  0.
  9. 1984.    1.  0.
 10. 1984.    1.  0.
 11. 1984.    1.  0.
 12. 1984.    1.  0.
```

WORKED EXAMPLE 2(e) - ACTUAL DEMAND SUPPLIED

```
DEMAND SUPPLIED
EX2E.log                    Time :15:51:35 Date
:12/04/01
Tutorial 2 Sub-Problem (e)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
DEMAND 1        SUPP
  1. 1982.    1.     2700.00
  2. 1982.    1.     1300.00
  3. 1982.    1.     1780.00
  4. 1982.    1.     1000.00
  5. 1982.    1.     1050.00
  6. 1982.    1.      700.00
  7. 1982.    1.     1200.00
  8. 1982.    1.     1800.00
  9. 1982.    1.     2200.00
 10. 1982.    1.     1300.00
 11. 1982.    1.     1400.00
 12. 1982.    1.     1400.00
  1. 1983.    1.     1900.00
  2. 1983.    1.     1100.00
  3. 1983.    1.     1300.00
  4. 1983.    1.      800.00
  5. 1983.    1.        0.00
  6. 1983.    1.      600.00
  7. 1983.    1.      900.00
  8. 1983.    1.      300.00
  9. 1983.    1.      600.00
 10. 1983.    1.     1400.00
 11. 1983.    1.     2100.00
 12. 1983.    1.     2100.00
  1. 1984.    1.     1100.00
  2. 1984.    1.     2300.00
  3. 1984.    1.     2800.00
  4. 1984.    1.     1900.00
  5. 1984.    1.      300.00
  6. 1984.    1.      600.00
  7. 1984.    1.      600.00
  8. 1984.    1.      100.00
  9. 1984.    1.     1600.00
 10. 1984.    1.     1300.00
 11. 1984.    1.     2400.00
 12. 1984.    1.     2100.00
```

WORKED EXAMPLE 2(e) – INVESTIGATION OF RESTRICTED DEMAND

```
####4
EX2E.log                          Time :15:51:35 Date :12/04/01
Tutorial 2 Sub-Problem (e)


(  6f12.2              )
   6
SEASON
YEAR
RESERVOIR 1     ESTO
DEMAND 1        UNRS
DEMAND 1        REST
DEMAND 1        RLVS
       1.00     1982.00     6716.00     2700.00     2700.00        0.00
       2.00     1982.00     5704.00     1300.00     1300.00        0.00
       3.00     1982.00     4949.00     2100.00     1780.00        2.00
       4.00     1982.00     4399.00     1500.00     1000.00        3.00
       5.00     1982.00     8337.00     1600.00     1050.00        3.00
       6.00     1982.00     9886.00      700.00      700.00        0.00
       7.00     1982.00     9920.00     1200.00     1200.00        0.00
       8.00     1982.00    10393.00     1800.00     1800.00        0.00
       9.00     1982.00    10353.00     2200.00     2200.00        0.00
      10.00     1982.00    10269.00     1300.00     1300.00        0.00
      11.00     1982.00    10207.00     1400.00     1400.00        0.00
      12.00     1982.00    10076.00     1400.00     1400.00        0.00
       1.00     1983.00     8348.00     1900.00     1900.00        0.00
       2.00     1983.00     7408.00     1100.00     1100.00        0.00
       3.00     1983.00     6674.00     1300.00     1300.00        0.00
       4.00     1983.00     9722.00      800.00      800.00        0.00
       5.00     1983.00    12000.00        0.00        0.00        0.00
       6.00     1983.00    12000.00      600.00      600.00        0.00
       7.00     1983.00    12000.00      900.00      900.00        0.00
       8.00     1983.00    12000.00      300.00      300.00        0.00
       9.00     1983.00    12000.00      600.00      600.00        0.00
      10.00     1983.00    12000.00     1400.00     1400.00        0.00
      11.00     1983.00    11923.00     2100.00     2100.00        0.00
      12.00     1983.00    12000.00     2100.00     2100.00        0.00
       1.00     1984.00    12000.00     1100.00     1100.00        0.00
       2.00     1984.00     9946.00     2300.00     2300.00        0.00
       3.00     1984.00     9672.00     2800.00     2800.00        0.00
       4.00     1984.00     9285.00     1900.00     1900.00        0.00
       5.00     1984.00     9510.00      300.00      300.00        0.00
       6.00     1984.00    11743.00      600.00      600.00        0.00
       7.00     1984.00    12000.00      600.00      600.00        0.00
       8.00     1984.00    12000.00      100.00      100.00        0.00
       9.00     1984.00    12000.00     1600.00     1600.00        0.00
      10.00     1984.00    12000.00     1300.00     1300.00        0.00
      11.00     1984.00     9849.00     2400.00     2400.00        0.00
      12.00     1984.00     8102.00     2100.00     2100.00        0.00
```

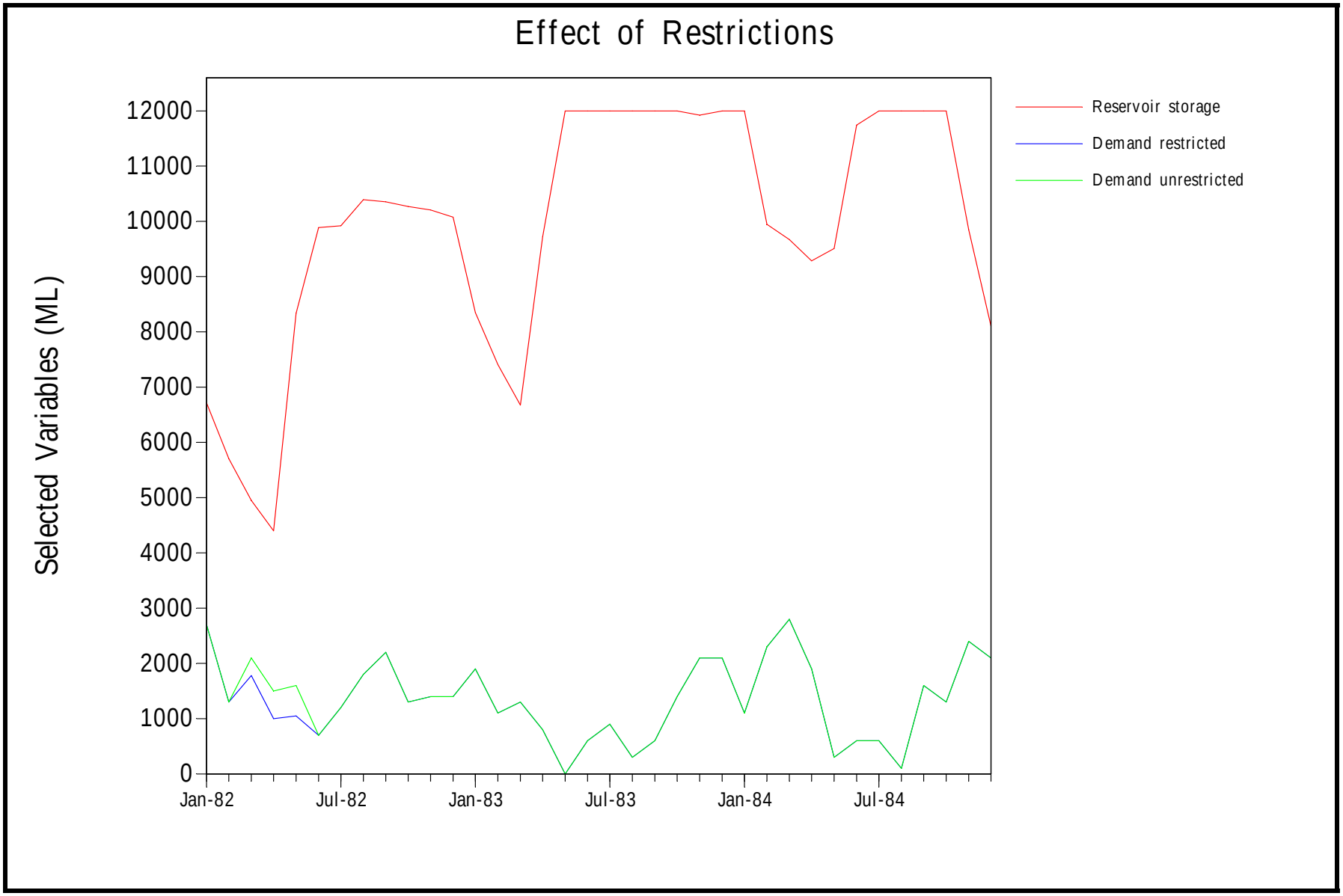

Figure 3.2-7 Worked Example 2(e) – Plot for Studying Effect of Restrictions

WORKED EXAMPLE 2(f) – SYSTEM LISTING

```
_____________________________________________________________

                R      E      A      L      M
_____________________________________________________________


              ****************************
              *   SYSTEM FILE LISTING    *
              ****************************

 File: C:\REALM\WorkedExamples\EX2F.sys

 Simulation label:
     Tutorial 2 - Sub-Problem (f)



 Date: 16:20:59 12/04/01


-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input          No
-------------------------------------------------------------------------------------------------------------
   1 RESERVOIR 1          Reservoir          48.63    93.12     0.00     1.00 STREAM1                1
   2 DEMAND 1             Demand             49.84     7.46     0.00     1.00                        2
   3 Stream Terminator    Strm terminator    14.44    18.32     0.00     1.00                        3


 Reservoir data:

      No       Name              Min     Max    No   No     Spill
                                 Cap     Cap  Above Below    Type
    ------------------------------------------------------------------
       1 RESERVOIR 1               0    12000  1    1     Downstream
```

Reservoir evaps: (if A=B=0 evaps not calculated!)

No	Name	NET EVAP =	(A	+	B	*	EVAPORATION)	-	RAINFALL
1	RESERVOIR 1		0.500		3.000		PAN EVAP		LOCAL RAIN

No	Name		Surface area/volume relationships									
			pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10
1	RESERVOIR 1	Vol	0	500	1000	4000	6000	8000	9000	10000	11000	12000
		Area	0	10	30	40	50	60	70	80	90	100

No	Name		Levels/volume relationships														
			pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR 1	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No	S/F		Monthly Factors										
		Bypass	Priority		Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	PIPE 1	Pipe	1	2	0	0	0fix	0		0%	1
2	River 1	River	1	3	1000	0	0fix	0		0%	2

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	PIPE 1	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350
2	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

```
------------------------------
|  RESTRICTION INFORMATION    |
------------------------------

 Number of restriction groups:  1

 NB. Each restriction group is treated separately
     with its own rule curve definitions;
     for irrigation demand groups by its allocations functions.

-----------------------------------------------------------------------
Restriction Group:  1     Type: Urban/industrial demand centers
-----------------------------------------------------------------------

      Reservoirs/               Demands
     arcs in Group             in Group
      ----------               --------
     RESERVOIR 1              DEMAND 1
```

Restriction Level	Relative Position	% of Restrictable Demand Restricted	Storage as % of Average Annual Demand											
			Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0.0	0.0	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00	-6500.00
1	25.0	10.0	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00	-5750.00
2	50.0	20.0	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00	-5000.00
3	75.0	50.0	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00	-4250.00
4	100.0	70.0	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00	-3500.00
Base levels (% AAD)			-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00	-500.00

```
 NB. Negative values will be interpreted as absolute values
```

WORKED EXAMPLE 2(f) - LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H          HHHHHHHHHH
      H   H     H           H    H    H          H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH        HHH  H   H
      HHH    H  HHH        HHH    H   HHH        HHH  H   H
      HHH    H  HHH        HHH    H   HHH        HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH   HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX2F.log

 Scenario file: scn2f.scn

 Simulation label:
     Tutorial 2 Sub-Problem (f)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf2.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem.dat

 Restrictions are ON

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 16:27:31 12/04/01
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX2F.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX2F.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     4211.     10073.      -19.      807.        0.     8217.
-------------------------------------------------------------------------------------------------------------
                              9000.     2083.        0.     10073.      -19.      807.        0.     8217.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1341.	1341.	24.	1317.
		1372.	1341.	1341.	24.	1317.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	3.0	2.3	4.0	0.0	0.0	0.0	3.0	10.0	16.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	PIPE 1	1317.2	2350.0	0.0	2350.0	0.0
2	River 1	806.5	99999999.0	0.0	4571.0	0.0
						0.

End run

WORKED EXAMPLE 2(f) - RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX2F.log                          Time :16:27:31 Date :12/04/01
Tutorial 2 Sub-Problem (f)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
RESERVOIR 1     ESTO
  1. 1982.    1.     7023.00
  2. 1982.    1.     5976.00
  3. 1982.    1.     5034.00
  4. 1982.    1.     4211.00
  5. 1982.    1.     8398.00
  6. 1982.    1.    10059.00
  7. 1982.    1.    10316.00
  8. 1982.    1.    10846.00
  9. 1982.    1.    10780.00
 10. 1982.    1.    10660.00
 11. 1982.    1.    10548.00
 12. 1982.    1.    10367.00
  1. 1983.    1.     8588.00
  2. 1983.    1.     7605.00
  3. 1983.    1.     6895.00
  4. 1983.    1.    10029.00
  5. 1983.    1.    12000.00
  6. 1983.    1.    12000.00
  7. 1983.    1.    12000.00
  8. 1983.    1.    12000.00
  9. 1983.    1.    12000.00
 10. 1983.    1.    12000.00
 11. 1983.    1.    11881.00
 12. 1983.    1.    12000.00
  1. 1984.    1.    12000.00
  2. 1984.    1.     9891.00
  3. 1984.    1.    10032.00
  4. 1984.    1.     9613.00
  5. 1984.    1.     9815.00
  6. 1984.    1.    12000.00
  7. 1984.    1.    12000.00
  8. 1984.    1.    12000.00
  9. 1984.    1.    12000.00
 10. 1984.    1.    12000.00
 11. 1984.    1.     9849.00
 12. 1984.    1.     8217.00
```

WORKED EXAMPLE 2(f) - RESERVOIR EVAPORATION

```
RESERVOIR EVAPS
EX2F.log                          Time :16:27:31 Date :12/04/01
Tutorial 2 Sub-Problem (f)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
RESERVOIR 1     EVAP
  1. 1982.    1.       43.00
  2. 1982.    1.       35.00
  3. 1982.    1.       27.00
  4. 1982.    1.      -27.00
  5. 1982.    1.      -29.00
  6. 1982.    1.     -112.00
  7. 1982.    1.     -223.00
  8. 1982.    1.      -57.00
  9. 1982.    1.       26.00
 10. 1982.    1.       36.00
 11. 1982.    1.       50.00
 12. 1982.    1.       50.00
  1. 1983.    1.       51.00
  2. 1983.    1.       43.00
  3. 1983.    1.      -24.00
  4. 1983.    1.      -86.00
  5. 1983.    1.     -216.00
  6. 1983.    1.     -182.00
  7. 1983.    1.      -78.00
  8. 1983.    1.       24.00
  9. 1983.    1.       31.00
 10. 1983.    1.      -62.00
 11. 1983.    1.       42.00
 12. 1983.    1.       55.00
  1. 1984.    1.       52.00
  2. 1984.    1.       55.00
  3. 1984.    1.       35.00
  4. 1984.    1.       32.00
  5. 1984.    1.       23.00
  6. 1984.    1.      -55.00
  7. 1984.    1.     -177.00
  8. 1984.    1.      -74.00
  9. 1984.    1.       27.00
 10. 1984.    1.       39.00
 11. 1984.    1.       50.00
 12. 1984.    1.     -115.00
```

WORKED EXAMPLE 2(f) - RESTRICTION LEVELS

```
DEMAND RESTN LVLS
EX2F.log                          Time :16:27:31 Date :12/04/01
Tutorial 2 Sub-Problem (f)


(F4.0,2F6.0,  1F4.0)
  4
SEASON
YEAR
REPLICATE
DEMAND 1        RLVS
  1. 1982.    1.  0.
  2. 1982.    1.  0.
  3. 1982.    1.  1.
  4. 1982.    1.  2.
  5. 1982.    1.  4.
  6. 1982.    1.  0.
  7. 1982.    1.  0.
  8. 1982.    1.  0.
  9. 1982.    1.  0.
 10. 1982.    1.  0.
 11. 1982.    1.  0.
 12. 1982.    1.  0.
  1. 1983.    1.  0.
  2. 1983.    1.  0.
  3. 1983.    1.  0.
  4. 1983.    1.  0.
  5. 1983.    1.  0.
  6. 1983.    1.  0.
  7. 1983.    1.  0.
  8. 1983.    1.  0.
  9. 1983.    1.  0.
 10. 1983.    1.  0.
 11. 1983.    1.  0.
 12. 1983.    1.  0.
  1. 1984.    1.  0.
  2. 1984.    1.  0.
  3. 1984.    1.  0.
  4. 1984.    1.  0.
  5. 1984.    1.  0.
  6. 1984.    1.  0.
  7. 1984.    1.  0.
  8. 1984.    1.  0.
  9. 1984.    1.  0.
 10. 1984.    1.  0.
 11. 1984.    1.  0.
 12. 1984.    1.  0.
```

WORKED EXAMPLE 2(f) - ACTUAL DEMAND SUPPLIED

```
DEMAND SUPPLIED
EX2F.log                          Time :16:27:31 Date :12/04/01
Tutorial 2 Sub-Problem (f)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
DEMAND 1        SUPP
  1. 1982.    1.     2350.00
  2. 1982.    1.     1300.00
  3. 1982.    1.     1940.00
  4. 1982.    1.     1300.00
  5. 1982.    1.      830.00
  6. 1982.    1.      700.00
  7. 1982.    1.     1200.00
  8. 1982.    1.     1800.00
  9. 1982.    1.     2200.00
 10. 1982.    1.     1300.00
 11. 1982.    1.     1400.00
 12. 1982.    1.     1400.00
  1. 1983.    1.     1900.00
  2. 1983.    1.     1100.00
  3. 1983.    1.     1300.00
  4. 1983.    1.      800.00
  5. 1983.    1.        0.00
  6. 1983.    1.      600.00
  7. 1983.    1.      900.00
  8. 1983.    1.      300.00
  9. 1983.    1.      600.00
 10. 1983.    1.     1400.00
 11. 1983.    1.     2100.00
 12. 1983.    1.     2100.00
  1. 1984.    1.     1100.00
  2. 1984.    1.     2300.00
  3. 1984.    1.     2350.00
  4. 1984.    1.     1900.00
  5. 1984.    1.      300.00
  6. 1984.    1.      600.00
  7. 1984.    1.      600.00
  8. 1984.    1.      100.00
  9. 1984.    1.     1600.00
 10. 1984.    1.     1300.00
 11. 1984.    1.     2350.00
 12. 1984.    1.     2100.00
```

WORKED EXAMPLE 2(f) - DEMAND SHORTFALLS

DEMAND SHORTFALL
EX2F.log Time :16:27:31 Date :12/04/01
Tutorial 2 Sub-Problem (f)

(F4.0,2F6.0, 1f12.2)
4
SEASON
YEAR
REPLICATE
DEMAND 1 SHRT

1.	1982.	1.	350.00
2.	1982.	1.	0.00
3.	1982.	1.	0.00
4.	1982.	1.	0.00
5.	1982.	1.	0.00
6.	1982.	1.	0.00
7.	1982.	1.	0.00
8.	1982.	1.	0.00
9.	1982.	1.	0.00
10.	1982.	1.	0.00
11.	1982.	1.	0.00
12.	1982.	1.	0.00
1.	1983.	1.	0.00
2.	1983.	1.	0.00
3.	1983.	1.	0.00
4.	1983.	1.	0.00
5.	1983.	1.	0.00
6.	1983.	1.	0.00
7.	1983.	1.	0.00
8.	1983.	1.	0.00
9.	1983.	1.	0.00
10.	1983.	1.	0.00
11.	1983.	1.	0.00
12.	1983.	1.	0.00
1.	1984.	1.	0.00
2.	1984.	1.	0.00
3.	1984.	1.	450.00
4.	1984.	1.	0.00
5.	1984.	1.	0.00
6.	1984.	1.	0.00
7.	1984.	1.	0.00
8.	1984.	1.	0.00
9.	1984.	1.	0.00
10.	1984.	1.	0.00
11.	1984.	1.	50.00
12.	1984.	1.	0.00

WORKED EXAMPLE 2(f) - CARRIER FLOWS

CARRIER FLOWS
EX2F.log Time :16:27:31 Date :12/04/01
Tutorial 2 Sub-Problem (f)

(F4.0,2F6.0, 1f12.2)
4
SEASON
YEAR
REPLICATE
PIPE 1 FLOW

1.	1982.	1.	2350.00
2.	1982.	1.	1300.00
3.	1982.	1.	1940.00
4.	1982.	1.	1300.00
5.	1982.	1.	830.00
6.	1982.	1.	700.00
7.	1982.	1.	1200.00
8.	1982.	1.	1800.00
9.	1982.	1.	2200.00
10.	1982.	1.	1300.00
11.	1982.	1.	1400.00
12.	1982.	1.	1400.00
1.	1983.	1.	1900.00
2.	1983.	1.	1100.00
3.	1983.	1.	1300.00
4.	1983.	1.	800.00
5.	1983.	1.	0.00
6.	1983.	1.	600.00
7.	1983.	1.	900.00
8.	1983.	1.	300.00
9.	1983.	1.	600.00
10.	1983.	1.	1400.00
11.	1983.	1.	2100.00
12.	1983.	1.	2100.00
1.	1984.	1.	1100.00
2.	1984.	1.	2300.00
3.	1984.	1.	2350.00
4.	1984.	1.	1900.00
5.	1984.	1.	300.00
6.	1984.	1.	600.00
7.	1984.	1.	600.00
8.	1984.	1.	100.00
9.	1984.	1.	1600.00
10.	1984.	1.	1300.00
11.	1984.	1.	2350.00
12.	1984.	1.	2100.00

WORKED EXAMPLE 2(f) – INVESTIGATION OF RESTRICTIONS

```
####4
EX2F.log                          Time :16:27:31 Date :12/04/01
Tutorial 2 Sub-Problem (f)


(  6f12.2              )
   6
SEASON
YEAR
RESERVOIR 1     ESTO
DEMAND 1        UNRS
DEMAND 1        REST
DEMAND 1        RLVS
        1.00     1982.00     7023.00     2700.00     2700.00        0.00
        2.00     1982.00     5976.00     1300.00     1300.00        0.00
        3.00     1982.00     5034.00     2100.00     1940.00        1.00
        4.00     1982.00     4211.00     1500.00     1300.00        2.00
        5.00     1982.00     8398.00     1600.00      830.00        4.00
        6.00     1982.00    10059.00      700.00      700.00        0.00
        7.00     1982.00    10316.00     1200.00     1200.00        0.00
        8.00     1982.00    10846.00     1800.00     1800.00        0.00
        9.00     1982.00    10780.00     2200.00     2200.00        0.00
       10.00     1982.00    10660.00     1300.00     1300.00        0.00
       11.00     1982.00    10548.00     1400.00     1400.00        0.00
       12.00     1982.00    10367.00     1400.00     1400.00        0.00
        1.00     1983.00     8588.00     1900.00     1900.00        0.00
        2.00     1983.00     7605.00     1100.00     1100.00        0.00
        3.00     1983.00     6895.00     1300.00     1300.00        0.00
        4.00     1983.00    10029.00      800.00      800.00        0.00
        5.00     1983.00    12000.00        0.00        0.00        0.00
        6.00     1983.00    12000.00      600.00      600.00        0.00
        7.00     1983.00    12000.00      900.00      900.00        0.00
        8.00     1983.00    12000.00      300.00      300.00        0.00
        9.00     1983.00    12000.00      600.00      600.00        0.00
       10.00     1983.00    12000.00     1400.00     1400.00        0.00
       11.00     1983.00    11881.00     2100.00     2100.00        0.00
       12.00     1983.00    12000.00     2100.00     2100.00        0.00
        1.00     1984.00    12000.00     1100.00     1100.00        0.00
        2.00     1984.00     9891.00     2300.00     2300.00        0.00
        3.00     1984.00    10032.00     2800.00     2800.00        0.00
        4.00     1984.00     9613.00     1900.00     1900.00        0.00
        5.00     1984.00     9815.00      300.00      300.00        0.00
        6.00     1984.00    12000.00      600.00      600.00        0.00
        7.00     1984.00    12000.00      600.00      600.00        0.00
        8.00     1984.00    12000.00      100.00      100.00        0.00
        9.00     1984.00    12000.00     1600.00     1600.00        0.00
       10.00     1984.00    12000.00     1300.00     1300.00        0.00
       11.00     1984.00     9849.00     2400.00     2400.00        0.00
       12.00     1984.00     8217.00     2100.00     2100.00        0.00
```

WORKED EXAMPLE 2(f) – INVESTIGATION OF DEMAND SHORTFALLS

```
####4
EX2F.log                          Time :16:27:31 Date :12/04/01
   Tutorial 2 Sub-Problem (f)


(  6f12.2              )
   6
SEASON
YEAR
DEMAND 1        SHRT
PIPE 1          FLOW
PIPE 1          CAPC
DEMAND 1        UNRS
        1.00     1982.00      350.00     2350.00     2350.00     2700.00
        2.00     1982.00        0.00     1300.00     2350.00     1300.00
        3.00     1982.00        0.00     1940.00     2350.00     2100.00
        4.00     1982.00        0.00     1300.00     2350.00     1500.00
        5.00     1982.00        0.00      830.00     2350.00     1600.00
        6.00     1982.00        0.00      700.00     2350.00      700.00
        7.00     1982.00        0.00     1200.00     2350.00     1200.00
        8.00     1982.00        0.00     1800.00     2350.00     1800.00
        9.00     1982.00        0.00     2200.00     2350.00     2200.00
       10.00     1982.00        0.00     1300.00     2350.00     1300.00
       11.00     1982.00        0.00     1400.00     2350.00     1400.00
       12.00     1982.00        0.00     1400.00     2350.00     1400.00
        1.00     1983.00        0.00     1900.00     2350.00     1900.00
        2.00     1983.00        0.00     1100.00     2350.00     1100.00
        3.00     1983.00        0.00     1300.00     2350.00     1300.00
        4.00     1983.00        0.00      800.00     2350.00      800.00
        5.00     1983.00        0.00        0.00     2350.00        0.00
        6.00     1983.00        0.00      600.00     2350.00      600.00
        7.00     1983.00        0.00      900.00     2350.00      900.00
        8.00     1983.00        0.00      300.00     2350.00      300.00
        9.00     1983.00        0.00      600.00     2350.00      600.00
       10.00     1983.00        0.00     1400.00     2350.00     1400.00
       11.00     1983.00        0.00     2100.00     2350.00     2100.00
       12.00     1983.00        0.00     2100.00     2350.00     2100.00
        1.00     1984.00        0.00     1100.00     2350.00     1100.00
        2.00     1984.00        0.00     2300.00     2350.00     2300.00
        3.00     1984.00      450.00     2350.00     2350.00     2800.00
        4.00     1984.00        0.00     1900.00     2350.00     1900.00
        5.00     1984.00        0.00      300.00     2350.00      300.00
        6.00     1984.00        0.00      600.00     2350.00      600.00
        7.00     1984.00        0.00      600.00     2350.00      600.00
        8.00     1984.00        0.00      100.00     2350.00      100.00
        9.00     1984.00        0.00     1600.00     2350.00     1600.00
       10.00     1984.00        0.00     1300.00     2350.00     1300.00
       11.00     1984.00       50.00     2350.00     2350.00     2400.00
       12.00     1984.00        0.00     2100.00     2350.00     2100.00
```

Figure 3.2-8 Worked Example 2(f) – Plot for Studying Restrictions

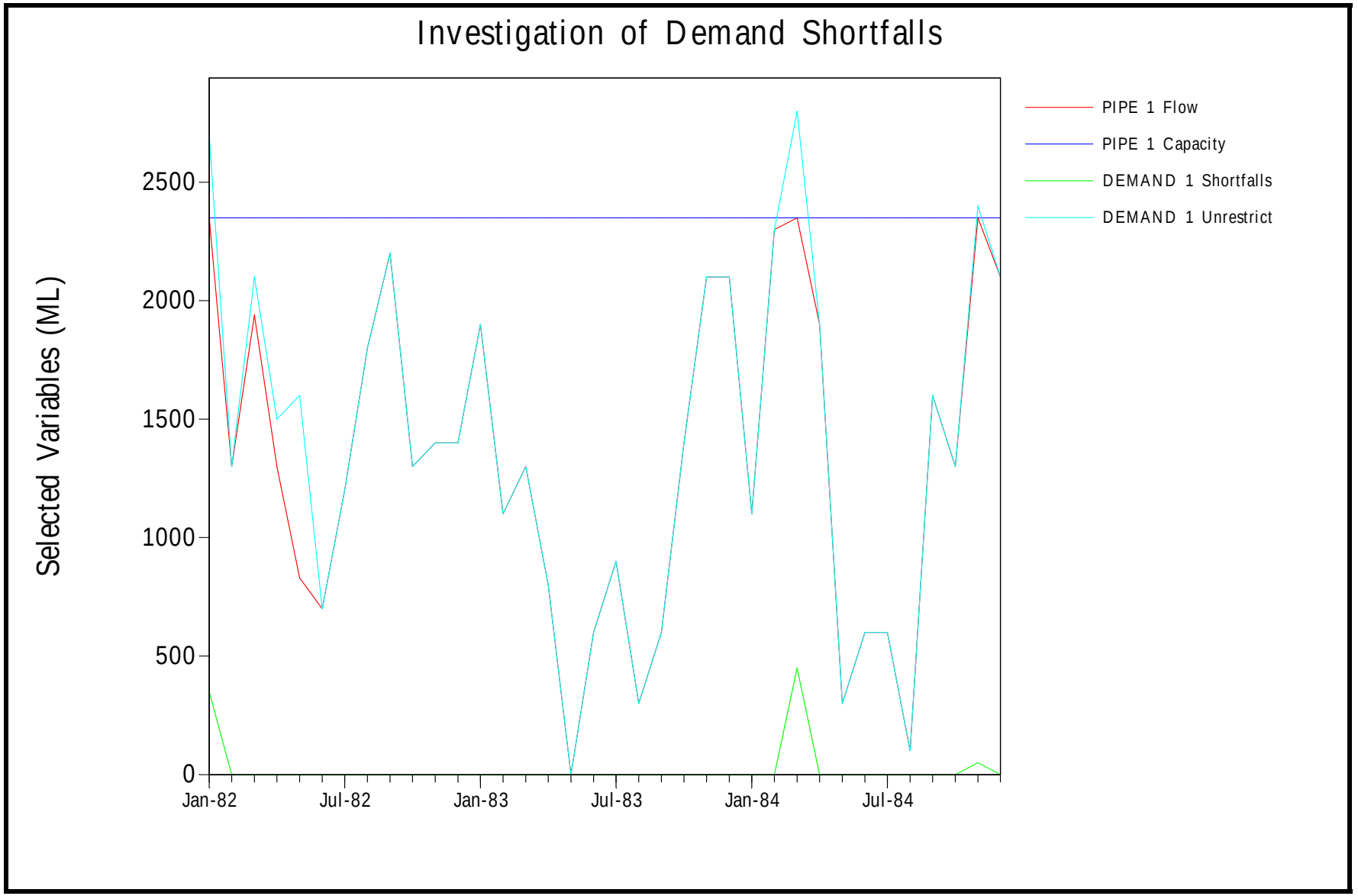

Figure 3.2-9 Worked Example 2(f) – Plot for Studyimg Demand Shortfalls

WORKED EXAMPLE 2(g) – SYSTEM LISTING

```
_____________________________________________________________

              R      E      A      L      M
_____________________________________________________________

            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX2G.sys

 Simulation label:
     Tutorial 2 - Sub-Problem (g)



 Date: 16:49:06 12/04/01


-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input          No
-------------------------------------------------------------------------------------------------------
   1 RESERVOIR 1          Reservoir          48.63     93.12     0.00     1.00 STREAM1                1
   2 DEMAND 1             Demand             49.84      7.46     0.00     1.00                        2
   3 Stream Terminator    Strm terminator    14.44     18.32     0.00     1.00                        3


 Reservoir data:

      No       Name               Min     Max    No   No     Spill
                                  Cap     Cap  Above Below    Type
     ------------------------------------------------------------------
        1 RESERVOIR 1                0    12000  1    1     Downstream



      No       Name                              Levels/volume relationships
                                    pt1     pt2     pt3     pt4     pt5     pt6    pt7    pt8     pt9     pt10     pt11   pt12    pt13   pt14    pt15
     ------------------------------------------------------------------------------------------------------------------------------------------
        1 RESERVOIR 1         Vol       0       0       0       0       0       0      0      0       0       0        0      0       0      0       0
                              Lvl    0.00    0.00    0.00    0.00    0.00    0.00   0.00   0.00    0.00    0.00     0.00   0.00    0.00   0.00    0.00
```

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	PIPE 1	Pipe	1	2	0	0	0fix	0		0%	1
2	River 1	River	1	3	1000	0	0fix	0		0%	2

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

Functional Capacities

No	Name		pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12
1	PIPE 1	V	0	6000	12000	0	0	0	0	0	0	0	0	0
	Fn Name:	C	0	1200	2400	0	0	0	0	0	0	0	0	0

Equation used: (0.75*'1)+(0.5*'2)-5000
' 1 = RESERVOIR 1 Type: STOR
' 2 = RESERVOIR 1 Type: ESTO

Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2

WORKED EXAMPLE 2(g) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX2G.log

 Scenario file: scn2g.scn

 Simulation label:
     Tutorial 2 Sub-Problem (g)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf1.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 16:51:41 12/04/01
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX2G.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX2G.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     7241.    11003.        0.      912.        0.     9270.
-------------------------------------------------------------------------------------------------------------
                              9000.     2083.        0.    11003.        0.      912.        0.     9270.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	209.	1163.
		1372.	1372.	1372.	209.	1163.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	15.0	23.1	57.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	PIPE 1	1163.2	1750.0	0.0	2000.0	0.0
2	River 1	912.1	99999999.0	0.0	4610.0	0.0
						0.

End run

WORKED EXAMPLE 2(g) – RESERVOIR VOLUME

RESERVOIR STORAGE
EX2G.log Time :16:51:41 Date :12/04/01
Tutorial 2 Sub-Problem (g)

(F4.0,2F6.0, 1f12.2)
4
SEASON
YEAR
REPLICATE
RESERVOIR 1 ESTO

1.	1982.	1.	8242.00
2.	1982.	1.	7539.00
3.	1982.	1.	7666.00
4.	1982.	1.	7241.00
5.	1982.	1.	11038.00
6.	1982.	1.	12000.00
7.	1982.	1.	12000.00
8.	1982.	1.	12000.00
9.	1982.	1.	12000.00
10.	1982.	1.	11916.00
11.	1982.	1.	11854.00
12.	1982.	1.	11723.00
1.	1983.	1.	10123.00
2.	1983.	1.	9183.00
3.	1983.	1.	8519.00
4.	1983.	1.	11567.00
5.	1983.	1.	12000.00
6.	1983.	1.	12000.00
7.	1983.	1.	12000.00
8.	1983.	1.	12000.00
9.	1983.	1.	12000.00
10.	1983.	1.	12000.00
11.	1983.	1.	12000.00
12.	1983.	1.	12000.00
1.	1984.	1.	12000.00
2.	1984.	1.	10404.00
3.	1984.	1.	11244.00
4.	1984.	1.	10972.00
5.	1984.	1.	11197.00
6.	1984.	1.	12000.00
7.	1984.	1.	12000.00
8.	1984.	1.	12000.00
9.	1984.	1.	12000.00
10.	1984.	1.	12000.00
11.	1984.	1.	10407.00
12.	1984.	1.	9270.00

WORKED EXAMPLE 2(g) – CARRIER FLOW

CARRIER FLOWS
EX2G.log Time :16:51:41 Date :12/04/01
Tutorial 2 Sub-Problem (g)

(F4.0,2F6.0, 1f12.2)
4
SEASON
YEAR
REPLICATE
PIPE 1 FLOW

1.	1982.	1.	1174.00
2.	1982.	1.	991.00
3.	1982.	1.	898.00
4.	1982.	1.	875.00
5.	1982.	1.	1191.00
6.	1982.	1.	700.00
7.	1982.	1.	1200.00
8.	1982.	1.	1800.00
9.	1982.	1.	2000.00
10.	1982.	1.	1300.00
11.	1982.	1.	1400.00
12.	1982.	1.	1400.00
1.	1983.	1.	1772.00
2.	1983.	1.	1100.00
3.	1983.	1.	1230.00
4.	1983.	1.	800.00
5.	1983.	1.	0.00
6.	1983.	1.	600.00
7.	1983.	1.	900.00
8.	1983.	1.	300.00
9.	1983.	1.	600.00
10.	1983.	1.	1400.00
11.	1983.	1.	2000.00
12.	1983.	1.	2000.00
1.	1984.	1.	1100.00
2.	1984.	1.	1842.00
3.	1984.	1.	1686.00
4.	1984.	1.	1785.00
5.	1984.	1.	300.00
6.	1984.	1.	600.00
7.	1984.	1.	600.00
8.	1984.	1.	100.00
9.	1984.	1.	1600.00
10.	1984.	1.	1300.00
11.	1984.	1.	1842.00
12.	1984.	1.	1490.00

WORKED EXAMPLE 2(g) – DEMAND SHORTFALLS

```
DEMAND SHORTFALL
EX2G.log                          Time :16:51:41 Date :12/04/01
Tutorial 2 Sub-Problem (g)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
DEMAND 1        SHRT
  1. 1982.    1.     1526.00
  2. 1982.    1.      309.00
  3. 1982.    1.     1202.00
  4. 1982.    1.      625.00
  5. 1982.    1.      409.00
  6. 1982.    1.        0.00
  7. 1982.    1.        0.00
  8. 1982.    1.        0.00
  9. 1982.    1.      200.00
 10. 1982.    1.        0.00
 11. 1982.    1.        0.00
 12. 1982.    1.        0.00
  1. 1983.    1.      128.00
  2. 1983.    1.        0.00
  3. 1983.    1.       70.00
  4. 1983.    1.        0.00
  5. 1983.    1.        0.00
  6. 1983.    1.        0.00
  7. 1983.    1.        0.00
  8. 1983.    1.        0.00
  9. 1983.    1.        0.00
 10. 1983.    1.        0.00
 11. 1983.    1.      100.00
 12. 1983.    1.      100.00
  1. 1984.    1.        0.00
  2. 1984.    1.      458.00
  3. 1984.    1.     1114.00
  4. 1984.    1.      115.00
  5. 1984.    1.        0.00
  6. 1984.    1.        0.00
  7. 1984.    1.        0.00
  8. 1984.    1.        0.00
  9. 1984.    1.        0.00
 10. 1984.    1.        0.00
 11. 1984.    1.      558.00
 12. 1984.    1.      610.00
```

WORKED EXAMPLE 2(g) - INVESTIGATION OF DEMAND SHORTFALLS

```
####4
EX2G.log                          Time :16:51:41 Date :12/04/01
Tutorial 2 Sub-Problem (g)


(  6f12.2              )
   6
SEASON
YEAR
PIPE 1          FLOW
PIPE 1          CAPC
DEMAND 1        SHRT
DEMAND 1        UNRS
       1.00     1982.00     1174.00     1174.00     1526.00     2700.00
       2.00     1982.00      991.00      991.00      309.00     1300.00
       3.00     1982.00      898.00      898.00     1202.00     2100.00
       4.00     1982.00      875.00      875.00      625.00     1500.00
       5.00     1982.00     1191.00     1191.00      409.00     1600.00
       6.00     1982.00      700.00     1856.00        0.00      700.00
       7.00     1982.00     1200.00     2000.00        0.00     1200.00
       8.00     1982.00     1800.00     2000.00        0.00     1800.00
       9.00     1982.00     2000.00     2000.00      200.00     2200.00
      10.00     1982.00     1300.00     1992.00        0.00     1300.00
      11.00     1982.00     1400.00     1973.00        0.00     1400.00
      12.00     1982.00     1400.00     1950.00        0.00     1400.00
       1.00     1983.00     1772.00     1772.00      128.00     1900.00
       2.00     1983.00     1100.00     1437.00        0.00     1100.00
       3.00     1983.00     1230.00     1230.00       70.00     1300.00
       4.00     1983.00      800.00     1435.00        0.00      800.00
       5.00     1983.00        0.00     1935.00        0.00        0.00
       6.00     1983.00      600.00     2000.00        0.00      600.00
       7.00     1983.00      900.00     2000.00        0.00      900.00
       8.00     1983.00      300.00     2000.00        0.00      300.00
       9.00     1983.00      600.00     2000.00        0.00      600.00
      10.00     1983.00     1400.00     2000.00        0.00     1400.00
      11.00     1983.00     2000.00     2000.00      100.00     2100.00
      12.00     1983.00     2000.00     2000.00      100.00     2100.00
       1.00     1984.00     1100.00     2000.00        0.00     1100.00
       2.00     1984.00     1842.00     1842.00      458.00     2300.00
       3.00     1984.00     1686.00     1686.00     1114.00     2800.00
       4.00     1984.00     1785.00     1785.00      115.00     1900.00
       5.00     1984.00      300.00     1766.00        0.00      300.00
       6.00     1984.00      600.00     1880.00        0.00      600.00
       7.00     1984.00      600.00     2000.00        0.00      600.00
       8.00     1984.00      100.00     2000.00        0.00      100.00
       9.00     1984.00     1600.00     2000.00        0.00     1600.00
      10.00     1984.00     1300.00     2000.00        0.00     1300.00
      11.00     1984.00     1842.00     1842.00      558.00     2400.00
      12.00     1984.00     1490.00     1490.00      610.00     2100.00
```

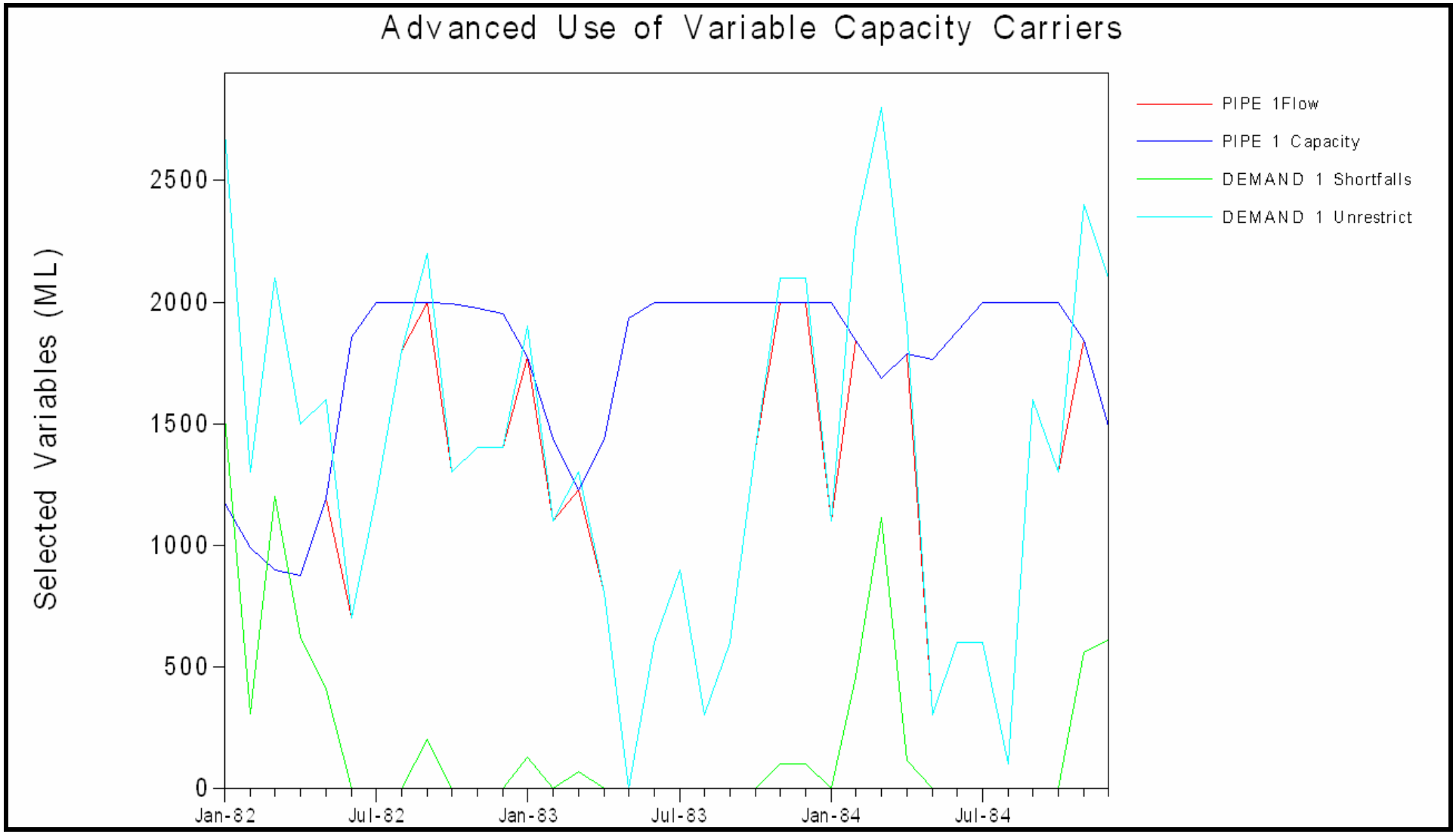

Figure 3.2-10 Worked Example 2(g) – Advanced Use of Variable Capacity Carriers

3.3 WORKED EXAMPLE 3

TWO RESERVOIR AND TWO DEMAND ZONE SYSTEM

WORKED EXAMPLE 3(a) - STREAMFLOW FILE (SF3.DAT)

```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 4F12.2)
   4
SEASON
YEAR
STREAM1
STREAM2
        1.00     1982.00      416.00     1340.00
        2.00     1982.00      288.00     1160.00
        3.00     1982.00     1025.00     1320.00
        4.00     1982.00      450.00     1740.00
        5.00     1982.00     4988.00     3700.00
        6.00     1982.00     2249.00     2000.00
        7.00     1982.00     1234.00      820.00
        8.00     1982.00     2273.00      890.00
        9.00     1982.00     2160.00      870.00
       10.00     1982.00     1216.00      850.00
       11.00     1982.00     1338.00      580.00
       12.00     1982.00     1269.00      720.00
        1.00     1983.00      172.00      440.00
        2.00     1983.00      160.00      400.00
        3.00     1983.00      566.00     1810.00
        4.00     1983.00     3848.00     2420.00
        5.00     1983.00     3220.00     5100.00
        6.00     1983.00     1500.00     1040.00
        7.00     1983.00     4640.00     1270.00
        8.00     1983.00     3900.00     5890.00
        9.00     1983.00     4600.00    11730.00
       10.00     1983.00     2360.00     9090.00
       11.00     1983.00     2023.00     3770.00
       12.00     1983.00     2967.00     3250.00
        1.00     1984.00     4426.00     5150.00
        2.00     1984.00      246.00     1080.00
        3.00     1984.00     2526.00     1350.00
        4.00     1984.00     1513.00     1870.00
        5.00     1984.00      525.00     3140.00
        6.00     1984.00     2833.00      640.00
        7.00     1984.00      908.00      620.00
        8.00     1984.00     2029.00     4020.00
        9.00     1984.00     4600.00     3820.00
       10.00     1984.00     5910.00     3190.00
       11.00     1984.00      249.00     4080.00
       12.00     1984.00      353.00     1590.00
```

WORKED EXAMPLE 3(a) - DEMAND FILE (DEM2.DAT)

```
####3
DEMANDS DATAFILE
HISTORICAL DATA
DATA ASSEMBLED AND REFORMATED ON
DATE : 9 JUL 1990
( 4F12.2)
   4
SEASON
YEAR
DEMAND 1
DEMAND 2
        1.00     1982.00     2700.00     2700.00
        2.00     1982.00     1300.00     1300.00
        3.00     1982.00     2100.00     2100.00
        4.00     1982.00     1500.00     1500.00
        5.00     1982.00     1600.00     1600.00
        6.00     1982.00      700.00     1700.00
        7.00     1982.00     1200.00     1200.00
        8.00     1982.00     1800.00     1800.00
        9.00     1982.00     2200.00     1200.00
       10.00     1982.00     1300.00     1300.00
       11.00     1982.00     1400.00     2400.00
       12.00     1982.00     1400.00     1400.00
        1.00     1983.00     1900.00     1900.00
        2.00     1983.00     1100.00     3100.00
        3.00     1983.00     1300.00     1300.00
        4.00     1983.00      800.00     1800.00
        5.00     1983.00        0.00     2000.00
        6.00     1983.00      600.00     1600.00
        7.00     1983.00      900.00     1900.00
        8.00     1983.00      300.00     1300.00
        9.00     1983.00      600.00     1600.00
       10.00     1983.00     1400.00     1400.00
       11.00     1983.00     2100.00     2100.00
       12.00     1983.00     2100.00     2100.00
        1.00     1984.00     1100.00     1100.00
        2.00     1984.00     2300.00     2300.00
        3.00     1984.00     2800.00     2800.00
        4.00     1984.00     1900.00     1900.00
        5.00     1984.00      300.00      300.00
        6.00     1984.00      600.00      600.00
        7.00     1984.00      600.00     1600.00
        8.00     1984.00      100.00     1100.00
        9.00     1984.00     1600.00     1600.00
       10.00     1984.00     1300.00     1300.00
       11.00     1984.00     2400.00     2400.00
       12.00     1984.00     2100.00     2100.00
```

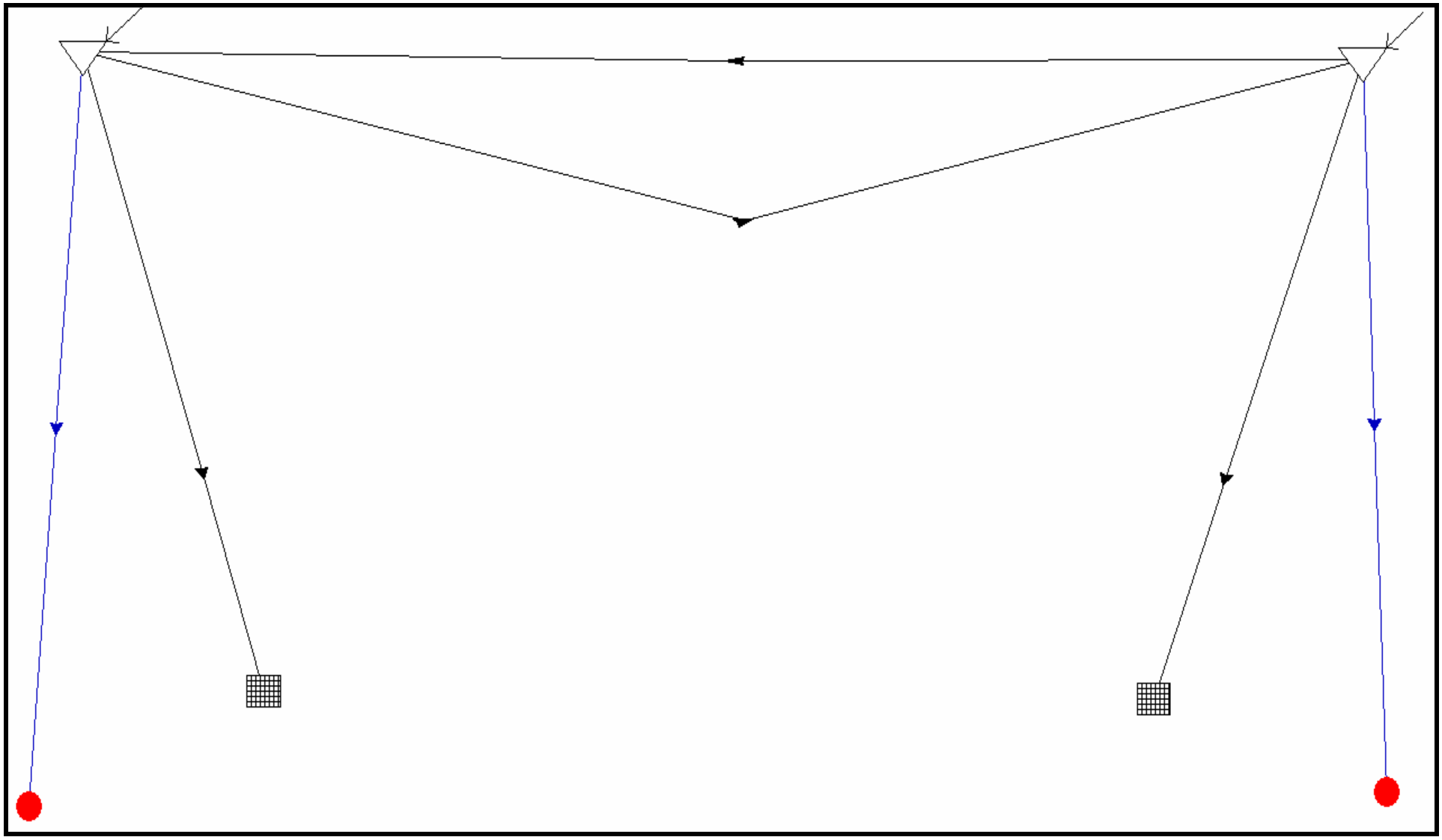

Figure 3.3-1 Worked Example 3(a) – System Plot (*EX3A.sys*)

WORKED EXAMPLE 3(a) – SYSTEM LISTING

R E A L M

****
* SYSTEM FILE LISTING *
****

File: C:\REALM\WorkedExamples\EX3A.sys

Simulation label:
Tutorial 3 - Sub-Problem (a)

Date: 11:43:59 12/10/01

| NODE INFORMATION |

No	Name	Type	X	Y	Z	Size	Aux Input	No
1	RESERVOIR 1	Reservoir	8.25	95.00	0.00	1.00	STREAM1	1
2	RESERVOIR 2	Reservoir	94.64	94.30	0.00	1.00	STREAM2	2
3	DEMAND 1	Demand	20.43	28.86	0.00	1.00		3
4	DEMAND 2	Demand	80.54	28.07	0.00	1.00		4
5	STRM TERM 1	Strm terminator	4.59	16.95	0.00	1.00		5
6	STRM TERM 2	Strm terminator	96.23	18.54	0.00	1.00		6

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
1	RESERVOIR 1	0	12000	1	1	Downstream
2	RESERVOIR 2	0	24000	1	1	Downstream

No	Name		Levels/volume relationships pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR 1	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	RESERVOIR 2	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	DEMAND 2	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp Shr%	No
1	CARRIER 1	Pipe	1	3	0	0	0fix	0	0%	1
2	CARRIER 2	Pipe	2	4	0	0	0fix	0	0%	2
3	CARRIER 3	Pipe	1	2	0	0	0fix	0	0%	3
4	CARRIER 4	Pipe	2	1	0	-1	0fix	0	0%	4
5	River 1	River	1	5	1000	0	0fix	0	0%	5
6	River 2	River	2	6	1000	0	0fix	0	0%	6

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	CARRIER 1	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
2	CARRIER 2	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
3	CARRIER 3	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
4	CARRIER 4	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
5	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
6	River 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

TARGET INFORMATION

Number of target sets: 1

Target set 1 (Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

Name	Draw	Pri	Targets								
RESERVOIR 1	1	0	1333	2667	4000	5333	6667	8000	9333	10667	12000
RESERVOIR 2	2	0	2667	5333	8000	10667	13333	16000	18667	21333	24000
totals		0	4000	8000	12000	16000	20000	24000	28000	32000	36000

```
------------------------------
|  MULTI SYSTEM INFORMATION   |
------------------------------

-------------------------------------------------------------------------------------------------------------------------
 Reservoirs
-------------------------------------------------------------------------------------------------------------------------
 RESERVOIR 1       1
 RESERVOIR 2       1
```

WORKED EXAMPLE 3(a) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX3A.log

 Scenario file: scn3a.scn

 Simulation label:
     Tutorial 3 Sub-Problem (a)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf3.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem2.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 14:54:28 12/05/01
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX3A.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX3A.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     1815.     7679.        0.        0.        0.    11091.
  2  RESERVOIR 2              8000.     2576.     3629.    15357.        0.        0.        0.    22181.
-------------------------------------------------------------------------------------------------------------
                             17000.     4659.        0.    23037.        0.        0.        0.    33272.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	0.	1372.
2	DEMAND 2	1706.	1706.	1706.	0.	1706.
		3078.	3078.	3078.	0.	3078.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	DEMAND 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	CARRIER 1	1372.2	12000.0	0.0	2800.0	0.0
2	CARRIER 2	1705.6	24000.0	300.0	3100.0	0.0
3	CARRIER 3	452.3	24000.0	0.0	2703.0	0.0
4	CARRIER 4	229.5	24000.0	0.0	1995.0	0.0
5	River 1	429.6	99999999.0	0.0	4610.0	0.0
6	River 2	699.8	99999999.0	0.0	7690.0	0.0
						0.

End run

WORKED EXAMPLE 3(a) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX3A.log                          Time :14:54:28 Date :12/05/01
Tutorial 3 Sub-Problem (a)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
RESERVOIR 1     ESTO
RESERVOIR 2     ESTO
  1. 1982.    1.     4452.00     8904.00
  2. 1982.    1.     4068.00     8136.00
  3. 1982.    1.     3450.00     6899.00
  4. 1982.    1.     3180.00     6359.00
  5. 1982.    1.     5009.00    10018.00
  6. 1982.    1.     5626.00    11250.00
  7. 1982.    1.     5510.00    11020.00
  8. 1982.    1.     5365.00    10728.00
  9. 1982.    1.     5241.00    10482.00
 10. 1982.    1.     5063.00    10126.00
 11. 1982.    1.     4436.00     8871.00
 12. 1982.    1.     4166.00     8330.00
  1. 1983.    1.     3103.00     6205.00
  2. 1983.    1.     1890.00     3778.00
  3. 1983.    1.     1815.00     3629.00
  4. 1983.    1.     3038.00     6074.00
  5. 1983.    1.     5144.00    10288.00
  6. 1983.    1.     5258.00    10514.00
  7. 1983.    1.     6295.00    12587.00
  8. 1983.    1.     9024.00    18048.00
  9. 1983.    1.    12000.00    24000.00
 10. 1983.    1.    12000.00    24000.00
 11. 1983.    1.    12000.00    24000.00
 12. 1983.    1.    12000.00    24000.00
  1. 1984.    1.    12000.00    24000.00
  2. 1984.    1.    10909.00    21817.00
  3. 1984.    1.    10335.00    20667.00
  4. 1984.    1.    10196.00    20389.00
  5. 1984.    1.    11217.00    22433.00
  6. 1984.    1.    11975.00    23948.00
  7. 1984.    1.    11751.00    23500.00
  8. 1984.    1.    12000.00    24000.00
  9. 1984.    1.    12000.00    24000.00
 10. 1984.    1.    12000.00    24000.00
 11. 1984.    1.    11844.00    23685.00
 12. 1984.    1.    11091.00    22181.00
```

WORKED EXAMPLE 3(a) – TARGET STORAGE VOLUME

```
RESERVOIR TARGETS
EX3A.log                          Time :14:54:28 Date :12/05/01
Tutorial 3 Sub-Problem (a)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
RESERVOIR 1     TARG
RESERVOIR 2     TARG
  1. 1982.    1.     4452.00     8904.00
  2. 1982.    1.     4068.00     8136.00
  3. 1982.    1.     3450.00     6899.00
  4. 1982.    1.     3180.00     6359.00
  5. 1982.    1.     5009.00    10018.00
  6. 1982.    1.     5626.00    11250.00
  7. 1982.    1.     5510.00    11020.00
  8. 1982.    1.     5365.00    10728.00
  9. 1982.    1.     5241.00    10482.00
 10. 1982.    1.     5063.00    10126.00
 11. 1982.    1.     4436.00     8871.00
 12. 1982.    1.     4166.00     8330.00
  1. 1983.    1.     3103.00     6205.00
  2. 1983.    1.     1890.00     3778.00
  3. 1983.    1.     1815.00     3629.00
  4. 1983.    1.     3038.00     6074.00
  5. 1983.    1.     5144.00    10288.00
  6. 1983.    1.     5258.00    10514.00
  7. 1983.    1.     6295.00    12587.00
  8. 1983.    1.     9024.00    18048.00
  9. 1983.    1.    12000.00    24000.00
 10. 1983.    1.    12000.00    24000.00
 11. 1983.    1.    12000.00    24000.00
 12. 1983.    1.    12000.00    24000.00
  1. 1984.    1.    12000.00    24000.00
  2. 1984.    1.    10909.00    21817.00
  3. 1984.    1.    10335.00    20667.00
  4. 1984.    1.    10196.00    20389.00
  5. 1984.    1.    11217.00    22433.00
  6. 1984.    1.    11975.00    23948.00
  7. 1984.    1.    11751.00    23500.00
  8. 1984.    1.    12000.00    24000.00
  9. 1984.    1.    12000.00    24000.00
 10. 1984.    1.    12000.00    24000.00
 11. 1984.    1.    11844.00    23685.00
 12. 1984.    1.    11091.00    22181.00
```

WORKED EXAMPLE 3(a) – CARRIER FLOW

```
CARRIER FLOWS
EX3A.log                          Time :14:54:28 Date :12/05/01
Tutorial 3 Sub-Problem (a)


(F4.0,2F6.0,  4f12.2              )
  7
SEASON
YEAR
REPLICATE
CARRIER 1       FLOW
CARRIER 2       FLOW
CARRIER 3       FLOW
CARRIER 4       FLOW
  1. 1982.    1.     2700.00     2700.00     2264.00        0.00
  2. 1982.    1.     1300.00     1300.00        0.00      628.00
  3. 1982.    1.     2100.00     2100.00        0.00      457.00
  4. 1982.    1.     1500.00     1500.00        0.00      780.00
  5. 1982.    1.     1600.00     1600.00     1559.00        0.00
  6. 1982.    1.      700.00     1700.00      932.00        0.00
  7. 1982.    1.     1200.00     1200.00      150.00        0.00
  8. 1982.    1.     1800.00     1800.00      618.00        0.00
  9. 1982.    1.     2200.00     1200.00       84.00        0.00
 10. 1982.    1.     1300.00     1300.00       94.00        0.00
 11. 1982.    1.     1400.00     2400.00      565.00        0.00
 12. 1982.    1.     1400.00     1400.00      139.00        0.00
  1. 1983.    1.     1900.00     1900.00        0.00      665.00
  2. 1983.    1.     1100.00     3100.00      273.00        0.00
  3. 1983.    1.     1300.00     1300.00        0.00      659.00
  4. 1983.    1.      800.00     1800.00     1825.00        0.00
  5. 1983.    1.        0.00     2000.00     1114.00        0.00
  6. 1983.    1.      600.00     1600.00      786.00        0.00
  7. 1983.    1.      900.00     1900.00     2703.00        0.00
  8. 1983.    1.      300.00     1300.00      871.00        0.00
  9. 1983.    1.      600.00     1600.00        0.00        0.00
 10. 1983.    1.     1400.00     1400.00        0.00        0.00
 11. 1983.    1.     2100.00     2100.00        0.00       77.00
 12. 1983.    1.     2100.00     2100.00        0.00        0.00
  1. 1984.    1.     1100.00     1100.00        0.00        0.00
  2. 1984.    1.     2300.00     2300.00        0.00      963.00
  3. 1984.    1.     2800.00     2800.00      300.00        0.00
  4. 1984.    1.     1900.00     1900.00        0.00      248.00
  5. 1984.    1.      300.00      300.00        0.00      796.00
  6. 1984.    1.      600.00      600.00     1475.00        0.00
  7. 1984.    1.      600.00     1600.00      532.00        0.00
  8. 1984.    1.      100.00     1100.00        0.00        0.00
  9. 1984.    1.     1600.00     1600.00        0.00        0.00
 10. 1984.    1.     1300.00     1300.00        0.00        0.00
 11. 1984.    1.     2400.00     2400.00        0.00     1995.00
 12. 1984.    1.     2100.00     2100.00        0.00      994.00
```

WORKED EXAMPLE 3(a) – COMPARISON OF STORAGE VOLUMES AND TARGETS

```
####4
EX3A.log                          Time :14:54:28 Date :12/05/01
Tutorial 3 Sub-Problem (a)


(  6f12.2              )
   6
SEASON
YEAR
RESERVOIR 1     ESTO
RESERVOIR 1     TARG
RESERVOIR 2     ESTO
RESERVOIR 2     TARG
        1.00     1982.00     4452.00     4452.00     8904.00     8904.00
        2.00     1982.00     4068.00     4068.00     8136.00     8136.00
        3.00     1982.00     3450.00     3450.00     6899.00     6899.00
        4.00     1982.00     3180.00     3180.00     6359.00     6359.00
        5.00     1982.00     5009.00     5009.00    10018.00    10018.00
        6.00     1982.00     5626.00     5626.00    11250.00    11250.00
        7.00     1982.00     5510.00     5510.00    11020.00    11020.00
        8.00     1982.00     5365.00     5365.00    10728.00    10728.00
        9.00     1982.00     5241.00     5241.00    10482.00    10482.00
       10.00     1982.00     5063.00     5063.00    10126.00    10126.00
       11.00     1982.00     4436.00     4436.00     8871.00     8871.00
       12.00     1982.00     4166.00     4166.00     8330.00     8330.00
        1.00     1983.00     3103.00     3103.00     6205.00     6205.00
        2.00     1983.00     1890.00     1890.00     3778.00     3778.00
        3.00     1983.00     1815.00     1815.00     3629.00     3629.00
        4.00     1983.00     3038.00     3038.00     6074.00     6074.00
        5.00     1983.00     5144.00     5144.00    10288.00    10288.00
        6.00     1983.00     5258.00     5258.00    10514.00    10514.00
        7.00     1983.00     6295.00     6295.00    12587.00    12587.00
        8.00     1983.00     9024.00     9024.00    18048.00    18048.00
        9.00     1983.00    12000.00    12000.00    24000.00    24000.00
       10.00     1983.00    12000.00    12000.00    24000.00    24000.00
       11.00     1983.00    12000.00    12000.00    24000.00    24000.00
       12.00     1983.00    12000.00    12000.00    24000.00    24000.00
        1.00     1984.00    12000.00    12000.00    24000.00    24000.00
        2.00     1984.00    10909.00    10909.00    21817.00    21817.00
        3.00     1984.00    10335.00    10335.00    20667.00    20667.00
        4.00     1984.00    10196.00    10196.00    20389.00    20389.00
        5.00     1984.00    11217.00    11217.00    22433.00    22433.00
        6.00     1984.00    11975.00    11975.00    23948.00    23948.00
        7.00     1984.00    11751.00    11751.00    23500.00    23500.00
        8.00     1984.00    12000.00    12000.00    24000.00    24000.00
        9.00     1984.00    12000.00    12000.00    24000.00    24000.00
       10.00     1984.00    12000.00    12000.00    24000.00    24000.00
       11.00     1984.00    11844.00    11844.00    23685.00    23685.00
       12.00     1984.00    11091.00    11091.00    22181.00    22181.00
```

WORKED EXAMPLE 3(b) – SYSTEM LISTING

```
_____________________________________________________________

              R      E      A      L      M
_____________________________________________________________


            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX3B.sys

 Simulation label:
     Tutorial 3 - Sub-Problem (b)



 Date: 11:48:27 12/10/01


-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input          No
-------------------------------------------------------------------------------------------------------------
   1 RESERVOIR 1          Reservoir           8.25     95.00     0.00     1.00 STREAM1                1
   2 RESERVOIR 2          Reservoir          94.64     94.30     0.00     1.00 STREAM2                2
   3 DEMAND 1             Demand             20.43     28.86     0.00     1.00                        3
   4 DEMAND 2             Demand             80.54     28.07     0.00     1.00                        4
   5 STRM TERM 1          Strm terminator     4.59     16.95     0.00     1.00                        5
   6 STRM TERM 2          Strm terminator    96.23     18.54     0.00     1.00                        6


 Reservoir data:

      No       Name              Min     Max    No   No     Spill
                                 Cap     Cap  Above Below    Type
    ------------------------------------------------------------------
       1 RESERVOIR 1               0    12000  1    1     Downstream
       2 RESERVOIR 2               0    24000  1    1     Downstream


      No       Name                              Levels/volume relationships
                                  pt1     pt2     pt3     pt4     pt5     pt6    pt7    pt8     pt9     pt10     pt11   pt12    pt13   pt14    pt15
    ------------------------------------------------------------------------------------------------------------------------------------------
       1 RESERVOIR 1        Vol       0       0       0       0       0       0      0      0       0       0       0      0       0      0       0
                            Lvl    0.00    0.00    0.00    0.00    0.00    0.00   0.00   0.00    0.00    0.00    0.00   0.00    0.00   0.00    0.00
       2 RESERVOIR 2        Vol       0       0       0       0       0       0      0      0       0       0       0      0       0      0       0
                            Lvl    0.00    0.00    0.00    0.00    0.00    0.00   0.00   0.00    0.00    0.00    0.00   0.00    0.00   0.00    0.00
```

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	DEMAND 2	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	CARRIER 1	Pipe	1	3	0	0	0fix	0		0%	1
2	CARRIER 2	Pipe	2	4	0	0	0fix	0		0%	2
3	CARRIER 3	Pipe	1	2	0	0	0fix	0		0%	3
4	CARRIER 4	Pipe	2	1	0	-1	0fix	0		0%	4
5	River 2	River	2	6	1000	0	0fix	0		0%	5
6	River 1	River	1	5	1000	0	0fix	0		0%	6

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	CARRIER 1	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
2	CARRIER 2	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
3	CARRIER 3	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
4	CARRIER 4	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
5	River 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
6	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

TARGET INFORMATION

Number of target sets: 1

Target set 1 (Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

Name	Draw	Pri	Targets								
RESERVOIR 1	1	0	1000	1000	2000	2000	3000	3000	4000	8000	12000
RESERVOIR 2	2	0	3000	7000	10000	14000	17000	21000	24000	24000	24000
totals		0	4000	8000	12000	16000	20000	24000	28000	32000	36000

```
------------------------------
|  MULTI SYSTEM INFORMATION   |
------------------------------

-------------------------------------------------------------------------------------------------------------------------
 Reservoirs
-------------------------------------------------------------------------------------------------------------------------
 RESERVOIR 1       1
 RESERVOIR 2       1
```

WORKED EXAMPLE 3(b) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX3B.log

 Scenario file: scn3b.scn

 Simulation label:
     Tutorial 3 Sub-Problem (b)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf3.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem2.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 15:27:04 12/05/01
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX3B.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX3B.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     1000.     5844.        0.        0.        0.     9272.
  2  RESERVOIR 2              8000.     2576.     4444.    17193.        0.        0.        0.    24000.
-------------------------------------------------------------------------------------------------------------
                             17000.     4659.        0.    23037.        0.        0.        0.    33272.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	0.	1372.
2	DEMAND 2	1706.	1706.	1706.	0.	1706.
		3078.	3078.	3078.	0.	3078.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	DEMAND 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	CARRIER 1	1372.2	12000.0	0.0	2800.0	0.0
2	CARRIER 2	1705.6	24000.0	300.0	3100.0	0.0
3	CARRIER 3	707.0	24000.0	0.0	4716.0	0.0
4	CARRIER 4	391.3	24000.0	0.0	4232.0	0.0
5	River 1	387.3	99999999.0	0.0	4610.0	0.0
6	River 2	742.1	99999999.0	0.0	7690.0	0.0
						0.

End run

WORKED EXAMPLE 3(b) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX3B.log                          Time :15:27:04 Date :12/05/01
Tutorial 3 Sub-Problem (b)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
RESERVOIR 1     ESTO
RESERVOIR 2     ESTO
  1. 1982.    1.     2000.00    11356.00
  2. 1982.    1.     2000.00    10204.00
  3. 1982.    1.     1588.00     8761.00
  4. 1982.    1.     1385.00     8154.00
  5. 1982.    1.     2000.00    13027.00
  6. 1982.    1.     2219.00    14657.00
  7. 1982.    1.     2133.00    14397.00
  8. 1982.    1.     2024.00    14069.00
  9. 1982.    1.     2000.00    13723.00
 10. 1982.    1.     2000.00    13189.00
 11. 1982.    1.     2000.00    11307.00
 12. 1982.    1.     2000.00    10496.00
  1. 1983.    1.     1327.00     7981.00
  2. 1983.    1.     1000.00     4668.00
  3. 1983.    1.     1000.00     4444.00
  4. 1983.    1.     1278.00     7834.00
  5. 1983.    1.     2000.00    13432.00
  6. 1983.    1.     2000.00    13772.00
  7. 1983.    1.     2721.00    16161.00
  8. 1983.    1.     3768.00    23304.00
  9. 1983.    1.    12000.00    24000.00
 10. 1983.    1.    12000.00    24000.00
 11. 1983.    1.    12000.00    24000.00
 12. 1983.    1.    12000.00    24000.00
  1. 1984.    1.    12000.00    24000.00
  2. 1984.    1.     8726.00    24000.00
  3. 1984.    1.     7002.00    24000.00
  4. 1984.    1.     6585.00    24000.00
  5. 1984.    1.     9650.00    24000.00
  6. 1984.    1.    11923.00    24000.00
  7. 1984.    1.    11251.00    24000.00
  8. 1984.    1.    12000.00    24000.00
  9. 1984.    1.    12000.00    24000.00
 10. 1984.    1.    12000.00    24000.00
 11. 1984.    1.    11529.00    24000.00
 12. 1984.    1.     9272.00    24000.00
```

WORKED EXAMPLE 3(b) – TARGET STORAGE VOLUME

```
RESERVOIR TARGETS
EX3B.log                          Time :15:27:04 Date :12/05/01
Tutorial 3 Sub-Problem (b)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
RESERVOIR 1     TARG
RESERVOIR 2     TARG
  1. 1982.    1.     2000.00    11356.00
  2. 1982.    1.     2000.00    10204.00
  3. 1982.    1.     1588.00     8761.00
  4. 1982.    1.     1385.00     8154.00
  5. 1982.    1.     2000.00    13027.00
  6. 1982.    1.     2219.00    14657.00
  7. 1982.    1.     2133.00    14397.00
  8. 1982.    1.     2024.00    14069.00
  9. 1982.    1.     2000.00    13723.00
 10. 1982.    1.     2000.00    13189.00
 11. 1982.    1.     2000.00    11307.00
 12. 1982.    1.     2000.00    10496.00
  1. 1983.    1.     1327.00     7981.00
  2. 1983.    1.     1000.00     4668.00
  3. 1983.    1.     1000.00     4444.00
  4. 1983.    1.     1278.00     7834.00
  5. 1983.    1.     2000.00    13432.00
  6. 1983.    1.     2000.00    13772.00
  7. 1983.    1.     2721.00    16161.00
  8. 1983.    1.     3768.00    23304.00
  9. 1983.    1.    12000.00    24000.00
 10. 1983.    1.    12000.00    24000.00
 11. 1983.    1.    12000.00    24000.00
 12. 1983.    1.    12000.00    24000.00
  1. 1984.    1.    12000.00    24000.00
  2. 1984.    1.     8726.00    24000.00
  3. 1984.    1.     7002.00    24000.00
  4. 1984.    1.     6585.00    24000.00
  5. 1984.    1.     9650.00    24000.00
  6. 1984.    1.    11923.00    24000.00
  7. 1984.    1.    11251.00    24000.00
  8. 1984.    1.    12000.00    24000.00
  9. 1984.    1.    12000.00    24000.00
 10. 1984.    1.    12000.00    24000.00
 11. 1984.    1.    11529.00    24000.00
 12. 1984.    1.     9272.00    24000.00
```

WORKED EXAMPLE 3(b) – CARRIER FLOW

```
CARRIER FLOWS
EX3B.log                       Time :15:27:04 Date :12/05/01
Tutorial 3 Sub-Problem (b)


(F4.0,2F6.0,  4f12.2              )
  7
SEASON
YEAR
REPLICATE
CARRIER 1       FLOW
CARRIER 2       FLOW
CARRIER 3       FLOW
CARRIER 4       FLOW
  1. 1982.    1.     2700.00     2700.00     4716.00        0.00
  2. 1982.    1.     1300.00     1300.00        0.00     1012.00
  3. 1982.    1.     2100.00     2100.00        0.00      663.00
  4. 1982.    1.     1500.00     1500.00        0.00      847.00
  5. 1982.    1.     1600.00     1600.00     2773.00        0.00
  6. 1982.    1.      700.00     1700.00     1330.00        0.00
  7. 1982.    1.     1200.00     1200.00      120.00        0.00
  8. 1982.    1.     1800.00     1800.00      582.00        0.00
  9. 1982.    1.     2200.00     1200.00        0.00       16.00
 10. 1982.    1.     1300.00     1300.00        0.00       84.00
 11. 1982.    1.     1400.00     2400.00        0.00       62.00
 12. 1982.    1.     1400.00     1400.00        0.00      131.00
  1. 1983.    1.     1900.00     1900.00        0.00     1055.00
  2. 1983.    1.     1100.00     3100.00        0.00      613.00
  3. 1983.    1.     1300.00     1300.00        0.00      734.00
  4. 1983.    1.      800.00     1800.00     2770.00        0.00
  5. 1983.    1.        0.00     2000.00     2498.00        0.00
  6. 1983.    1.      600.00     1600.00      900.00        0.00
  7. 1983.    1.      900.00     1900.00     3019.00        0.00
  8. 1983.    1.      300.00     1300.00     2553.00        0.00
  9. 1983.    1.      600.00     1600.00        0.00     4232.00
 10. 1983.    1.     1400.00     1400.00        0.00        0.00
 11. 1983.    1.     2100.00     2100.00        0.00       77.00
 12. 1983.    1.     2100.00     2100.00        0.00        0.00
  1. 1984.    1.     1100.00     1100.00        0.00        0.00
  2. 1984.    1.     2300.00     2300.00     1220.00        0.00
  3. 1984.    1.     2800.00     2800.00     1450.00        0.00
  4. 1984.    1.     1900.00     1900.00       30.00        0.00
  5. 1984.    1.      300.00      300.00        0.00     2840.00
  6. 1984.    1.      600.00      600.00        0.00       40.00
  7. 1984.    1.      600.00     1600.00      980.00        0.00
  8. 1984.    1.      100.00     1100.00        0.00        0.00
  9. 1984.    1.     1600.00     1600.00        0.00        0.00
 10. 1984.    1.     1300.00     1300.00        0.00        0.00
 11. 1984.    1.     2400.00     2400.00        0.00     1680.00
 12. 1984.    1.     2100.00     2100.00      510.00        0.00
```

WORKED EXAMPLE 3(b) - EFFECT OF TARGETS ON STORAGE VOLUMES

```
####4
EX3A.log + EX3B.log            Time :14:54:28 Date :12/05/01
Tutorial 3 Sub-Problem (a) and (b)


(  6f12.2              )
   6
SEASON
YEAR
RESERVOIR 1     ESTO          Sub problem (a)       linear targets
RESERVOIR 1     ESTO          Sub problem (b)       non-linear targets
RESERVOIR 2     ESTO          Sub problem (a)       linear targets
RESERVOIR 2     ESTO          Sub problem (b)       non-linear targets
       1.00     1982.00     4452.00     2000.00     8904.00    11356.00
       2.00     1982.00     4068.00     2000.00     8136.00    10204.00
       3.00     1982.00     3450.00     1588.00     6899.00     8761.00
       4.00     1982.00     3180.00     1385.00     6359.00     8154.00
       5.00     1982.00     5009.00     2000.00    10018.00    13027.00
       6.00     1982.00     5626.00     2219.00    11250.00    14657.00
       7.00     1982.00     5510.00     2133.00    11020.00    14397.00
       8.00     1982.00     5365.00     2024.00    10728.00    14069.00
       9.00     1982.00     5241.00     2000.00    10482.00    13723.00
      10.00     1982.00     5063.00     2000.00    10126.00    13189.00
      11.00     1982.00     4436.00     2000.00     8871.00    11307.00
      12.00     1982.00     4166.00     2000.00     8330.00    10496.00
       1.00     1983.00     3103.00     1327.00     6205.00     7981.00
       2.00     1983.00     1890.00     1000.00     3778.00     4668.00
       3.00     1983.00     1815.00     1000.00     3629.00     4444.00
       4.00     1983.00     3038.00     1278.00     6074.00     7834.00
       5.00     1983.00     5144.00     2000.00    10288.00    13432.00
       6.00     1983.00     5258.00     2000.00    10514.00    13772.00
       7.00     1983.00     6295.00     2721.00    12587.00    16161.00
       8.00     1983.00     9024.00     3768.00    18048.00    23304.00
       9.00     1983.00    12000.00    12000.00    24000.00    24000.00
      10.00     1983.00    12000.00    12000.00    24000.00    24000.00
      11.00     1983.00    12000.00    12000.00    24000.00    24000.00
      12.00     1983.00    12000.00    12000.00    24000.00    24000.00
       1.00     1984.00    12000.00    12000.00    24000.00    24000.00
       2.00     1984.00    10909.00     8726.00    21817.00    24000.00
       3.00     1984.00    10335.00     7002.00    20667.00    24000.00
       4.00     1984.00    10196.00     6585.00    20389.00    24000.00
       5.00     1984.00    11217.00     9650.00    22433.00    24000.00
       6.00     1984.00    11975.00    11923.00    23948.00    24000.00
       7.00     1984.00    11751.00    11251.00    23500.00    24000.00
       8.00     1984.00    12000.00    12000.00    24000.00    24000.00
       9.00     1984.00    12000.00    12000.00    24000.00    24000.00
      10.00     1984.00    12000.00    12000.00    24000.00    24000.00
      11.00     1984.00    11844.00    11529.00    23685.00    24000.00
      12.00     1984.00    11091.00     9272.00    22181.00    24000.00
```

Figure 3.3-2 Worked Example 3(b) –Investigation of Target Storage Curves on Storage Volumes

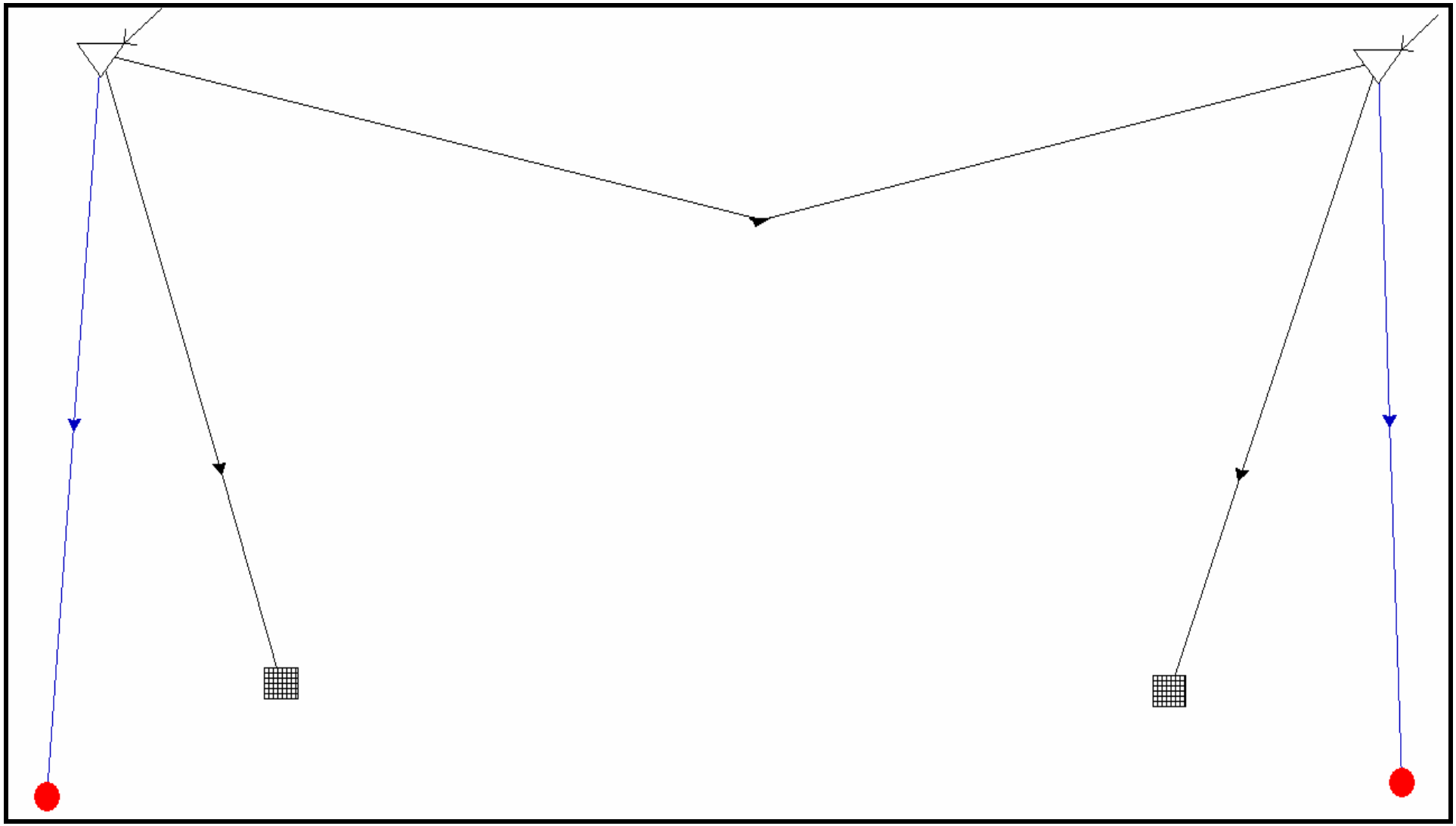

Figure 3.3-3 Worked Example 3(c) – System Plot (*EX3C.sys*)

WORKED EXAMPLE 3(c) – SYSTEM LISTING

```
_____________________________________________________________

              R      E      A      L      M
_____________________________________________________________


            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX3C.SYS


 Simulation label:
     Tutorial 3 - Sub-Problem (a)



 Date: 06:37    15/03/2005


-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input          No
-------------------------------------------------------------------------------------------------------------
   1 RESERVOIR 1          Reservoir           8.25    95.00     0.00     1.00 STREAM1                1
   2 RESERVOIR 2          Reservoir          94.64    94.30     0.00     1.00 STREAM2                2
   3 DEMAND 1             Demand             20.43    28.86     0.00     1.00                        3
   4 DEMAND 2             Demand             80.54    28.07     0.00     1.00                        4
   5 STRM TERM 1          Strm terminator     4.59    16.95     0.00     1.00                        5
   6 STRM TERM 2          Strm terminator    96.23    18.54     0.00     1.00                        6


 Reservoir data:

      No       Name              Min     Max    No   No     Spill
                                 Cap     Cap  Above Below    Type
     ------------------------------------------------------------------
        1 RESERVOIR 1               0    12000  1    1     Downstream
        2 RESERVOIR 2               0    24000  1    1     Downstream
```

No	Name		Levels/volume relationships pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR 1	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	RESERVOIR 2	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	DEMAND 2	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp Shr%	No
1	CARRIER 1	Pipe	1	3	0	0	0fix	0	0%	1
2	CARRIER 2	Pipe	2	4	0	0	0fix	0	0%	2
3	CARRIER 3	Pipe	1	2	0	0	0fix	0	0%	3
4	River 1	River	1	5	1000	0	0fix	0	0%	4
5	River 2	River	2	6	1000	0	0fix	0	0%	5

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	CARRIER 1	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
2	CARRIER 2	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
3	CARRIER 3	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
4	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
5	River 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

```
------------------------------
|  TARGET INFORMATION         |
------------------------------

 Number of target sets:  1

-------------------------------------------------------------------------------------------------------------------------
 Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)
 Name                 Draw Pri                                    Targets
-------------------------------------------------------------------------------------------------------------------------
RESERVOIR 1             1          0      1333      2667      4000      5333      6667      8000      9333      10667      12000
RESERVOIR 2             2          0      2667      5333      8000     10667     13333     16000     18667      21333      24000

 totals                            0      4000      8000     12000     16000     20000     24000     28000      32000      36000
```

WORKED EXAMPLE 3(c) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX3C.log

 Scenario file: scn3c.scn

 Simulation label:
     Tutorial 3 Sub-Problem (c)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf3.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem2.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 16:18:42 12/05/01
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX3C.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX3C.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.      764.     7246.        0.      426.        0.     8102.
  2  RESERVOIR 2              8000.     2576.     4170.    15681.        0.      750.        0.    23490.
-------------------------------------------------------------------------------------------------------------
                             17000.     4659.        0.    22927.        0.     1176.        0.    31592.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	0.	1372.
2	DEMAND 2	1706.	1706.	1706.	0.	1706.
		3078.	3078.	3078.	0.	3078.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	DEMAND 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	CARRIER 1	1372.2	12000.0	0.0	2800.0	0.0
2	CARRIER 2	1705.6	24000.0	300.0	3100.0	0.0
3	CARRIER 3	309.7	24000.0	0.0	2703.0	0.0
4	River 1	425.8	99999999.0	0.0	4610.0	0.0
5	River 2	750.2	99999999.0	0.0	7690.0	0.0
						0.

End run

WORKED EXAMPLE 3(c) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX3C.log                          Time :16:18:42 Date :12/05/01
Tutorial 3 Sub-Problem (c)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
RESERVOIR 1     ESTO
RESERVOIR 2     ESTO
  1. 1982.    1.     4452.00     8904.00
  2. 1982.    1.     3440.00     8764.00
  3. 1982.    1.     2365.00     7984.00
  4. 1982.    1.     1315.00     8224.00
  5. 1982.    1.     4703.00    10324.00
  6. 1982.    1.     5626.00    11250.00
  7. 1982.    1.     5510.00    11020.00
  8. 1982.    1.     5365.00    10728.00
  9. 1982.    1.     5241.00    10482.00
 10. 1982.    1.     5063.00    10126.00
 11. 1982.    1.     4436.00     8871.00
 12. 1982.    1.     4166.00     8330.00
  1. 1983.    1.     2438.00     6870.00
  2. 1983.    1.     1498.00     4170.00
  3. 1983.    1.      764.00     4680.00
  4. 1983.    1.     3038.00     6074.00
  5. 1983.    1.     5144.00    10288.00
  6. 1983.    1.     5258.00    10514.00
  7. 1983.    1.     6295.00    12587.00
  8. 1983.    1.     9024.00    18048.00
  9. 1983.    1.    12000.00    24000.00
 10. 1983.    1.    12000.00    24000.00
 11. 1983.    1.    11923.00    24000.00
 12. 1983.    1.    12000.00    24000.00
  1. 1984.    1.    12000.00    24000.00
  2. 1984.    1.     9946.00    22780.00
  3. 1984.    1.     9672.00    21330.00
  4. 1984.    1.     9285.00    21300.00
  5. 1984.    1.     9510.00    24000.00
  6. 1984.    1.    11743.00    24000.00
  7. 1984.    1.    11691.00    23380.00
  8. 1984.    1.    12000.00    24000.00
  9. 1984.    1.    12000.00    24000.00
 10. 1984.    1.    12000.00    24000.00
 11. 1984.    1.     9849.00    24000.00
 12. 1984.    1.     8102.00    23490.00
```

WORKED EXAMPLE 3(c) – TARGET STORAGE VOLUME

```
RESERVOIR TARGETS
EX3C.log                          Time :16:18:42 Date :12/05/01
Tutorial 3 Sub-Problem (c)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
RESERVOIR 1     TARG
RESERVOIR 2     TARG
  1. 1982.    1.     4452.00     8904.00
  2. 1982.    1.     4068.00     8136.00
  3. 1982.    1.     3450.00     6899.00
  4. 1982.    1.     3180.00     6359.00
  5. 1982.    1.     5009.00    10018.00
  6. 1982.    1.     5626.00    11250.00
  7. 1982.    1.     5510.00    11020.00
  8. 1982.    1.     5365.00    10728.00
  9. 1982.    1.     5241.00    10482.00
 10. 1982.    1.     5063.00    10126.00
 11. 1982.    1.     4436.00     8871.00
 12. 1982.    1.     4166.00     8330.00
  1. 1983.    1.     3103.00     6205.00
  2. 1983.    1.     1890.00     3778.00
  3. 1983.    1.     1815.00     3629.00
  4. 1983.    1.     3038.00     6074.00
  5. 1983.    1.     5144.00    10288.00
  6. 1983.    1.     5258.00    10514.00
  7. 1983.    1.     6295.00    12587.00
  8. 1983.    1.     9024.00    18048.00
  9. 1983.    1.    12000.00    24000.00
 10. 1983.    1.    12000.00    24000.00
 11. 1983.    1.    11975.00    23948.00
 12. 1983.    1.    12000.00    24000.00
  1. 1984.    1.    12000.00    24000.00
  2. 1984.    1.    10909.00    21817.00
  3. 1984.    1.    10335.00    20667.00
  4. 1984.    1.    10196.00    20389.00
  5. 1984.    1.    11171.00    22339.00
  6. 1984.    1.    11928.00    23855.00
  7. 1984.    1.    11691.00    23380.00
  8. 1984.    1.    12000.00    24000.00
  9. 1984.    1.    12000.00    24000.00
 10. 1984.    1.    12000.00    24000.00
 11. 1984.    1.    11284.00    22565.00
 12. 1984.    1.    10531.00    21061.00
```

WORKED EXAMPLE 3(c) – CARRIER FLOWS

```
CARRIER FLOWS
EX3C.log                    Time :16:03:52 Date :12/05/01
Tutorial 3 Sub-Problem (c)


(F4.0,2F6.0,  4f12.2              )
  7
SEASON
YEAR
REPLICATE
CARRIER 1       FLOW
CARRIER 2       FLOW
CARRIER 3       FLOW
River 2         FLOW
  1. 1982.    1.     2700.00     2700.00     2264.00        0.00
  2. 1982.    1.     1300.00     1300.00        0.00        0.00
  3. 1982.    1.     2100.00     2100.00        0.00        0.00
  4. 1982.    1.     1500.00     1500.00        0.00        0.00
  5. 1982.    1.     1600.00     1600.00        0.00        0.00
  6. 1982.    1.      700.00     1700.00      626.00        0.00
  7. 1982.    1.     1200.00     1200.00      150.00        0.00
  8. 1982.    1.     1800.00     1800.00      618.00        0.00
  9. 1982.    1.     2200.00     1200.00       84.00        0.00
 10. 1982.    1.     1300.00     1300.00       94.00        0.00
 11. 1982.    1.     1400.00     2400.00      565.00        0.00
 12. 1982.    1.     1400.00     1400.00      139.00        0.00
  1. 1983.    1.     1900.00     1900.00        0.00        0.00
  2. 1983.    1.     1100.00     3100.00        0.00        0.00
  3. 1983.    1.     1300.00     1300.00        0.00        0.00
  4. 1983.    1.      800.00     1800.00      774.00        0.00
  5. 1983.    1.        0.00     2000.00     1114.00        0.00
  6. 1983.    1.      600.00     1600.00      786.00        0.00
  7. 1983.    1.      900.00     1900.00     2703.00        0.00
  8. 1983.    1.      300.00     1300.00      871.00        0.00
  9. 1983.    1.      600.00     1600.00        0.00     4178.00
 10. 1983.    1.     1400.00     1400.00        0.00     7690.00
 11. 1983.    1.     2100.00     2100.00        0.00     1670.00
 12. 1983.    1.     2100.00     2100.00        0.00     1150.00
  1. 1984.    1.     1100.00     1100.00        0.00     4050.00
  2. 1984.    1.     2300.00     2300.00        0.00        0.00
  3. 1984.    1.     2800.00     2800.00        0.00        0.00
  4. 1984.    1.     1900.00     1900.00        0.00        0.00
  5. 1984.    1.      300.00      300.00        0.00      140.00
  6. 1984.    1.      600.00      600.00        0.00       40.00
  7. 1984.    1.      600.00     1600.00      360.00        0.00
  8. 1984.    1.      100.00     1100.00        0.00     2300.00
  9. 1984.    1.     1600.00     1600.00        0.00     2220.00
 10. 1984.    1.     1300.00     1300.00        0.00     1890.00
 11. 1984.    1.     2400.00     2400.00        0.00     1680.00
 12. 1984.    1.     2100.00     2100.00        0.00        0.00
```

WORKED EXAMPLE 3(c) – COMPARISON OF RESERVOIR STORAGE AND TARGET STORAGE VOLUMES

```
####4
EX3C.log                          Time :16:18:42 Date :12/05/01
Tutorial 3 Sub-Problem (c)


(  6f12.2              )
   6
SEASON
YEAR
RESERVOIR 1     ESTO
RESERVOIR 1     TARG
RESERVOIR 2     ESTO
RESERVOIR 2     TARG
        1.00     1982.00     4452.00     4452.00     8904.00     8904.00
        2.00     1982.00     3440.00     4068.00     8764.00     8136.00
        3.00     1982.00     2365.00     3450.00     7984.00     6899.00
        4.00     1982.00     1315.00     3180.00     8224.00     6359.00
        5.00     1982.00     4703.00     5009.00    10324.00    10018.00
        6.00     1982.00     5626.00     5626.00    11250.00    11250.00
        7.00     1982.00     5510.00     5510.00    11020.00    11020.00
        8.00     1982.00     5365.00     5365.00    10728.00    10728.00
        9.00     1982.00     5241.00     5241.00    10482.00    10482.00
       10.00     1982.00     5063.00     5063.00    10126.00    10126.00
       11.00     1982.00     4436.00     4436.00     8871.00     8871.00
       12.00     1982.00     4166.00     4166.00     8330.00     8330.00
        1.00     1983.00     2438.00     3103.00     6870.00     6205.00
        2.00     1983.00     1498.00     1890.00     4170.00     3778.00
        3.00     1983.00      764.00     1815.00     4680.00     3629.00
        4.00     1983.00     3038.00     3038.00     6074.00     6074.00
        5.00     1983.00     5144.00     5144.00    10288.00    10288.00
        6.00     1983.00     5258.00     5258.00    10514.00    10514.00
        7.00     1983.00     6295.00     6295.00    12587.00    12587.00
        8.00     1983.00     9024.00     9024.00    18048.00    18048.00
        9.00     1983.00    12000.00    12000.00    24000.00    24000.00
       10.00     1983.00    12000.00    12000.00    24000.00    24000.00
       11.00     1983.00    11923.00    11975.00    24000.00    23948.00
       12.00     1983.00    12000.00    12000.00    24000.00    24000.00
        1.00     1984.00    12000.00    12000.00    24000.00    24000.00
        2.00     1984.00     9946.00    10909.00    22780.00    21817.00
        3.00     1984.00     9672.00    10335.00    21330.00    20667.00
        4.00     1984.00     9285.00    10196.00    21300.00    20389.00
        5.00     1984.00     9510.00    11171.00    24000.00    22339.00
        6.00     1984.00    11743.00    11928.00    24000.00    23855.00
        7.00     1984.00    11691.00    11691.00    23380.00    23380.00
        8.00     1984.00    12000.00    12000.00    24000.00    24000.00
        9.00     1984.00    12000.00    12000.00    24000.00    24000.00
       10.00     1984.00    12000.00    12000.00    24000.00    24000.00
       11.00     1984.00     9849.00    11284.00    24000.00    22565.00
       12.00     1984.00     8102.00    10531.00    23490.00    21061.00
```

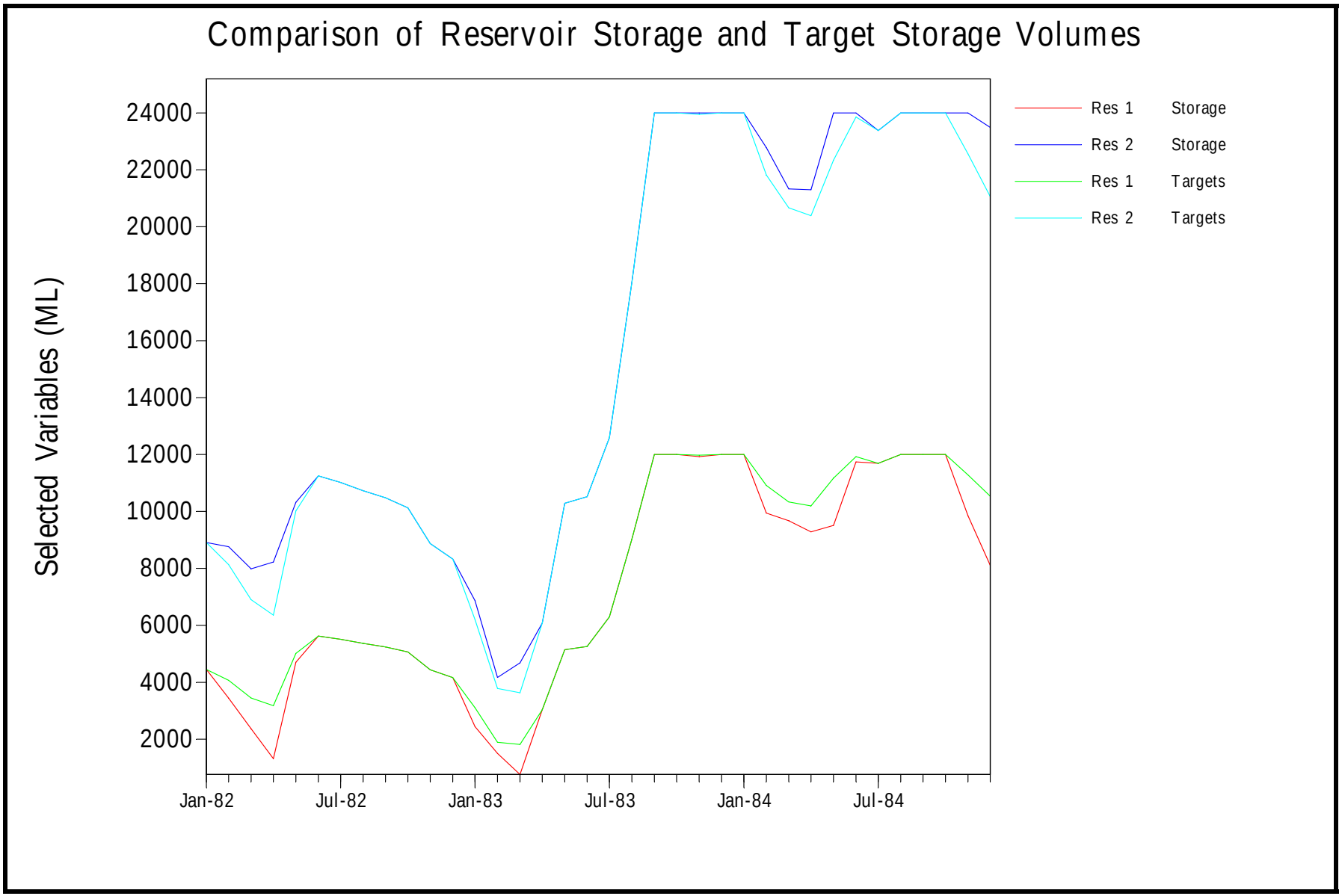

Figure 3.3-4 Worked Example 3(c) – Comparison of Reservoir Storage and Target Storage Volumes

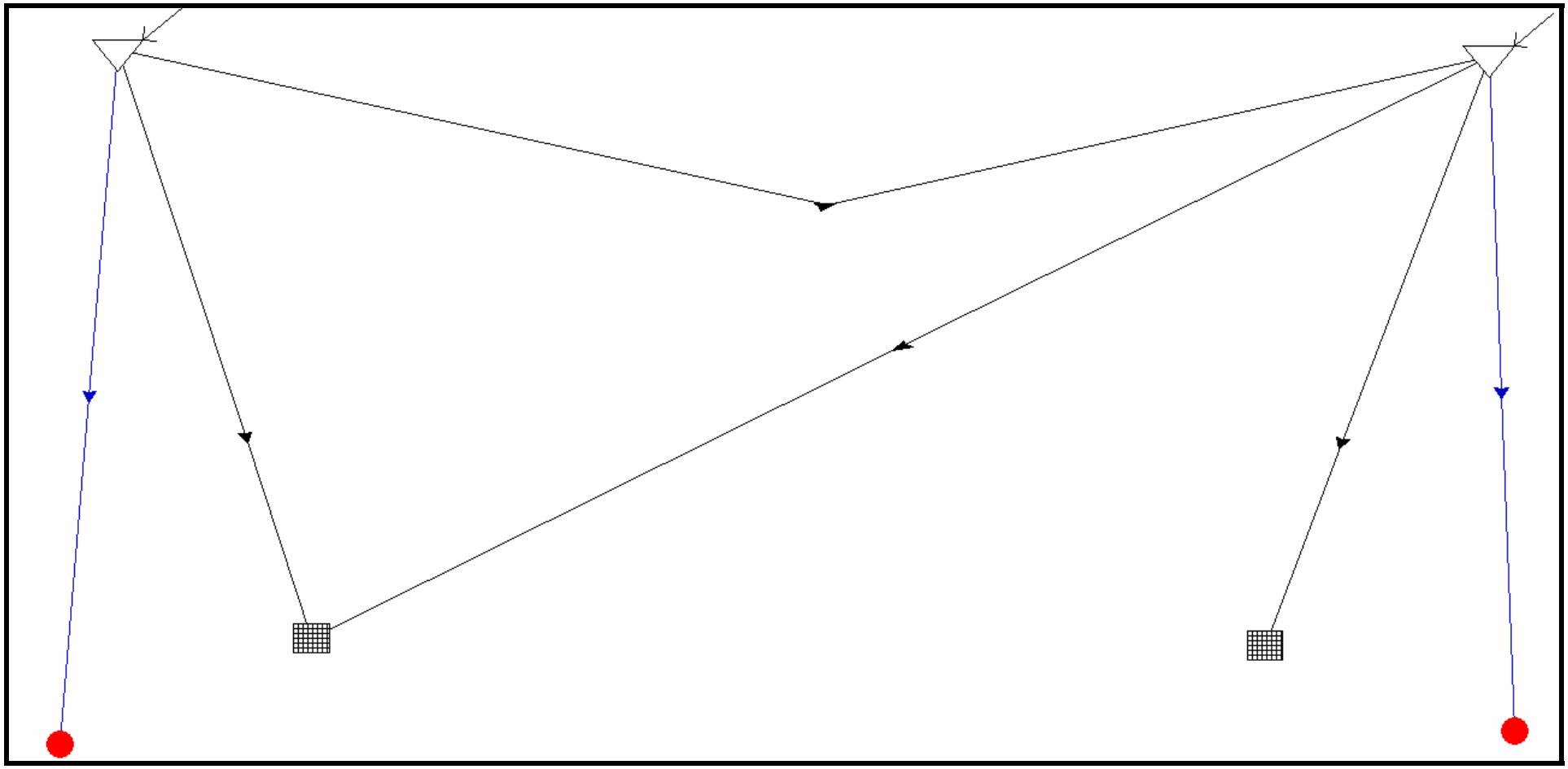

Figure 3.3-5 Worked Example 3(d) – System Plot (*EX3D.sys*)

WORKED EXAMPLE 3(d) – SYSTEM LISTING

```
_____________________________________________________________

              R      E      A      L      M
_____________________________________________________________

            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX3D.sys

 Simulation label:
     Tutorial 3 - Sub-Problem (d)



 Date: 11:53:48 12/10/01


-------------------------------
|  NODE INFORMATION           |
-------------------------------
```

No	Name	Type	X	Y	Z	Size	Aux Input	No
1	RESERVOIR 1	Reservoir	8.25	95.00	0.00	1.00	STREAM1	1
2	RESERVOIR 2	Reservoir	94.64	94.30	0.00	1.00	STREAM2	2
3	DEMAND 1	Demand	20.43	28.86	0.00	1.00		3
4	DEMAND 2	Demand	80.54	28.07	0.00	1.00		4
5	STRM TERM 1	Strm terminator	4.59	16.95	0.00	1.00		5
6	STRM TERM 2	Strm terminator	96.23	18.54	0.00	1.00		6

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
1	RESERVOIR 1	0	12000	1	1	Downstream
2	RESERVOIR 2	0	24000	1	1	Downstream

No	Name		Levels/volume relationships pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR 1	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	RESERVOIR 2	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	DEMAND 2	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	CARRIER 1	Pipe	1	3	0	0	0fix	0		0%	1
2	CARRIER 2	Pipe	2	4	0	0	0fix	0		0%	2
3	CARRIER 3	Pipe	1	2	0	0	0fix	0		0%	3
4	River 1	River	1	5	1000	0	0fix	0		0%	6
5	River 2	River	2	6	1000	0	0fix	0		0%	5
6	CARRIER 5	Pipe	2	3	0	0	0fix	0		0%	4

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	CARRIER 1	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
2	CARRIER 2	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
3	CARRIER 3	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000
4	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
5	River 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
6	CARRIER 5	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000

TARGET INFORMATION

Number of target sets: 1

Target set 1 (Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

Name	Draw	Pri	Targets								
RESERVOIR 1	1	0	1333	2667	4000	5333	6667	8000	9333	10667	12000
RESERVOIR 2	2	0	2667	5333	8000	10667	13333	16000	18667	21333	24000
totals		0	4000	8000	12000	16000	20000	24000	28000	32000	36000

```
------------------------------
|  MULTI SYSTEM INFORMATION   |
------------------------------

-------------------------------------------------------------------------------------------------------------------------
 Reservoirs
-------------------------------------------------------------------------------------------------------------------------
 RESERVOIR 1       1
 RESERVOIR 2       1
```

WORKED EXAMPLE 3(d) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX3D.log

 Scenario file: scn3d.scn

 Simulation label:
     Tutorial 3 Sub-Problem (d)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf3.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem2.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 16:56:11 12/05/01
```

```
Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX3D.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX3D.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR 1              9000.     2083.     1815.     7665.        0.      603.        0.    11091.
  2  RESERVOIR 2              8000.     2576.     3629.    15371.        0.      527.        0.    22181.
-------------------------------------------------------------------------------------------------------------
                             17000.     4659.        0.    23037.        0.     1129.        0.    33272.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	0.	1372.
2	DEMAND 2	1706.	1706.	1706.	0.	1706.
		3078.	3078.	3078.	0.	3078.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	DEMAND 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	CARRIER 1	936.4	2000.0	0.0	2000.0	0.0
2	CARRIER 2	1705.6	24000.0	300.0	3100.0	0.0
3	CARRIER 3	513.3	24000.0	0.0	2964.0	0.0
4	River 1	575.0	99999999.0	0.0	5910.0	0.0
5	River 2	554.4	99999999.0	0.0	6290.0	0.0
6	CARRIER 5	435.8	24000.0	0.0	1995.0	0.0
						0.

End run

WORKED EXAMPLE 3(d) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX3D.log                          Time :16:56:11 Date :12/05/01
Tutorial 3 Sub-Problem (d)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
RESERVOIR 1     ESTO
RESERVOIR 2     ESTO
  1. 1982.    1.     4452.00     8904.00
  2. 1982.    1.     4068.00     8136.00
  3. 1982.    1.     3450.00     6899.00
  4. 1982.    1.     3180.00     6359.00
  5. 1982.    1.     5009.00    10018.00
  6. 1982.    1.     5626.00    11250.00
  7. 1982.    1.     5510.00    11020.00
  8. 1982.    1.     5365.00    10728.00
  9. 1982.    1.     5241.00    10482.00
 10. 1982.    1.     5063.00    10126.00
 11. 1982.    1.     4436.00     8871.00
 12. 1982.    1.     4166.00     8330.00
  1. 1983.    1.     3103.00     6205.00
  2. 1983.    1.     1890.00     3778.00
  3. 1983.    1.     1815.00     3629.00
  4. 1983.    1.     3038.00     6074.00
  5. 1983.    1.     5144.00    10288.00
  6. 1983.    1.     5258.00    10514.00
  7. 1983.    1.     6295.00    12587.00
  8. 1983.    1.     9024.00    18048.00
  9. 1983.    1.    12000.00    24000.00
 10. 1983.    1.    12000.00    24000.00
 11. 1983.    1.    12000.00    24000.00
 12. 1983.    1.    12000.00    24000.00
  1. 1984.    1.    12000.00    24000.00
  2. 1984.    1.    10909.00    21817.00
  3. 1984.    1.    10335.00    20667.00
  4. 1984.    1.    10196.00    20389.00
  5. 1984.    1.    10721.00    22929.00
  6. 1984.    1.    11975.00    23948.00
  7. 1984.    1.    11751.00    23500.00
  8. 1984.    1.    12000.00    24000.00
  9. 1984.    1.    12000.00    24000.00
 10. 1984.    1.    12000.00    24000.00
 11. 1984.    1.    11844.00    23685.00
 12. 1984.    1.    11091.00    22181.00
```

WORKED EXAMPLE 3(d) – TARGET STORAGE

```
RESERVOIR TARGETS
EX3D.log                          Time :16:56:11 Date :12/05/01
Tutorial 3 Sub-Problem (d)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
RESERVOIR 1     TARG
RESERVOIR 2     TARG
  1. 1982.    1.     4452.00     8904.00
  2. 1982.    1.     4068.00     8136.00
  3. 1982.    1.     3450.00     6899.00
  4. 1982.    1.     3180.00     6359.00
  5. 1982.    1.     5009.00    10018.00
  6. 1982.    1.     5626.00    11250.00
  7. 1982.    1.     5510.00    11020.00
  8. 1982.    1.     5365.00    10728.00
  9. 1982.    1.     5241.00    10482.00
 10. 1982.    1.     5063.00    10126.00
 11. 1982.    1.     4436.00     8871.00
 12. 1982.    1.     4166.00     8330.00
  1. 1983.    1.     3103.00     6205.00
  2. 1983.    1.     1890.00     3778.00
  3. 1983.    1.     1815.00     3629.00
  4. 1983.    1.     3038.00     6074.00
  5. 1983.    1.     5144.00    10288.00
  6. 1983.    1.     5258.00    10514.00
  7. 1983.    1.     6295.00    12587.00
  8. 1983.    1.     9024.00    18048.00
  9. 1983.    1.    12000.00    24000.00
 10. 1983.    1.    12000.00    24000.00
 11. 1983.    1.    12000.00    24000.00
 12. 1983.    1.    12000.00    24000.00
  1. 1984.    1.    12000.00    24000.00
  2. 1984.    1.    10909.00    21817.00
  3. 1984.    1.    10335.00    20667.00
  4. 1984.    1.    10196.00    20389.00
  5. 1984.    1.    11217.00    22433.00
  6. 1984.    1.    11975.00    23948.00
  7. 1984.    1.    11751.00    23500.00
  8. 1984.    1.    12000.00    24000.00
  9. 1984.    1.    12000.00    24000.00
 10. 1984.    1.    12000.00    24000.00
 11. 1984.    1.    11844.00    23685.00
 12. 1984.    1.    11091.00    22181.00
```

WORKED EXAMPLE 3(d) – CARRIER FLOW

```
CARRIER FLOWS
EX3D.log                    Time :16:56:11 Date :12/05/01
Tutorial 3 Sub-Problem (d)


(F4.0,2F6.0,  4f12.2              )
  7
SEASON
YEAR
REPLICATE
CARRIER 1       FLOW
CARRIER 2       FLOW
CARRIER 3       FLOW
CARRIER 5       FLOW
  1. 1982.    1.     2000.00     2700.00     2964.00      700.00
  2. 1982.    1.      672.00     1300.00        0.00      628.00
  3. 1982.    1.     1643.00     2100.00        0.00      457.00
  4. 1982.    1.      720.00     1500.00        0.00      780.00
  5. 1982.    1.     1600.00     1600.00     1559.00        0.00
  6. 1982.    1.      700.00     1700.00      932.00        0.00
  7. 1982.    1.     1200.00     1200.00      150.00        0.00
  8. 1982.    1.     1800.00     1800.00      618.00        0.00
  9. 1982.    1.     2000.00     1200.00      284.00      200.00
 10. 1982.    1.     1300.00     1300.00       94.00        0.00
 11. 1982.    1.     1400.00     2400.00      565.00        0.00
 12. 1982.    1.     1400.00     1400.00      139.00        0.00
  1. 1983.    1.     1235.00     1900.00        0.00      665.00
  2. 1983.    1.     1100.00     3100.00      273.00        0.00
  3. 1983.    1.      641.00     1300.00        0.00      659.00
  4. 1983.    1.      800.00     1800.00     1825.00        0.00
  5. 1983.    1.        0.00     2000.00     1114.00        0.00
  6. 1983.    1.      600.00     1600.00      786.00        0.00
  7. 1983.    1.      900.00     1900.00     2703.00        0.00
  8. 1983.    1.      300.00     1300.00      871.00        0.00
  9. 1983.    1.        0.00     1600.00        0.00      600.00
 10. 1983.    1.        0.00     1400.00        0.00     1400.00
 11. 1983.    1.     2000.00     2100.00        0.00      100.00
 12. 1983.    1.     2000.00     2100.00        0.00      100.00
  1. 1984.    1.        0.00     1100.00        0.00     1100.00
  2. 1984.    1.     1337.00     2300.00        0.00      963.00
  3. 1984.    1.     2000.00     2800.00     1100.00      800.00
  4. 1984.    1.     1652.00     1900.00        0.00      248.00
  5. 1984.    1.        0.00      300.00        0.00      300.00
  6. 1984.    1.      600.00      600.00      979.00        0.00
  7. 1984.    1.      600.00     1600.00      532.00        0.00
  8. 1984.    1.        0.00     1100.00        0.00      100.00
  9. 1984.    1.        0.00     1600.00        0.00     1600.00
 10. 1984.    1.        0.00     1300.00        0.00     1300.00
 11. 1984.    1.      405.00     2400.00        0.00     1995.00
 12. 1984.    1.     1106.00     2100.00        0.00      994.00
```

WORKED EXAMPLE 3(d) – COMPARISON OF RESERVOIR STORAGE AND TARGET STORAGE VOLUMES

```
####4
EX3D.log                          Time :16:56:11 Date :12/05/01
Tutorial 3 Sub-Problem (d)


(  6f12.2              )
   6
SEASON
YEAR
RESERVOIR 1     ESTO
RESERVOIR 1     TARG
RESERVOIR 2     ESTO
RESERVOIR 2     TARG
        1.00     1982.00     4452.00     4452.00     8904.00     8904.00
        2.00     1982.00     4068.00     4068.00     8136.00     8136.00
        3.00     1982.00     3450.00     3450.00     6899.00     6899.00
        4.00     1982.00     3180.00     3180.00     6359.00     6359.00
        5.00     1982.00     5009.00     5009.00    10018.00    10018.00
        6.00     1982.00     5626.00     5626.00    11250.00    11250.00
        7.00     1982.00     5510.00     5510.00    11020.00    11020.00
        8.00     1982.00     5365.00     5365.00    10728.00    10728.00
        9.00     1982.00     5241.00     5241.00    10482.00    10482.00
       10.00     1982.00     5063.00     5063.00    10126.00    10126.00
       11.00     1982.00     4436.00     4436.00     8871.00     8871.00
       12.00     1982.00     4166.00     4166.00     8330.00     8330.00
        1.00     1983.00     3103.00     3103.00     6205.00     6205.00
        2.00     1983.00     1890.00     1890.00     3778.00     3778.00
        3.00     1983.00     1815.00     1815.00     3629.00     3629.00
        4.00     1983.00     3038.00     3038.00     6074.00     6074.00
        5.00     1983.00     5144.00     5144.00    10288.00    10288.00
        6.00     1983.00     5258.00     5258.00    10514.00    10514.00
        7.00     1983.00     6295.00     6295.00    12587.00    12587.00
        8.00     1983.00     9024.00     9024.00    18048.00    18048.00
        9.00     1983.00    12000.00    12000.00    24000.00    24000.00
       10.00     1983.00    12000.00    12000.00    24000.00    24000.00
       11.00     1983.00    12000.00    12000.00    24000.00    24000.00
       12.00     1983.00    12000.00    12000.00    24000.00    24000.00
        1.00     1984.00    12000.00    12000.00    24000.00    24000.00
        2.00     1984.00    10909.00    10909.00    21817.00    21817.00
        3.00     1984.00    10335.00    10335.00    20667.00    20667.00
        4.00     1984.00    10196.00    10196.00    20389.00    20389.00
        5.00     1984.00    10721.00    11217.00    22929.00    22433.00
        6.00     1984.00    11975.00    11975.00    23948.00    23948.00
        7.00     1984.00    11751.00    11751.00    23500.00    23500.00
        8.00     1984.00    12000.00    12000.00    24000.00    24000.00
        9.00     1984.00    12000.00    12000.00    24000.00    24000.00
       10.00     1984.00    12000.00    12000.00    24000.00    24000.00
       11.00     1984.00    11844.00    11844.00    23685.00    23685.00
       12.00     1984.00    11091.00    11091.00    22181.00    22181.00
```

Figure 3.3-6 Worked Example 3(d) – Comparison of Reservoir Storage and Target Storage Volume

3.4 WORKED EXAMPLE 4

ILLUSTRATION OF ABOVE AND BELOW TARGET ZONES AND DRAWDOWN PRIORITY

WORKED EXAMPLE 4(a) - STREAMFLOW FILE (SF3.DAT)

```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 4F12.2)
   4
SEASON
YEAR
STREAM1
STREAM2
        1.00     1982.00      416.00     1340.00
        2.00     1982.00      288.00     1160.00
        3.00     1982.00     1025.00     1320.00
        4.00     1982.00      450.00     1740.00
        5.00     1982.00     4988.00     3700.00
        6.00     1982.00     2249.00     2000.00
        7.00     1982.00     1234.00      820.00
        8.00     1982.00     2273.00      890.00
        9.00     1982.00     2160.00      870.00
       10.00     1982.00     1216.00      850.00
       11.00     1982.00     1338.00      580.00
       12.00     1982.00     1269.00      720.00
        1.00     1983.00      172.00      440.00
        2.00     1983.00      160.00      400.00
        3.00     1983.00      566.00     1810.00
        4.00     1983.00     3848.00     2420.00
        5.00     1983.00     3220.00     5100.00
        6.00     1983.00     1500.00     1040.00
        7.00     1983.00     4640.00     1270.00
        8.00     1983.00     3900.00     5890.00
        9.00     1983.00     4600.00    11730.00
       10.00     1983.00     2360.00     9090.00
       11.00     1983.00     2023.00     3770.00
       12.00     1983.00     2967.00     3250.00
        1.00     1984.00     4426.00     5150.00
        2.00     1984.00      246.00     1080.00
        3.00     1984.00     2526.00     1350.00
        4.00     1984.00     1513.00     1870.00
        5.00     1984.00      525.00     3140.00
        6.00     1984.00     2833.00      640.00
        7.00     1984.00      908.00      620.00
        8.00     1984.00     2029.00     4020.00
        9.00     1984.00     4600.00     3820.00
       10.00     1984.00     5910.00     3190.00
       11.00     1984.00      249.00     4080.00
       12.00     1984.00      353.00     1590.00
```

WORKED EXAMPLE 4(a) - DEMAND FILE (DEM2.DAT)

```
####3
DEMANDS DATAFILE
HISTORICAL DATA
DATA ASSEMBLED AND REFORMATED ON
DATE : 9 JUL 1990
( 4F12.2)
   4
SEASON
YEAR
DEMAND 1
DEMAND 2
        1.00     1982.00     2700.00     2700.00
        2.00     1982.00     1300.00     1300.00
        3.00     1982.00     2100.00     2100.00
        4.00     1982.00     1500.00     1500.00
        5.00     1982.00     1600.00     1600.00
        6.00     1982.00      700.00     1700.00
        7.00     1982.00     1200.00     1200.00
        8.00     1982.00     1800.00     1800.00
        9.00     1982.00     2200.00     1200.00
       10.00     1982.00     1300.00     1300.00
       11.00     1982.00     1400.00     2400.00
       12.00     1982.00     1400.00     1400.00
        1.00     1983.00     1900.00     1900.00
        2.00     1983.00     1100.00     3100.00
        3.00     1983.00     1300.00     1300.00
        4.00     1983.00      800.00     1800.00
        5.00     1983.00        0.00     2000.00
        6.00     1983.00      600.00     1600.00
        7.00     1983.00      900.00     1900.00
        8.00     1983.00      300.00     1300.00
        9.00     1983.00      600.00     1600.00
       10.00     1983.00     1400.00     1400.00
       11.00     1983.00     2100.00     2100.00
       12.00     1983.00     2100.00     2100.00
        1.00     1984.00     1100.00     1100.00
        2.00     1984.00     2300.00     2300.00
        3.00     1984.00     2800.00     2800.00
        4.00     1984.00     1900.00     1900.00
        5.00     1984.00      300.00      300.00
        6.00     1984.00      600.00      600.00
        7.00     1984.00      600.00     1600.00
        8.00     1984.00      100.00     1100.00
        9.00     1984.00     1600.00     1600.00
       10.00     1984.00     1300.00     1300.00
       11.00     1984.00     2400.00     2400.00
       12.00     1984.00     2100.00     2100.00
```

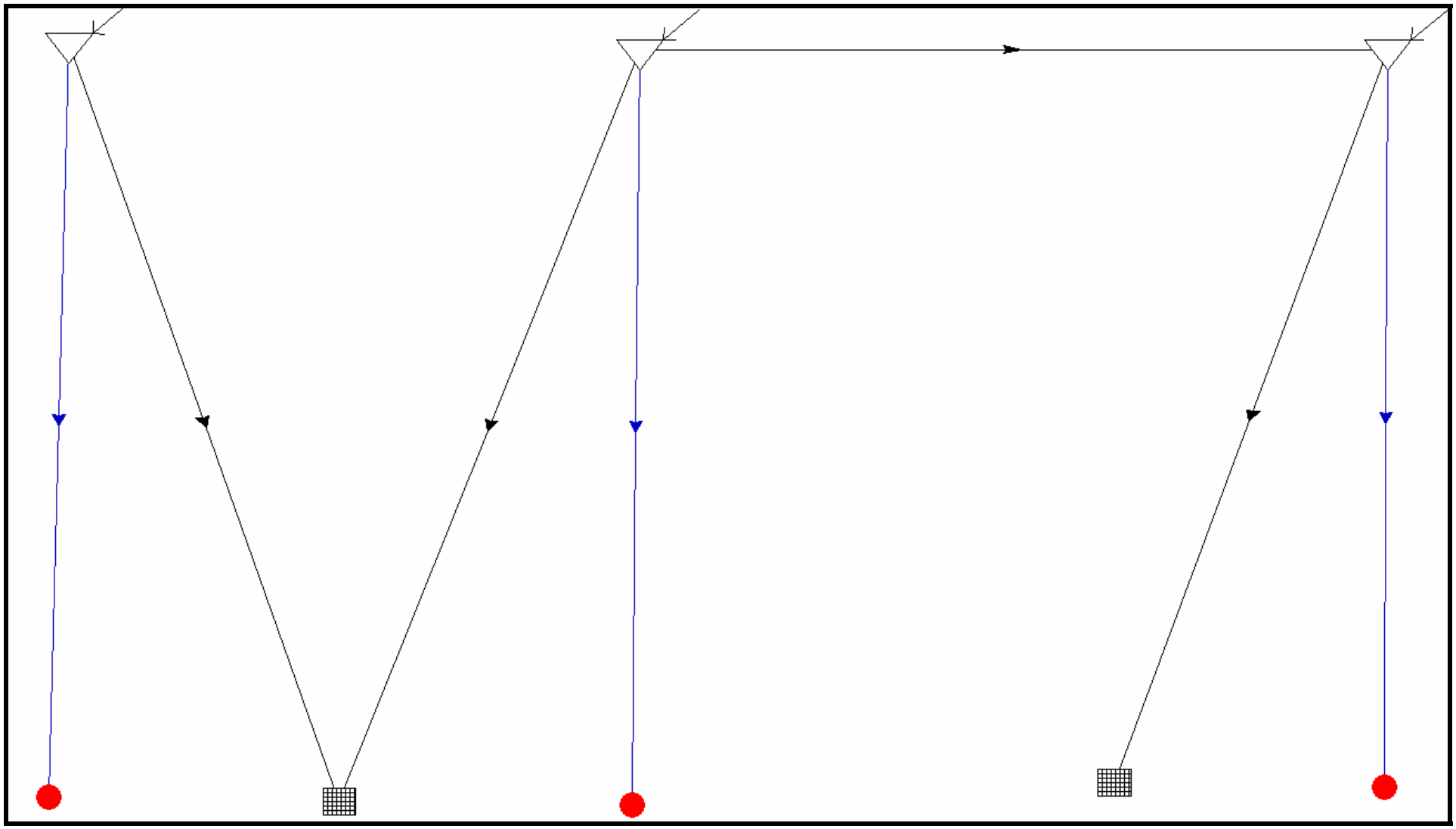

Figure 3.4-1 Worked Example 4(a) – System Plot (*EX4A.sys*)

WORKED EXAMPLE 4(a) – SYSTEM LISTING

R E A L M

```
            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX4A.sys

 Simulation label:
     Tutorial 4 - Sub-Problem (a)



 Date: 14:37:52 01/11/02
```

NODE INFORMATION

No	Name	Type	X	Y	Z	Size	Aux Input	No
1	RESERVOIR A	Reservoir	5.00	95.00	0.00	1.00	STREAM1	1
2	RESERVOIR B	Reservoir	43.95	94.24	0.00	1.00	STREAM2	2
3	RESERVOIR C	Reservoir	95.00	94.24	0.00	1.00	STREAM1	3
4	DEMAND 1	Demand	23.42	5.00	0.00	1.00		4
5	DEMAND 2	Demand	76.32	7.27	0.00	1.00		5
6	STRM TERM 1	Strm terminator	3.60	5.56	0.00	1.00		6
7	STRM TERM 2	Strm terminator	43.40	4.68	0.00	1.00		7
8	STRM TERM 3	Strm terminator	94.71	6.70	0.00	1.00		8

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
1	RESERVOIR A	0	12000	1	1	Downstream
2	RESERVOIR B	0	20000	1	1	Downstream
3	RESERVOIR C	0	10000	1	1	Downstream

No	Name		Levels/volume relationships pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR A	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	RESERVOIR B	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	RESERVOIR C	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	DEMAND 2	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	RES C TO DEMAND 2	Pipe	3	5	0	0	0fix	0		0%	1
2	RES B TO DEMAND 1	Pipe	2	4	0	0	0fix	0		0%	2
3	RES A TO DEMAND 1	Pipe	1	4	0	0	0fix	0		0%	3
4	RES B TO RES C	Pipe	2	3	0	0	0fix	0		0%	4
5	River 1	River	1	6	1000	0	0fix	0		0%	5
6	River 2	River	2	7	1000	0	0fix	0		0%	6
7	River 3	River	3	8	1000	0	0fix	0		0%	7

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	RES C TO DEMAND 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
2	RES B TO DEMAND 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
3	RES A TO DEMAND 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
4	RES B TO RES C	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
5	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
6	River 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
7	River 3	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

TARGET INFORMATION

Number of target sets: 1

Target set 1 (Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

Name	Draw	Pri	Targets									
RESERVOIR A	1	0	1333	2667	4000	5333	6667	8000	9333	10667	12000	
RESERVOIR B	2	0	2222	4444	6667	8889	11111	13333	15556	17778	20000	
RESERVOIR C	3	0	1112	2222	3333	4445	5555	6667	7778	8888	10000	
totals		0	4667	9333	14000	18667	23333	28000	32667	37333	42000	

MULTI SYSTEM INFORMATION

Reservoirs

RESERVOIR A	1
RESERVOIR B	1
RESERVOIR C	1

WORKED EXAMPLE 4(a) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX4A.log

 Scenario file: scn4a.scn

 Simulation label:
     Tutorial 4 Sub-Problem (a)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf3.dat
 Demand file(s):
     C:\REALM\ WorkedExamples\Dem2.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 14:58:37 01/11/02
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX4A.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX4A.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR A             8000.     2083.     5921.    10878.        0.      929.        0.    11394.
  2  RESERVOIR B            10000.     2576.     9865.    17864.        0.     1630.        0.    18987.
  3  RESERVOIR C             8000.     2083.     4932.     9112.        0.      721.        0.     9493.
-------------------------------------------------------------------------------------------------------------
                            26000.     6742.        0.    37854.        0.     3279.        0.    39874.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	0.	1372.
2	DEMAND 2	1706.	1706.	1706.	0.	1706.
		3078.	3078.	3078.	0.	3078.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	DEMAND 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	RES C TO DEMAND 2	1705.6	99999999.0	300.0	3100.0	0.0
2	RES B TO DEMAND 1	312.4	99999999.0	0.0	2088.0	0.0
3	RES A TO DEMAND 1	1059.9	99999999.0	0.0	2297.0	0.0
4	RES B TO RES C	384.9	99999999.0	0.0	2112.0	0.0
5	River 1	928.6	99999999.0	0.0	4610.0	0.0
6	River 2	1629.5	99999999.0	0.0	11730.0	0.0
7	River 3	720.6	99999999.0	0.0	4610.0	0.0
						0.

End run

WORKED EXAMPLE 4(a) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX4A.log                          Time :14:58:37 Date :01/11/02
Tutorial 4 Sub-Problem (a)


(F4.0,2F6.0,  3f12.2              )
  6
SEASON
YEAR
REPLICATE
RESERVOIR A     ESTO
RESERVOIR B     ESTO
RESERVOIR C     ESTO
  1. 1982.    1.     6213.00    10843.00     5716.00
  2. 1982.    1.     6260.00    10432.00     5216.00
  3. 1982.    1.     6023.00    10037.00     5018.00
  4. 1982.    1.     5921.00     9865.00     4932.00
  5. 1982.    1.     9309.00    13565.00     8320.00
  6. 1982.    1.    10858.00    15565.00     8869.00
  7. 1982.    1.    10892.00    16385.00     8903.00
  8. 1982.    1.    11365.00    17275.00     9376.00
  9. 1982.    1.    11325.00    18145.00    10000.00
 10. 1982.    1.    11241.00    18995.00     9916.00
 11. 1982.    1.    11317.00    18861.00     9430.00
 12. 1982.    1.    11448.00    19079.00     9539.00
  1. 1983.    1.    10587.00    17643.00     8820.00
  2. 1983.    1.     9647.00    15931.00     7992.00
  3. 1983.    1.     9690.00    16148.00     8074.00
  4. 1983.    1.    12000.00    18568.00    10000.00
  5. 1983.    1.    12000.00    20000.00    10000.00
  6. 1983.    1.    12000.00    20000.00    10000.00
  7. 1983.    1.    12000.00    20000.00    10000.00
  8. 1983.    1.    12000.00    20000.00    10000.00
  9. 1983.    1.    12000.00    20000.00    10000.00
 10. 1983.    1.    12000.00    20000.00    10000.00
 11. 1983.    1.    12000.00    20000.00    10000.00
 12. 1983.    1.    12000.00    20000.00    10000.00
  1. 1984.    1.    12000.00    20000.00    10000.00
  2. 1984.    1.    11136.00    18558.00     9278.00
  3. 1984.    1.    11365.00    18940.00     9469.00
  4. 1984.    1.    11679.00    19461.00     9730.00
  5. 1984.    1.    12000.00    20000.00    10000.00
  6. 1984.    1.    12000.00    20000.00    10000.00
  7. 1984.    1.    12000.00    19928.00    10000.00
  8. 1984.    1.    12000.00    20000.00    10000.00
  9. 1984.    1.    12000.00    20000.00    10000.00
 10. 1984.    1.    12000.00    20000.00    10000.00
 11. 1984.    1.    11937.00    19894.00     9947.00
 12. 1984.    1.    11394.00    18987.00     9493.00
```

WORKED EXAMPLE 4(a) – TARGET STORAGE

```
RESERVOIR TARGETS
EX4A.log                          Time :14:58:37 Date :01/11/02
Tutorial 4 Sub-Problem (a)


(F4.0,2F6.0,  3f12.2              )
  6
SEASON
YEAR
REPLICATE
RESERVOIR A     TARG
RESERVOIR B     TARG
RESERVOIR C     TARG
  1. 1982.    1.     6508.00    10843.00     5421.00
  2. 1982.    1.     6260.00    10432.00     5216.00
  3. 1982.    1.     6023.00    10037.00     5018.00
  4. 1982.    1.     5921.00     9865.00     4932.00
  5. 1982.    1.     8913.00    14854.00     7427.00
  6. 1982.    1.    10084.00    16806.00     8402.00
  7. 1982.    1.    10339.00    17228.00     8613.00
  8. 1982.    1.    10863.00    18103.00     9050.00
  9. 1982.    1.    11278.00    18795.00     9397.00
 10. 1982.    1.    11473.00    19120.00     9559.00
 11. 1982.    1.    11317.00    18861.00     9430.00
 12. 1982.    1.    11448.00    19079.00     9539.00
  1. 1983.    1.    10587.00    17643.00     8820.00
  2. 1983.    1.     9592.00    15986.00     7992.00
  3. 1983.    1.     9690.00    16148.00     8074.00
  4. 1983.    1.    11592.00    19318.00     9658.00
  5. 1983.    1.    12000.00    20000.00    10000.00
  6. 1983.    1.    12000.00    20000.00    10000.00
  7. 1983.    1.    12000.00    20000.00    10000.00
  8. 1983.    1.    12000.00    20000.00    10000.00
  9. 1983.    1.    12000.00    20000.00    10000.00
 10. 1983.    1.    12000.00    20000.00    10000.00
 11. 1983.    1.    12000.00    20000.00    10000.00
 12. 1983.    1.    12000.00    20000.00    10000.00
  1. 1984.    1.    12000.00    20000.00    10000.00
  2. 1984.    1.    11136.00    18558.00     9278.00
  3. 1984.    1.    11365.00    18940.00     9469.00
  4. 1984.    1.    11679.00    19461.00     9730.00
  5. 1984.    1.    12000.00    20000.00    10000.00
  6. 1984.    1.    12000.00    20000.00    10000.00
  7. 1984.    1.    12000.00    20000.00    10000.00
  8. 1984.    1.    12000.00    20000.00    10000.00
  9. 1984.    1.    12000.00    20000.00    10000.00
 10. 1984.    1.    12000.00    20000.00    10000.00
 11. 1984.    1.    11937.00    19894.00     9947.00
 12. 1984.    1.    11394.00    18987.00     9493.00
```

WORKED EXAMPLE 4(a) – CARRIER FLOW

```
CARRIER FLOWS
EX4A.log                          Time :14:58:37 Date :01/11/02
Tutorial 4 Sub-Problem (a)


(F4.0,2F6.0,  4f12.2               )
  7
SEASON
YEAR
REPLICATE
RES C TO DEMAND FLOW
RES B TO DEMAND FLOW
RES A TO DEMAND FLOW
RES B TO RES C  FLOW
  1. 1982.    1.     2700.00      497.00     2203.00        0.00
  2. 1982.    1.     1300.00     1059.00      241.00      512.00
  3. 1982.    1.     2100.00      838.00     1262.00      877.00
  4. 1982.    1.     1500.00      948.00      552.00      964.00
  5. 1982.    1.     1600.00        0.00     1600.00        0.00
  6. 1982.    1.     1700.00        0.00      700.00        0.00
  7. 1982.    1.     1200.00        0.00     1200.00        0.00
  8. 1982.    1.     1800.00        0.00     1800.00        0.00
  9. 1982.    1.     1200.00        0.00     2200.00        0.00
 10. 1982.    1.     1300.00        0.00     1300.00        0.00
 11. 1982.    1.     2400.00      138.00     1262.00      576.00
 12. 1982.    1.     1400.00      262.00     1138.00      240.00
  1. 1983.    1.     1900.00      867.00     1033.00     1009.00
  2. 1983.    1.     3100.00        0.00     1100.00     2112.00
  3. 1983.    1.     1300.00      777.00      523.00      816.00
  4. 1983.    1.     1800.00        0.00      800.00        0.00
  5. 1983.    1.     2000.00        0.00        0.00        0.00
  6. 1983.    1.     1600.00        0.00      600.00      100.00
  7. 1983.    1.     1900.00        0.00      900.00        0.00
  8. 1983.    1.     1300.00        0.00      300.00        0.00
  9. 1983.    1.     1600.00        0.00      600.00        0.00
 10. 1983.    1.     1400.00        0.00     1400.00        0.00
 11. 1983.    1.     2100.00       77.00     2023.00       77.00
 12. 1983.    1.     2100.00        0.00     2100.00        0.00
  1. 1984.    1.     1100.00        0.00     1100.00        0.00
  2. 1984.    1.     2300.00     1190.00     1110.00     1332.00
  3. 1984.    1.     2800.00      503.00     2297.00      465.00
  4. 1984.    1.     1900.00      701.00     1199.00      648.00
  5. 1984.    1.      300.00       96.00      204.00       45.00
  6. 1984.    1.      600.00        0.00      600.00        0.00
  7. 1984.    1.     1600.00        0.00      600.00      692.00
  8. 1984.    1.     1100.00        0.00      100.00        0.00
  9. 1984.    1.     1600.00        0.00     1600.00        0.00
 10. 1984.    1.     1300.00        0.00     1300.00        0.00
 11. 1984.    1.     2400.00     2088.00      312.00     2098.00
 12. 1984.    1.     2100.00     1204.00      896.00     1293.00
```

WORKED EXAMPLE 4(b) – SYSTEM LISTING

R E A L M

```
            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX4B.sys

 Simulation label:
     Tutorial 4 - Sub-Problem (b)



 Date: 15:17:27 01/11/02


-------------------------------
|  NODE INFORMATION           |
-------------------------------
```

No	Name	Type	X	Y	Z	Size	Aux Input	No
1	RESERVOIR A	Reservoir	5.00	95.00	0.00	1.00	STREAM1	1
2	RESERVOIR B	Reservoir	43.95	94.24	0.00	1.00	STREAM2	2
3	RESERVOIR C	Reservoir	95.00	94.24	0.00	1.00	STREAM1	3
4	DEMAND 1	Demand	23.42	5.00	0.00	1.00		4
5	DEMAND 2	Demand	76.32	7.27	0.00	1.00		5
6	STRM TERM 1	Strm terminator	3.60	5.56	0.00	1.00		6
7	STRM TERM 2	Strm terminator	43.40	4.68	0.00	1.00		7
8	STRM TERM 3	Strm terminator	94.71	6.70	0.00	1.00		8

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
1	RESERVOIR A	0	12000	1	25	Downstream
2	RESERVOIR B	0	20000	1	1	Downstream
3	RESERVOIR C	0	10000	1	1	Downstream

No	Name		Levels/volume relationships pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	RESERVOIR A	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	RESERVOIR B	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	RESERVOIR C	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	DEMAND 2	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	RES C TO DEMAND 2	Pipe	3	5	0	0	0fix	0		0%	1
2	RES B TO DEMAND 1	Pipe	2	4	0	0	0fix	0		0%	2
3	RES A TO DEMAND 1	Pipe	1	4	0	0	0fix	0		0%	3
4	RES B TO RES C	Pipe	2	3	0	0	0fix	0		0%	4
5	River 1	River	1	6	1000	0	0fix	0		0%	5
6	River 2	River	2	7	1000	0	0fix	0		0%	6
7	River 3	River	3	8	1000	0	0fix	0		0%	7

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	RES C TO DEMAND 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
2	RES B TO DEMAND 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
3	RES A TO DEMAND 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
4	RES B TO RES C	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
5	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
6	River 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
7	River 3	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

TARGET INFORMATION

Number of target sets: 1

Target set 1 (Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

Name	Draw	Pri	Targets									
RESERVOIR A	1	0	1333	2667	4000	5333	6667	8000	9333	10667	12000	
RESERVOIR B	2	0	2222	4444	6667	8889	11111	13333	15556	17778	20000	
RESERVOIR C	3	0	1112	2222	3333	4445	5555	6667	7778	8888	10000	
totals		0	4667	9333	14000	18667	23333	28000	32667	37333	42000	

MULTI SYSTEM INFORMATION

Reservoirs

RESERVOIR A	1
RESERVOIR B	1
RESERVOIR C	1

WORKED EXAMPLE 4(b) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX4B.log

 Scenario file: scn4b.scn

 Simulation label:
     Tutorial 4 Sub-Problem (b)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf3.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem2.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 15:20:10 01/11/02
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX4B.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX4B.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR A             8000.     2083.     5921.    10879.        0.      929.        0.    11394.
  2  RESERVOIR B            10000.     2576.     9865.    17863.        0.     1630.        0.    18987.
  3  RESERVOIR C             8000.     2083.     4932.     9112.        0.      721.        0.     9493.
-------------------------------------------------------------------------------------------------------------
                            26000.     6742.        0.    37854.        0.     3279.        0.    39874.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	0.	1372.
2	DEMAND 2	1706.	1706.	1706.	0.	1706.
		3078.	3078.	3078.	0.	3078.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	DEMAND 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	RES C TO DEMAND 2	1705.6	99999999.0	300.0	3100.0	0.0
2	RES B TO DEMAND 1	312.4	99999999.0	0.0	2088.0	0.0
3	RES A TO DEMAND 1	1059.9	99999999.0	0.0	2297.0	0.0
4	RES B TO RES C	384.9	99999999.0	0.0	2112.0	0.0
5	River 1	928.6	99999999.0	0.0	4610.0	0.0
6	River 2	1629.5	99999999.0	0.0	11730.0	0.0
7	River 3	720.6	99999999.0	0.0	4610.0	0.0
						0.

End run

WORKED EXAMPLE 4(b) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX4B.log                          Time :15:20:10 Date :01/11/02
Tutorial 4 Sub-Problem (b)


(F4.0,2F6.0,  3f12.2              )
  6
SEASON
YEAR
REPLICATE
RESERVOIR A     ESTO
RESERVOIR B     ESTO
RESERVOIR C     ESTO
  1. 1982.    1.     6248.00    10808.00     5716.00
  2. 1982.    1.     6260.00    10432.00     5216.00
  3. 1982.    1.     6023.00    10037.00     5018.00
  4. 1982.    1.     5921.00     9865.00     4932.00
  5. 1982.    1.     9309.00    13565.00     8320.00
  6. 1982.    1.    10858.00    15565.00     8869.00
  7. 1982.    1.    10892.00    16385.00     8903.00
  8. 1982.    1.    11365.00    17275.00     9376.00
  9. 1982.    1.    11325.00    18145.00    10000.00
 10. 1982.    1.    11241.00    18995.00     9916.00
 11. 1982.    1.    11317.00    18861.00     9430.00
 12. 1982.    1.    11448.00    19079.00     9539.00
  1. 1983.    1.    10587.00    17643.00     8820.00
  2. 1983.    1.     9647.00    15931.00     7992.00
  3. 1983.    1.     9690.00    16148.00     8074.00
  4. 1983.    1.    12000.00    18568.00    10000.00
  5. 1983.    1.    12000.00    20000.00    10000.00
  6. 1983.    1.    12000.00    20000.00    10000.00
  7. 1983.    1.    12000.00    20000.00    10000.00
  8. 1983.    1.    12000.00    20000.00    10000.00
  9. 1983.    1.    12000.00    20000.00    10000.00
 10. 1983.    1.    12000.00    20000.00    10000.00
 11. 1983.    1.    12000.00    20000.00    10000.00
 12. 1983.    1.    12000.00    20000.00    10000.00
  1. 1984.    1.    12000.00    20000.00    10000.00
  2. 1984.    1.    11136.00    18558.00     9278.00
  3. 1984.    1.    11365.00    18940.00     9469.00
  4. 1984.    1.    11679.00    19461.00     9730.00
  5. 1984.    1.    12000.00    20000.00    10000.00
  6. 1984.    1.    12000.00    20000.00    10000.00
  7. 1984.    1.    12000.00    19928.00    10000.00
  8. 1984.    1.    12000.00    20000.00    10000.00
  9. 1984.    1.    12000.00    20000.00    10000.00
 10. 1984.    1.    12000.00    20000.00    10000.00
 11. 1984.    1.    11937.00    19894.00     9947.00
 12. 1984.    1.    11394.00    18987.00     9493.00
```

WORKED EXAMPLE 4(b) – TARGET STORAGE

```
RESERVOIR TARGETS
EX4B.log                          Time :15:20:10 Date :01/11/02
Tutorial 4 Sub-Problem (b)


(F4.0,2F6.0,  3f12.2              )
  6
SEASON
YEAR
REPLICATE
RESERVOIR A     TARG
RESERVOIR B     TARG
RESERVOIR C     TARG
  1. 1982.    1.     6508.00    10843.00     5421.00
  2. 1982.    1.     6260.00    10432.00     5216.00
  3. 1982.    1.     6023.00    10037.00     5018.00
  4. 1982.    1.     5921.00     9865.00     4932.00
  5. 1982.    1.     8913.00    14854.00     7427.00
  6. 1982.    1.    10084.00    16806.00     8402.00
  7. 1982.    1.    10339.00    17228.00     8613.00
  8. 1982.    1.    10863.00    18103.00     9050.00
  9. 1982.    1.    11278.00    18795.00     9397.00
 10. 1982.    1.    11473.00    19120.00     9559.00
 11. 1982.    1.    11317.00    18861.00     9430.00
 12. 1982.    1.    11448.00    19079.00     9539.00
  1. 1983.    1.    10587.00    17643.00     8820.00
  2. 1983.    1.     9592.00    15986.00     7992.00
  3. 1983.    1.     9690.00    16148.00     8074.00
  4. 1983.    1.    11592.00    19318.00     9658.00
  5. 1983.    1.    12000.00    20000.00    10000.00
  6. 1983.    1.    12000.00    20000.00    10000.00
  7. 1983.    1.    12000.00    20000.00    10000.00
  8. 1983.    1.    12000.00    20000.00    10000.00
  9. 1983.    1.    12000.00    20000.00    10000.00
 10. 1983.    1.    12000.00    20000.00    10000.00
 11. 1983.    1.    12000.00    20000.00    10000.00
 12. 1983.    1.    12000.00    20000.00    10000.00
  1. 1984.    1.    12000.00    20000.00    10000.00
  2. 1984.    1.    11136.00    18558.00     9278.00
  3. 1984.    1.    11365.00    18940.00     9469.00
  4. 1984.    1.    11679.00    19461.00     9730.00
  5. 1984.    1.    12000.00    20000.00    10000.00
  6. 1984.    1.    12000.00    20000.00    10000.00
  7. 1984.    1.    12000.00    20000.00    10000.00
  8. 1984.    1.    12000.00    20000.00    10000.00
  9. 1984.    1.    12000.00    20000.00    10000.00
 10. 1984.    1.    12000.00    20000.00    10000.00
 11. 1984.    1.    11937.00    19894.00     9947.00
 12. 1984.    1.    11394.00    18987.00     9493.00
```

WORKED EXAMPLE 4(b) – CARRIER FLOW

```
CARRIER FLOWS
EX4B.log                          Time :15:20:10 Date :01/11/02
Tutorial 4 Sub-Problem (b)


(F4.0,2F6.0,  4f12.2               )
  7
SEASON
YEAR
REPLICATE
RES C TO DEMAND FLOW
RES B TO DEMAND FLOW
RES A TO DEMAND FLOW
RES B TO RES C  FLOW
  1. 1982.    1.     2700.00      532.00     2168.00        0.00
  2. 1982.    1.     1300.00     1024.00      276.00      512.00
  3. 1982.    1.     2100.00      838.00     1262.00      877.00
  4. 1982.    1.     1500.00      948.00      552.00      964.00
  5. 1982.    1.     1600.00        0.00     1600.00        0.00
  6. 1982.    1.     1700.00        0.00      700.00        0.00
  7. 1982.    1.     1200.00        0.00     1200.00        0.00
  8. 1982.    1.     1800.00        0.00     1800.00        0.00
  9. 1982.    1.     1200.00        0.00     2200.00        0.00
 10. 1982.    1.     1300.00        0.00     1300.00        0.00
 11. 1982.    1.     2400.00      138.00     1262.00      576.00
 12. 1982.    1.     1400.00      262.00     1138.00      240.00
  1. 1983.    1.     1900.00      867.00     1033.00     1009.00
  2. 1983.    1.     3100.00        0.00     1100.00     2112.00
  3. 1983.    1.     1300.00      777.00      523.00      816.00
  4. 1983.    1.     1800.00        0.00      800.00        0.00
  5. 1983.    1.     2000.00        0.00        0.00        0.00
  6. 1983.    1.     1600.00        0.00      600.00      100.00
  7. 1983.    1.     1900.00        0.00      900.00        0.00
  8. 1983.    1.     1300.00        0.00      300.00        0.00
  9. 1983.    1.     1600.00        0.00      600.00        0.00
 10. 1983.    1.     1400.00        0.00     1400.00        0.00
 11. 1983.    1.     2100.00       77.00     2023.00       77.00
 12. 1983.    1.     2100.00        0.00     2100.00        0.00
  1. 1984.    1.     1100.00        0.00     1100.00        0.00
  2. 1984.    1.     2300.00     1190.00     1110.00     1332.00
  3. 1984.    1.     2800.00      503.00     2297.00      465.00
  4. 1984.    1.     1900.00      701.00     1199.00      648.00
  5. 1984.    1.      300.00       96.00      204.00       45.00
  6. 1984.    1.      600.00        0.00      600.00        0.00
  7. 1984.    1.     1600.00        0.00      600.00      692.00
  8. 1984.    1.     1100.00        0.00      100.00        0.00
  9. 1984.    1.     1600.00        0.00     1600.00        0.00
 10. 1984.    1.     1300.00        0.00     1300.00        0.00
 11. 1984.    1.     2400.00     2088.00      312.00     2098.00
 12. 1984.    1.     2100.00     1204.00      896.00     1293.00
```

WORKED EXAMPLE 4(b) – COMPARISON OF TARGETS AND STORAGE VOLUMES FOR CASES (a) AND (b)

```
####4
EX4A.log + EX4B.log                          Time :14:30:11 Date :12/11/01
Tutorial 4 Sub-Problem (a)


( 14f12.2              )
  14
SEASON
YEAR
RESERVOIR A     TARG      case (a)
RESERVOIR B     TARG      case (a)
RESERVOIR C     TARG      case (a)
RESERVOIR A     TARG      case (b)
RESERVOIR B     TARG      case (b)
RESERVOIR C     TARG      case (b)
RESERVOIR A     ESTO      case (a)
RESERVOIR B     ESTO      case (a)
RESERVOIR C     ESTO      case (a)
RESERVOIR A     ESTO      case (b)
RESERVOIR B     ESTO      case (b)
RESERVOIR C     ESTO      case (b)
```

1.00	1982.00	6508.00	10843.00	5421.00	6508.00	10843.00	5421.00	6213.00	10843.00	5716.00	6248.00	10808.00	5716.00
2.00	1982.00	6260.00	10432.00	5216.00	6260.00	10432.00	5216.00	6260.00	10432.00	5216.00	6260.00	10432.00	5216.00
3.00	1982.00	6023.00	10037.00	5018.00	6023.00	10037.00	5018.00	6023.00	10037.00	5018.00	6023.00	10037.00	5018.00
4.00	1982.00	5921.00	9865.00	4932.00	5921.00	9865.00	4932.00	5921.00	9865.00	4932.00	5921.00	9865.00	4932.00
5.00	1982.00	8913.00	14854.00	7427.00	8913.00	14854.00	7427.00	9309.00	13565.00	8320.00	9309.00	13565.00	8320.00
6.00	1982.00	10084.00	16806.00	8402.00	10084.00	16806.00	8402.00	10858.00	15565.00	8869.00	10858.00	15565.00	8869.00
7.00	1982.00	10339.00	17228.00	8613.00	10339.00	17228.00	8613.00	10892.00	16385.00	8903.00	10892.00	16385.00	8903.00
8.00	1982.00	10863.00	18103.00	9050.00	10863.00	18103.00	9050.00	11365.00	17275.00	9376.00	11365.00	17275.00	9376.00
9.00	1982.00	11278.00	18795.00	9397.00	11278.00	18795.00	9397.00	11325.00	18145.00	10000.00	11325.00	18145.00	10000.00
10.00	1982.00	11473.00	19120.00	9559.00	11473.00	19120.00	9559.00	11241.00	18995.00	9916.00	11241.00	18995.00	9916.00
11.00	1982.00	11317.00	18861.00	9430.00	11317.00	18861.00	9430.00	11317.00	18861.00	9430.00	11317.00	18861.00	9430.00
12.00	1982.00	11448.00	19079.00	9539.00	11448.00	19079.00	9539.00	11448.00	19079.00	9539.00	11448.00	19079.00	9539.00
1.00	1983.00	10587.00	17643.00	8820.00	10587.00	17643.00	8820.00	10587.00	17643.00	8820.00	10587.00	17643.00	8820.00
2.00	1983.00	9592.00	15986.00	7992.00	9592.00	15986.00	7992.00	9647.00	15931.00	7992.00	9647.00	15931.00	7992.00
3.00	1983.00	9690.00	16148.00	8074.00	9690.00	16148.00	8074.00	9690.00	16148.00	8074.00	9690.00	16148.00	8074.00
4.00	1983.00	11592.00	19318.00	9658.00	11592.00	19318.00	9658.00	12000.00	18568.00	10000.00	12000.00	18568.00	10000.00
5.00	1983.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
6.00	1983.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
7.00	1983.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
8.00	1983.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
9.00	1983.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
10.00	1983.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
11.00	1983.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
12.00	1983.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
1.00	1984.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
2.00	1984.00	11136.00	18558.00	9278.00	11136.00	18558.00	9278.00	11136.00	18558.00	9278.00	11136.00	18558.00	9278.00
3.00	1984.00	11365.00	18940.00	9469.00	11365.00	18940.00	9469.00	11365.00	18940.00	9469.00	11365.00	18940.00	9469.00
4.00	1984.00	11679.00	19461.00	9730.00	11679.00	19461.00	9730.00	11679.00	19461.00	9730.00	11679.00	19461.00	9730.00
5.00	1984.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
6.00	1984.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
7.00	1984.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	19928.00	10000.00	12000.00	19928.00	10000.00
8.00	1984.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
9.00	1984.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
10.00	1984.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00	12000.00	20000.00	10000.00
11.00	1984.00	11937.00	19894.00	9947.00	11937.00	19894.00	9947.00	11937.00	19894.00	9947.00	11937.00	19894.00	9947.00
12.00	1984.00	11394.00	18987.00	9493.00	11394.00	18987.00	9493.00	11394.00	18987.00	9493.00	11394.00	18987.00	9493.00

Figure 3.4-2 Worked Example 4(b) – Comparison of Targets and Storage Volumes for Cases (a) and (b) for Reservoir A

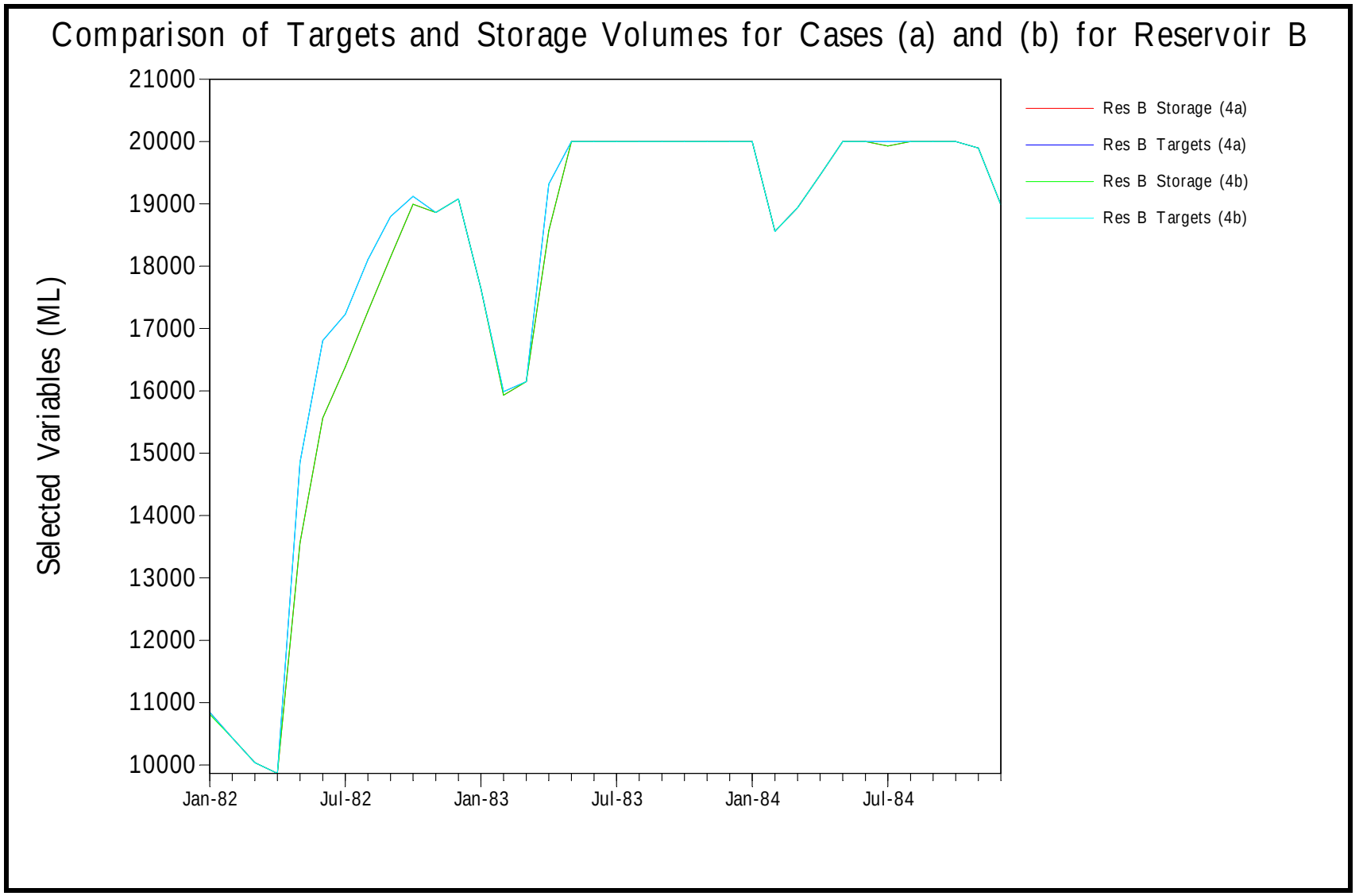

Figure 3.4-3 Worked Example 4(b) – Comparison of Targets and Storage Volumes for Cases (a) and (b) for Reservoir B

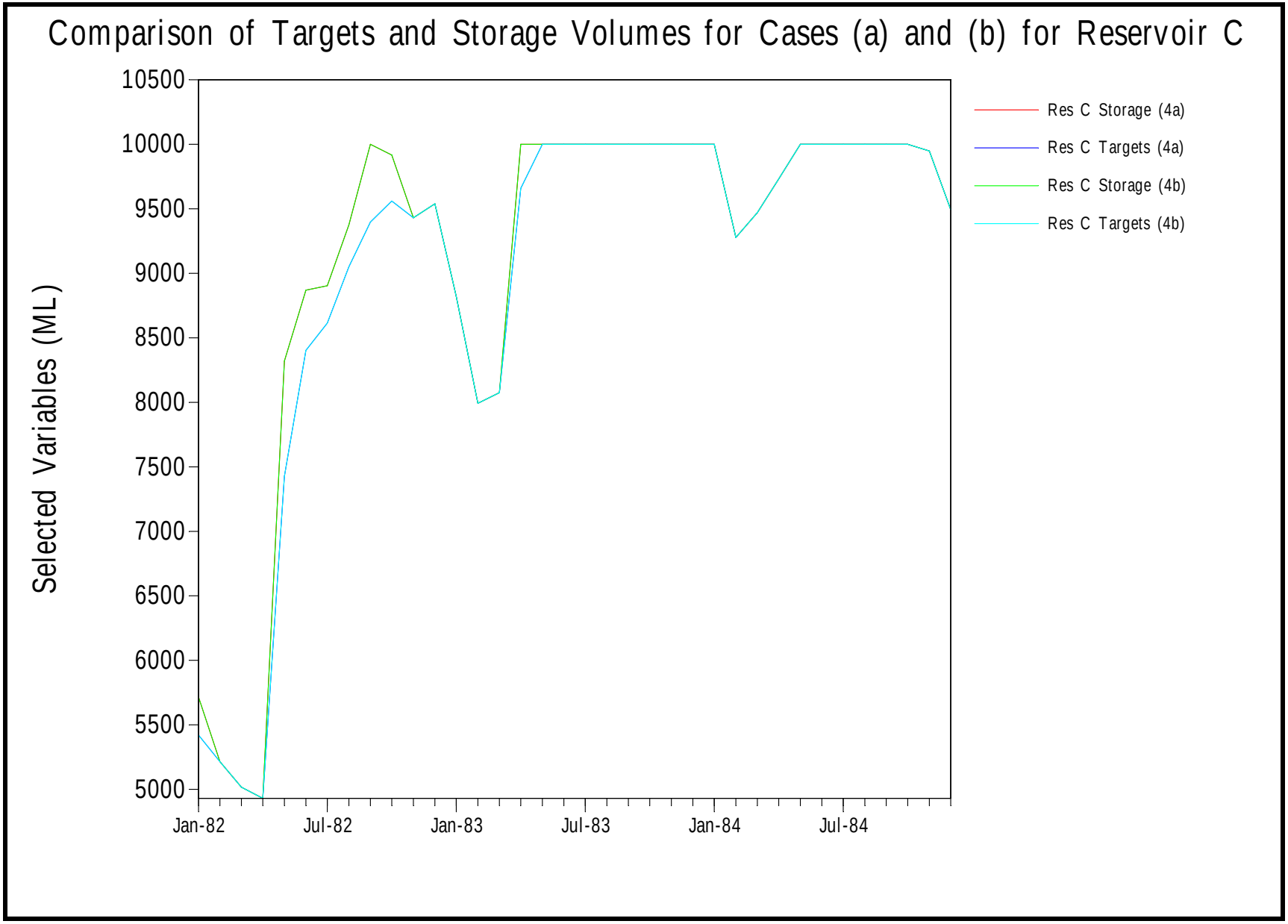

Figure 3.4-4 Worked Example 4(b) – Comparison of Targets and Storage Volumes for Cases (a) and (b) for Reservoir C

3.5 WORKED EXAMPLE 5

ILLUSTRATION OF DEMAND SHORTFALL ZONES AND SHORTFALL PRIORITY

WORKED EXAMPLE 5(a) - STREAMFLOW FILE (SF3.DAT)

```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 4F12.2)
   4
SEASON
YEAR
STREAM1
STREAM2
        1.00     1982.00      416.00     1340.00
        2.00     1982.00      288.00     1160.00
        3.00     1982.00     1025.00     1320.00
        4.00     1982.00      450.00     1740.00
        5.00     1982.00     4988.00     3700.00
        6.00     1982.00     2249.00     2000.00
        7.00     1982.00     1234.00      820.00
        8.00     1982.00     2273.00      890.00
        9.00     1982.00     2160.00      870.00
       10.00     1982.00     1216.00      850.00
       11.00     1982.00     1338.00      580.00
       12.00     1982.00     1269.00      720.00
        1.00     1983.00      172.00      440.00
        2.00     1983.00      160.00      400.00
        3.00     1983.00      566.00     1810.00
        4.00     1983.00     3848.00     2420.00
        5.00     1983.00     3220.00     5100.00
        6.00     1983.00     1500.00     1040.00
        7.00     1983.00     4640.00     1270.00
        8.00     1983.00     3900.00     5890.00
        9.00     1983.00     4600.00    11730.00
       10.00     1983.00     2360.00     9090.00
       11.00     1983.00     2023.00     3770.00
       12.00     1983.00     2967.00     3250.00
        1.00     1984.00     4426.00     5150.00
        2.00     1984.00      246.00     1080.00
        3.00     1984.00     2526.00     1350.00
        4.00     1984.00     1513.00     1870.00
        5.00     1984.00      525.00     3140.00
        6.00     1984.00     2833.00      640.00
        7.00     1984.00      908.00      620.00
        8.00     1984.00     2029.00     4020.00
        9.00     1984.00     4600.00     3820.00
       10.00     1984.00     5910.00     3190.00
       11.00     1984.00      249.00     4080.00
       12.00     1984.00      353.00     1590.00
```

WORKED EXAMPLE 5(a) - DEMAND FILE (DEM2.DAT)

```
####3
DEMANDS DATAFILE
HISTORICAL DATA
DATA ASSEMBLED AND REFORMATED ON
DATE : 9 JUL 1990
( 4F12.2)
   4
SEASON
YEAR
DEMAND 1
DEMAND 2
        1.00     1982.00     2700.00     2700.00
        2.00     1982.00     1300.00     1300.00
        3.00     1982.00     2100.00     2100.00
        4.00     1982.00     1500.00     1500.00
        5.00     1982.00     1600.00     1600.00
        6.00     1982.00      700.00     1700.00
        7.00     1982.00     1200.00     1200.00
        8.00     1982.00     1800.00     1800.00
        9.00     1982.00     2200.00     1200.00
       10.00     1982.00     1300.00     1300.00
       11.00     1982.00     1400.00     2400.00
       12.00     1982.00     1400.00     1400.00
        1.00     1983.00     1900.00     1900.00
        2.00     1983.00     1100.00     3100.00
        3.00     1983.00     1300.00     1300.00
        4.00     1983.00      800.00     1800.00
        5.00     1983.00        0.00     2000.00
        6.00     1983.00      600.00     1600.00
        7.00     1983.00      900.00     1900.00
        8.00     1983.00      300.00     1300.00
        9.00     1983.00      600.00     1600.00
       10.00     1983.00     1400.00     1400.00
       11.00     1983.00     2100.00     2100.00
       12.00     1983.00     2100.00     2100.00
        1.00     1984.00     1100.00     1100.00
        2.00     1984.00     2300.00     2300.00
        3.00     1984.00     2800.00     2800.00
        4.00     1984.00     1900.00     1900.00
        5.00     1984.00      300.00      300.00
        6.00     1984.00      600.00      600.00
        7.00     1984.00      600.00     1600.00
        8.00     1984.00      100.00     1100.00
        9.00     1984.00     1600.00     1600.00
       10.00     1984.00     1300.00     1300.00
       11.00     1984.00     2400.00     2400.00
       12.00     1984.00     2100.00     2100.00
```

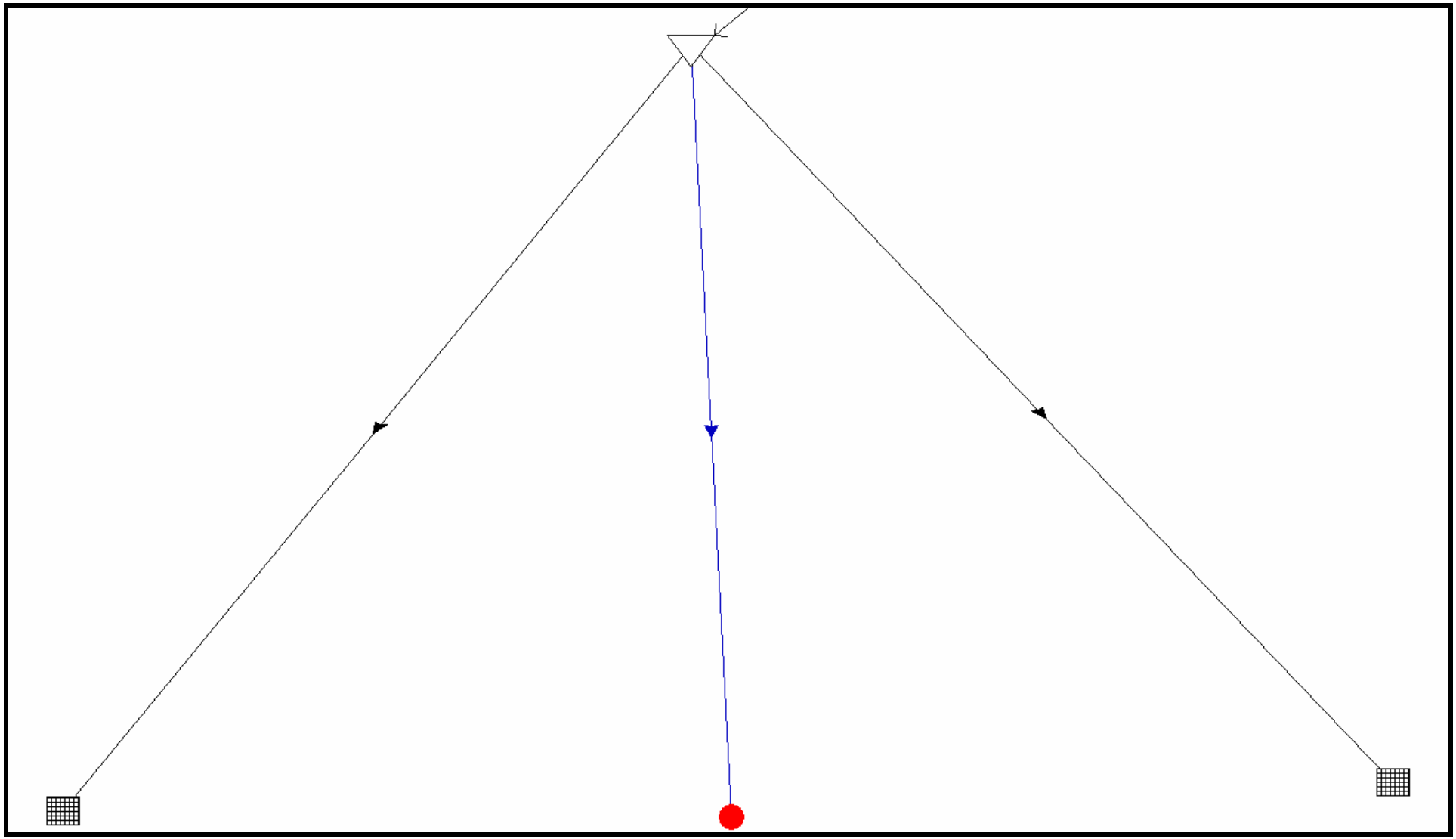

Figure 3.5-1 Worked Example 5(a) System Plot

WORKED EXAMPLE 5(a) – SYSTEM LISTING

```
_____________________________________________________________

              R      E      A      L      M
_____________________________________________________________

            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX5A.sys

 Simulation label:
     Tutorial 5 - Sub-Problem (a)



 Date: 15:37:53 01/11/02


-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input          No
-------------------------------------------------------------------------------------------------------------
   1 RESERVOIR A          Reservoir          47.51    95.00     0.00     1.00 STREAM1                1
   2 DEMAND 1             Demand              5.00     5.00     0.00     1.00                        2
   3 DEMAND 2             Demand             95.00     8.36     0.00     1.00                        3
   4 Stream Terminator 1  Strm terminator    50.22     4.22     0.00     1.00                        4


 Reservoir data:

      No       Name              Min     Max    No   No     Spill
                                 Cap     Cap  Above Below    Type
    ------------------------------------------------------------------
       1 RESERVOIR A               0    12000  1    1     Downstream


      No       Name                              Levels/volume relationships
                                    pt1     pt2     pt3     pt4     pt5     pt6    pt7    pt8     pt9     pt10     pt11   pt12    pt13   pt14    pt15
    ------------------------------------------------------------------------------------------------------------------
       1 RESERVOIR A         Vol       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0
                             Lvl    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
3	DEMAND 2	1	2	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	Carrier 1	Pipe	1	2	0	0	0fix	0		0%	1
2	Carrier 2	Pipe	1	3	0	0	0fix	0		0%	2
3	River 1	River	1	4	1000	0	0fix	0		0%	3

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Carrier 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
2	Carrier 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
3	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

TARGET INFORMATION

Number of target sets: 1

Target set 1 (Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

Name	Draw	Pri	Targets									
RESERVOIR A	1	0	1333	2667	4000	5333	6667	8000	9333	10667	12000	
totals		0	1333	2667	4000	5333	6667	8000	9333	10667	12000	

MULTI SYSTEM INFORMATION

Reservoirs

RESERVOIR A 1

WORKED EXAMPLE 5(a) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H          HHHHHHHHHH
      H   H     H           H    H    H          H    H   H
      HHHHHHHH  HHHHHH      HHHHHHHH  HHH        HHH  H   H
      HHH    H  HHH         HHH    H  HHH        HHH  H   H
      HHH    H  HHH         HHH    H  HHH        HHH  H   H
      HHH    H  HHHHHHHH    HHH    H  HHHHHHHH   HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX5A.log

 Scenario file: scn5a.scn

 Simulation label:
     Tutorial 5 Sub-Problem (a)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf3.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem2.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 15:46:52 01/11/02
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamplesEX5A.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX5A.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR A             8000.     2083.        0.     1969.        0.        0.        0.        0.
-------------------------------------------------------------------------------------------------------------
                             8000.     2083.        0.     1969.        0.        0.        0.        0.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	525.	847.
2	DEMAND 2	1706.	1706.	1706.	247.	1458.
		3078.	3078.	3078.	773.	2305.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	14.0	82.4	100.0
2	DEMAND 2	0.0	0.0	0.0	0.0	0.0	0.0	10.0	42.5	94.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	Carrier 1	846.8	99999999.0	0.0	2700.0	0.0
2	Carrier 2	1458.2	99999999.0	160.0	2800.0	0.0
3	River 1	0.0	99999999.0	0.0	0.0	0.0
						0.

End run

WORKED EXAMPLE 5(a) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX5A.log                          Time :15:46:52 Date :01/11/02
Tutorial 5 Sub-Problem (a)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
RESERVOIR A     ESTO
  1. 1982.    1.     3016.00
  2. 1982.    1.      704.00
  3. 1982.    1.        0.00
  4. 1982.    1.        0.00
  5. 1982.    1.     1788.00
  6. 1982.    1.     1637.00
  7. 1982.    1.      471.00
  8. 1982.    1.        0.00
  9. 1982.    1.        0.00
 10. 1982.    1.        0.00
 11. 1982.    1.        0.00
 12. 1982.    1.        0.00
  1. 1983.    1.        0.00
  2. 1983.    1.        0.00
  3. 1983.    1.        0.00
  4. 1983.    1.     1248.00
  5. 1983.    1.     2468.00
  6. 1983.    1.     1768.00
  7. 1983.    1.     3608.00
  8. 1983.    1.     5908.00
  9. 1983.    1.     8308.00
 10. 1983.    1.     7868.00
 11. 1983.    1.     5691.00
 12. 1983.    1.     4458.00
  1. 1984.    1.     6684.00
  2. 1984.    1.     2330.00
  3. 1984.    1.        0.00
  4. 1984.    1.        0.00
  5. 1984.    1.        0.00
  6. 1984.    1.     1633.00
  7. 1984.    1.      341.00
  8. 1984.    1.     1170.00
  9. 1984.    1.     2570.00
 10. 1984.    1.     5880.00
 11. 1984.    1.     1329.00
 12. 1984.    1.        0.00
```

WORKED EXAMPLE 5(a) – CARRIER FLOWS

```
CARRIER FLOWS
EX5A.log                          Time :15:46:52 Date :01/11/02
Tutorial 5 Sub-Problem (a)


(F4.0,2F6.0,  3f12.2              )
  6
SEASON
YEAR
REPLICATE
Carrier 1       FLOW
Carrier 2       FLOW
River 1         FLOW
  1. 1982.    1.     2700.00     2700.00        0.00
  2. 1982.    1.     1300.00     1300.00        0.00
  3. 1982.    1.        0.00     1729.00        0.00
  4. 1982.    1.        0.00      450.00        0.00
  5. 1982.    1.     1600.00     1600.00        0.00
  6. 1982.    1.      700.00     1700.00        0.00
  7. 1982.    1.     1200.00     1200.00        0.00
  8. 1982.    1.      944.00     1800.00        0.00
  9. 1982.    1.      960.00     1200.00        0.00
 10. 1982.    1.        0.00     1216.00        0.00
 11. 1982.    1.        0.00     1338.00        0.00
 12. 1982.    1.        0.00     1269.00        0.00
  1. 1983.    1.        0.00      172.00        0.00
  2. 1983.    1.        0.00      160.00        0.00
  3. 1983.    1.        0.00      566.00        0.00
  4. 1983.    1.      800.00     1800.00        0.00
  5. 1983.    1.        0.00     2000.00        0.00
  6. 1983.    1.      600.00     1600.00        0.00
  7. 1983.    1.      900.00     1900.00        0.00
  8. 1983.    1.      300.00     1300.00        0.00
  9. 1983.    1.      600.00     1600.00        0.00
 10. 1983.    1.     1400.00     1400.00        0.00
 11. 1983.    1.     2100.00     2100.00        0.00
 12. 1983.    1.     2100.00     2100.00        0.00
  1. 1984.    1.     1100.00     1100.00        0.00
  2. 1984.    1.     2300.00     2300.00        0.00
  3. 1984.    1.     2056.00     2800.00        0.00
  4. 1984.    1.        0.00     1513.00        0.00
  5. 1984.    1.      225.00      300.00        0.00
  6. 1984.    1.      600.00      600.00        0.00
  7. 1984.    1.      600.00     1600.00        0.00
  8. 1984.    1.      100.00     1100.00        0.00
  9. 1984.    1.     1600.00     1600.00        0.00
 10. 1984.    1.     1300.00     1300.00        0.00
 11. 1984.    1.     2400.00     2400.00        0.00
 12. 1984.    1.        0.00     1682.00        0.00
```

WORKED EXAMPLE 5(a) – DEMAND SHORTFALLS

```
DEMAND SHORTFALL
EX5A.log                          Time :15:46:52 Date :01/11/02
Tutorial 5 Sub-Problem (a)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
DEMAND 1        SHRT
DEMAND 2        SHRT
  1. 1982.    1.        0.00        0.00
  2. 1982.    1.        0.00        0.00
  3. 1982.    1.     2100.00      371.00
  4. 1982.    1.     1500.00     1050.00
  5. 1982.    1.        0.00        0.00
  6. 1982.    1.        0.00        0.00
  7. 1982.    1.        0.00        0.00
  8. 1982.    1.      856.00        0.00
  9. 1982.    1.     1240.00        0.00
 10. 1982.    1.     1300.00       84.00
 11. 1982.    1.     1400.00     1062.00
 12. 1982.    1.     1400.00      131.00
  1. 1983.    1.     1900.00     1728.00
  2. 1983.    1.     1100.00     2940.00
  3. 1983.    1.     1300.00      734.00
  4. 1983.    1.        0.00        0.00
  5. 1983.    1.        0.00        0.00
  6. 1983.    1.        0.00        0.00
  7. 1983.    1.        0.00        0.00
  8. 1983.    1.        0.00        0.00
  9. 1983.    1.        0.00        0.00
 10. 1983.    1.        0.00        0.00
 11. 1983.    1.        0.00        0.00
 12. 1983.    1.        0.00        0.00
  1. 1984.    1.        0.00        0.00
  2. 1984.    1.        0.00        0.00
  3. 1984.    1.      744.00        0.00
  4. 1984.    1.     1900.00      387.00
  5. 1984.    1.       75.00        0.00
  6. 1984.    1.        0.00        0.00
  7. 1984.    1.        0.00        0.00
  8. 1984.    1.        0.00        0.00
  9. 1984.    1.        0.00        0.00
 10. 1984.    1.        0.00        0.00
 11. 1984.    1.        0.00        0.00
 12. 1984.    1.     2100.00      418.00
```

WORKED EXAMPLE 5(a) – UNRESTRICTED DEMAND

```
DEMAND UNREST
EX5A.log                          Time :15:46:52 Date :01/11/02
Tutorial 5 Sub-Problem (a)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
DEMAND 1        UNRS
DEMAND 2        UNRS
  1. 1982.    1.     2700.00     2700.00
  2. 1982.    1.     1300.00     1300.00
  3. 1982.    1.     2100.00     2100.00
  4. 1982.    1.     1500.00     1500.00
  5. 1982.    1.     1600.00     1600.00
  6. 1982.    1.      700.00     1700.00
  7. 1982.    1.     1200.00     1200.00
  8. 1982.    1.     1800.00     1800.00
  9. 1982.    1.     2200.00     1200.00
 10. 1982.    1.     1300.00     1300.00
 11. 1982.    1.     1400.00     2400.00
 12. 1982.    1.     1400.00     1400.00
  1. 1983.    1.     1900.00     1900.00
  2. 1983.    1.     1100.00     3100.00
  3. 1983.    1.     1300.00     1300.00
  4. 1983.    1.      800.00     1800.00
  5. 1983.    1.        0.00     2000.00
  6. 1983.    1.      600.00     1600.00
  7. 1983.    1.      900.00     1900.00
  8. 1983.    1.      300.00     1300.00
  9. 1983.    1.      600.00     1600.00
 10. 1983.    1.     1400.00     1400.00
 11. 1983.    1.     2100.00     2100.00
 12. 1983.    1.     2100.00     2100.00
  1. 1984.    1.     1100.00     1100.00
  2. 1984.    1.     2300.00     2300.00
  3. 1984.    1.     2800.00     2800.00
  4. 1984.    1.     1900.00     1900.00
  5. 1984.    1.      300.00      300.00
  6. 1984.    1.      600.00      600.00
  7. 1984.    1.      600.00     1600.00
  8. 1984.    1.      100.00     1100.00
  9. 1984.    1.     1600.00     1600.00
 10. 1984.    1.     1300.00     1300.00
 11. 1984.    1.     2400.00     2400.00
 12. 1984.    1.     2100.00     2100.00
```

WORKED EXAMPLE 5(b) – SYSTEM LISTING

```
_____________________________________________________________

              R      E      A      L      M
_____________________________________________________________

            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX5B.sys

 Simulation label:
     Tutorial 5 - Sub-Problem (b)



 Date: 15:55:01 01/11/02


-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input           No
-------------------------------------------------------------------------------------------------------------
   1 RESERVOIR A          Reservoir          47.51    95.00     0.00     1.00 STREAM1                 1
   2 DEMAND 1             Demand              5.00     5.00     0.00     1.00                         2
   3 DEMAND 2             Demand             95.00     8.36     0.00     1.00                         3
   4 Stream Terminator 1  Strm terminator    50.22     4.22     0.00     1.00                         4


 Reservoir data:

      No       Name               Min     Max    No   No     Spill
                                  Cap     Cap  Above Below    Type
    ------------------------------------------------------------------
       1 RESERVOIR A                0    12000  1    1     Downstream


      No       Name                              Levels/volume relationships
                                    pt1     pt2     pt3     pt4     pt5     pt6    pt7    pt8     pt9     pt10     pt11   pt12    pt13   pt14    pt15
    ------------------------------------------------------------------------------------------------------------------
       1 RESERVOIR A         Vol       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0
                             Lvl    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	DEMAND 1	2	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
3	DEMAND 2	4	2	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	Carrier 1	Pipe	1	2	0	0	0fix	0		0%	1
2	Carrier 2	Pipe	1	3	0	0	0fix	0		0%	2
3	River 1	River	1	4	1000	0	0fix	0		0%	3

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Carrier 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
2	Carrier 2	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
3	River 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

TARGET INFORMATION

Number of target sets: 1

Target set 1 (Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

Name	Draw	Pri	Targets									
RESERVOIR A	1	0	1333	2667	4000	5333	6667	8000	9333	10667	12000	
totals		0	1333	2667	4000	5333	6667	8000	9333	10667	12000	

MULTI SYSTEM INFORMATION

Reservoirs

RESERVOIR A 1

WORKED EXAMPLE 5(b) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H          HHHHHHHHHH
      H   H     H           H    H    H          H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH        HHH  H   H
      HHH    H  HHH        HHH    H   HHH        HHH  H   H
      HHH    H  HHH        HHH    H   HHH        HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH   HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX5B.log

 Scenario file: scn5b.scn

 Simulation label:
     Tutorial 5 Sub-Problem (b)




 Streamflow file(s):
     C:\REALM\WorkedExamples\Sf3.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem2.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 15:57:53 01/11/02
```

```
 Time Step = Monthly

 SYSTEM CHANGES:
 No    Seas  Year   System File
 --------------------------------
   1     1  1982     C:\REALM\WorkedExamples\EX5B.sys
 --------------------------------

 Total number of seasons:-   36







 ******** RUN TIME MESSAGES:- ********


  ****INPUT DATA TYPE=  1 ****

 1982
  C:\REALM\WorkedExamples\EX5B.sys
 1983
 1984
 ******** END RUN TIME MESSAGES ********



  SUMMARY INFORMATION



 Reservoir data:

          Name              Start     File       Min      Average    Evapn   Release    Spill      End
                           Storage    Inflow   Storage    Storage            to river            Storage
  1  RESERVOIR A             8000.     2083.        0.     1969.        0.        0.        0.        0.
-------------------------------------------------------------------------------------------------------------
                             8000.     2083.        0.     1969.        0.        0.        0.        0.
-------------------------------------------------------------------------------------------------------------
```

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	DEMAND 1	1372.	1372.	1372.	499.	873.
2	DEMAND 2	1706.	1706.	1706.	274.	1432.
		3078.	3078.	3078.	773.	2305.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	DEMAND 1	0.0	0.0	0.0	0.0	0.0	0.0	14.0	78.1	100.0
2	DEMAND 2	0.0	0.0	0.0	0.0	0.0	0.0	11.0	44.5	94.0

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	Carrier 1	873.2	99999999.0	0.0	2700.0	0.0
2	Carrier 2	1431.8	99999999.0	160.0	2800.0	0.0
3	River 1	0.0	99999999.0	0.0	0.0	0.0
						0.

End run

WORKED EXAMPLE 5(b) – RESERVOIR VOLUME

```
RESERVOIR STORAGE
EX5B.log                          Time :15:57:53 Date :01/11/02
Tutorial 5 Sub-Problem (b)


(F4.0,2F6.0,  1f12.2              )
  4
SEASON
YEAR
REPLICATE
RESERVOIR A     ESTO
  1. 1982.    1.     3016.00
  2. 1982.    1.      704.00
  3. 1982.    1.        0.00
  4. 1982.    1.        0.00
  5. 1982.    1.     1788.00
  6. 1982.    1.     1637.00
  7. 1982.    1.      471.00
  8. 1982.    1.        0.00
  9. 1982.    1.        0.00
 10. 1982.    1.        0.00
 11. 1982.    1.        0.00
 12. 1982.    1.        0.00
  1. 1983.    1.        0.00
  2. 1983.    1.        0.00
  3. 1983.    1.        0.00
  4. 1983.    1.     1248.00
  5. 1983.    1.     2468.00
  6. 1983.    1.     1768.00
  7. 1983.    1.     3608.00
  8. 1983.    1.     5908.00
  9. 1983.    1.     8308.00
 10. 1983.    1.     7868.00
 11. 1983.    1.     5691.00
 12. 1983.    1.     4458.00
  1. 1984.    1.     6684.00
  2. 1984.    1.     2330.00
  3. 1984.    1.        0.00
  4. 1984.    1.        0.00
  5. 1984.    1.        0.00
  6. 1984.    1.     1633.00
  7. 1984.    1.      341.00
  8. 1984.    1.     1170.00
  9. 1984.    1.     2570.00
 10. 1984.    1.     5880.00
 11. 1984.    1.     1329.00
 12. 1984.    1.        0.00
```

WORKED EXAMPLE 5(b) – CARRIER FLOWS

```
CARRIER FLOWS
EX5B.log                          Time :15:57:53 Date :01/11/02
Tutorial 5 Sub-Problem (b)


(F4.0,2F6.0,  3f12.2              )
  6
SEASON
YEAR
REPLICATE
Carrier 1       FLOW
Carrier 2       FLOW
River 1         FLOW
  1. 1982.    1.     2700.00     2700.00        0.00
  2. 1982.    1.     1300.00     1300.00        0.00
  3. 1982.    1.      154.00     1575.00        0.00
  4. 1982.    1.        0.00      450.00        0.00
  5. 1982.    1.     1600.00     1600.00        0.00
  6. 1982.    1.      700.00     1700.00        0.00
  7. 1982.    1.     1200.00     1200.00        0.00
  8. 1982.    1.      944.00     1800.00        0.00
  9. 1982.    1.     1100.00     1060.00        0.00
 10. 1982.    1.      241.00      975.00        0.00
 11. 1982.    1.        0.00     1338.00        0.00
 12. 1982.    1.      219.00     1050.00        0.00
  1. 1983.    1.        0.00      172.00        0.00
  2. 1983.    1.        0.00      160.00        0.00
  3. 1983.    1.        0.00      566.00        0.00
  4. 1983.    1.      800.00     1800.00        0.00
  5. 1983.    1.        0.00     2000.00        0.00
  6. 1983.    1.      600.00     1600.00        0.00
  7. 1983.    1.      900.00     1900.00        0.00
  8. 1983.    1.      300.00     1300.00        0.00
  9. 1983.    1.      600.00     1600.00        0.00
 10. 1983.    1.     1400.00     1400.00        0.00
 11. 1983.    1.     2100.00     2100.00        0.00
 12. 1983.    1.     2100.00     2100.00        0.00
  1. 1984.    1.     1100.00     1100.00        0.00
  2. 1984.    1.     2300.00     2300.00        0.00
  3. 1984.    1.     2056.00     2800.00        0.00
  4. 1984.    1.       88.00     1425.00        0.00
  5. 1984.    1.      225.00      300.00        0.00
  6. 1984.    1.      600.00      600.00        0.00
  7. 1984.    1.      600.00     1600.00        0.00
  8. 1984.    1.      100.00     1100.00        0.00
  9. 1984.    1.     1600.00     1600.00        0.00
 10. 1984.    1.     1300.00     1300.00        0.00
 11. 1984.    1.     2400.00     2400.00        0.00
 12. 1984.    1.      107.00     1575.00        0.00
```

WORKED EXAMPLE 5(b) – DEMAND SHORTFALLS

```
DEMAND SHORTFALL
EX5B.log                          Time :15:57:53 Date :01/11/02
Tutorial 5 Sub-Problem (b)


(F4.0,2F6.0,  2f12.2              )
  5
SEASON
YEAR
REPLICATE
DEMAND 1        SHRT
DEMAND 2        SHRT
  1. 1982.    1.        0.00        0.00
  2. 1982.    1.        0.00        0.00
  3. 1982.    1.     1946.00      525.00
  4. 1982.    1.     1500.00     1050.00
  5. 1982.    1.        0.00        0.00
  6. 1982.    1.        0.00        0.00
  7. 1982.    1.        0.00        0.00
  8. 1982.    1.      856.00        0.00
  9. 1982.    1.     1100.00      140.00
 10. 1982.    1.     1059.00      325.00
 11. 1982.    1.     1400.00     1062.00
 12. 1982.    1.     1181.00      350.00
  1. 1983.    1.     1900.00     1728.00
  2. 1983.    1.     1100.00     2940.00
  3. 1983.    1.     1300.00      734.00
  4. 1983.    1.        0.00        0.00
  5. 1983.    1.        0.00        0.00
  6. 1983.    1.        0.00        0.00
  7. 1983.    1.        0.00        0.00
  8. 1983.    1.        0.00        0.00
  9. 1983.    1.        0.00        0.00
 10. 1983.    1.        0.00        0.00
 11. 1983.    1.        0.00        0.00
 12. 1983.    1.        0.00        0.00
  1. 1984.    1.        0.00        0.00
  2. 1984.    1.        0.00        0.00
  3. 1984.    1.      744.00        0.00
  4. 1984.    1.     1812.00      475.00
  5. 1984.    1.       75.00        0.00
  6. 1984.    1.        0.00        0.00
  7. 1984.    1.        0.00        0.00
  8. 1984.    1.        0.00        0.00
  9. 1984.    1.        0.00        0.00
 10. 1984.    1.        0.00        0.00
 11. 1984.    1.        0.00        0.00
 12. 1984.    1.     1993.00      525.00
```

WORKED EXAMPLE 5(b) – INVESTIGATION OF SHORTFALL PRIORITY AND BYPASS ZONES

```
####4
EX5A.log + EX5B.log               Time :15:46:52 Date :01/11/02
Tutorial 5 Sub-Problem (a)


(  6f12.2              )
   6
SEASON
YEAR
DEMAND 1        SHRT   case (a)
DEMAND 2        SHRT   case (a)
DEMAND 1        SHRT   case (b)
DEMAND 2        SHRT   case (b)
       1.00     1982.00        0.00        0.00        0.00        0.00
       2.00     1982.00        0.00        0.00        0.00        0.00
       3.00     1982.00     2100.00      371.00     1946.00      525.00
       4.00     1982.00     1500.00     1050.00     1500.00     1050.00
       5.00     1982.00        0.00        0.00        0.00        0.00
       6.00     1982.00        0.00        0.00        0.00        0.00
       7.00     1982.00        0.00        0.00        0.00        0.00
       8.00     1982.00      856.00        0.00      856.00        0.00
       9.00     1982.00     1240.00        0.00     1100.00      140.00
      10.00     1982.00     1300.00       84.00     1059.00      325.00
      11.00     1982.00     1400.00     1062.00     1400.00     1062.00
      12.00     1982.00     1400.00      131.00     1181.00      350.00
       1.00     1983.00     1900.00     1728.00     1900.00     1728.00
       2.00     1983.00     1100.00     2940.00     1100.00     2940.00
       3.00     1983.00     1300.00      734.00     1300.00      734.00
       4.00     1983.00        0.00        0.00        0.00        0.00
       5.00     1983.00        0.00        0.00        0.00        0.00
       6.00     1983.00        0.00        0.00        0.00        0.00
       7.00     1983.00        0.00        0.00        0.00        0.00
       8.00     1983.00        0.00        0.00        0.00        0.00
       9.00     1983.00        0.00        0.00        0.00        0.00
      10.00     1983.00        0.00        0.00        0.00        0.00
      11.00     1983.00        0.00        0.00        0.00        0.00
      12.00     1983.00        0.00        0.00        0.00        0.00
       1.00     1984.00        0.00        0.00        0.00        0.00
       2.00     1984.00        0.00        0.00        0.00        0.00
       3.00     1984.00      744.00        0.00      744.00        0.00
       4.00     1984.00     1900.00      387.00     1812.00      475.00
       5.00     1984.00       75.00        0.00       75.00        0.00
       6.00     1984.00        0.00        0.00        0.00        0.00
       7.00     1984.00        0.00        0.00        0.00        0.00
       8.00     1984.00        0.00        0.00        0.00        0.00
       9.00     1984.00        0.00        0.00        0.00        0.00
      10.00     1984.00        0.00        0.00        0.00        0.00
      11.00     1984.00        0.00        0.00        0.00        0.00
      12.00     1984.00     2100.00      418.00     1993.00      525.00
```

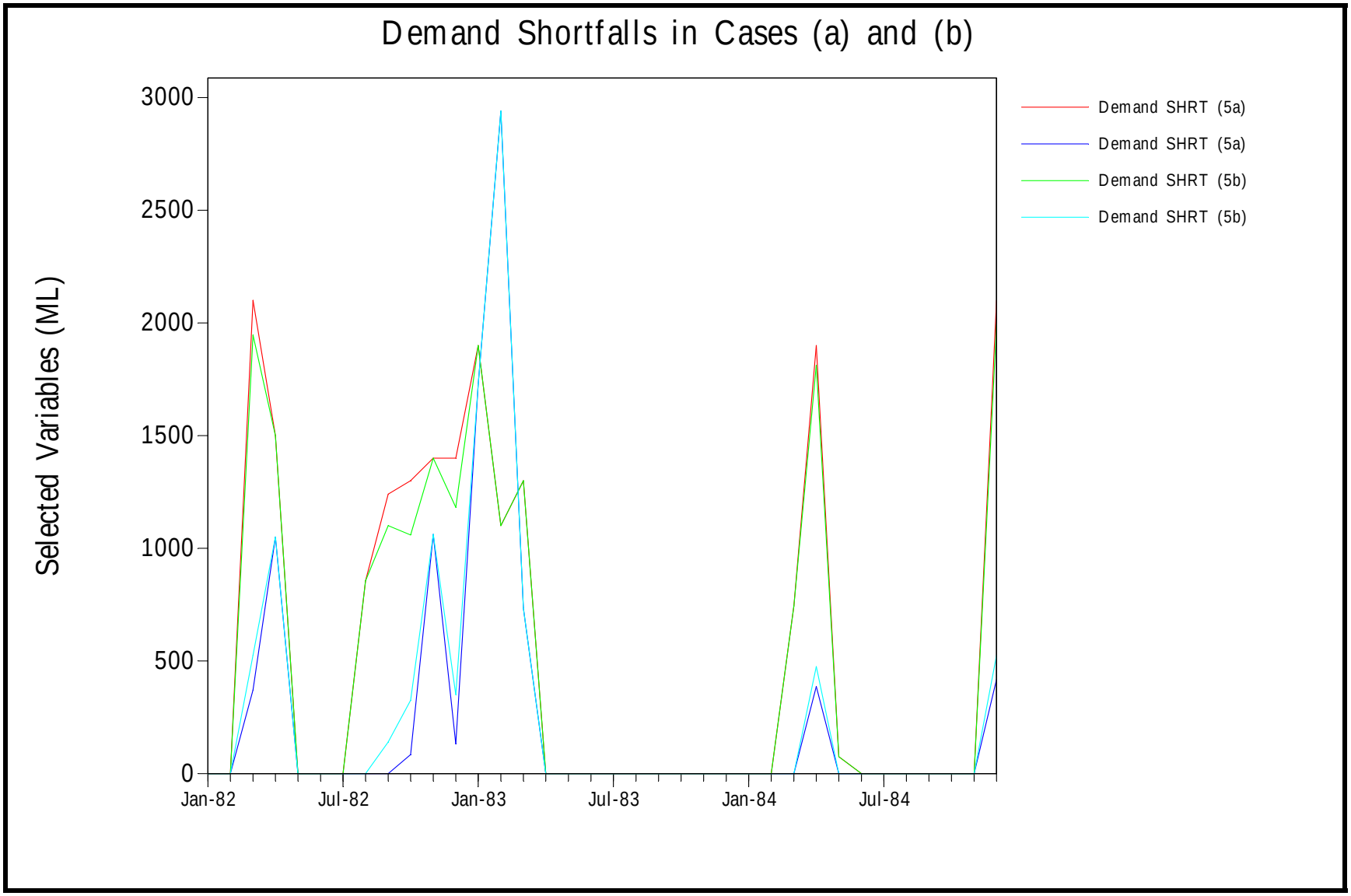

Figure 3.5-2 Worked Example 5(b) – Demand Shortfalls in Cases (a) and (b)

3.6 WORKED EXAMPLE 6

WATER QUALITY MODELLING

WORKED EXAMPLE 6 - DATA FILE: DEM.DAT

```
####3
DEMANDS DATA FILE
HISTORICAL DATA
DATA ASSEMBLED AND REFORMATED ON
DATE : 9 JUL 1990
( 3F12.2)
   3
SEASON
YEAR
DEMAND 1
        1.00     1982.00     2700.00
        2.00     1982.00     1300.00
        3.00     1982.00     2100.00
        4.00     1982.00     1500.00
        5.00     1982.00     1600.00
        6.00     1982.00      700.00
        7.00     1982.00     1200.00
        8.00     1982.00     1800.00
        9.00     1982.00     2200.00
       10.00     1982.00     1300.00
       11.00     1982.00     1400.00
       12.00     1982.00     1400.00
        1.00     1983.00     1900.00
        2.00     1983.00     1100.00
        3.00     1983.00     1300.00
        4.00     1983.00      800.00
        5.00     1983.00        0.00
        6.00     1983.00      600.00
        7.00     1983.00      900.00
        8.00     1983.00      300.00
        9.00     1983.00      600.00
       10.00     1983.00     1400.00
       11.00     1983.00     2100.00
       12.00     1983.00     2100.00
        1.00     1984.00     1100.00
        2.00     1984.00     2300.00
        3.00     1984.00     2800.00
        4.00     1984.00     1900.00
        5.00     1984.00      300.00
        6.00     1984.00      600.00
        7.00     1984.00      600.00
        8.00     1984.00      100.00
        9.00     1984.00     1600.00
       10.00     1984.00     1300.00
       11.00     1984.00     2400.00
       12.00     1984.00     2100.00
```

WORKED EXAMPLE 6 - DATA FILE: SF4.DAT

```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 4F12.2)
   4
SEASON
YEAR
STREAM1
EC_VALUES
        1.00     1982.00      416.00      500.00
        2.00     1982.00      288.00      600.00
        3.00     1982.00     1025.00      500.00
        4.00     1982.00      450.00      450.00
        5.00     1982.00     4988.00      420.00
        6.00     1982.00     2249.00      400.00
        7.00     1982.00     1234.00      380.00
        8.00     1982.00     2273.00      350.00
        9.00     1982.00     2160.00      400.00
       10.00     1982.00     1216.00      450.00
       11.00     1982.00     1338.00      480.00
       12.00     1982.00     1269.00      500.00
        1.00     1983.00      172.00      520.00
        2.00     1983.00      160.00      600.00
        3.00     1983.00      566.00      580.00
        4.00     1983.00     3848.00      550.00
        5.00     1983.00     3220.00      340.00
        6.00     1983.00     1500.00      300.00
        7.00     1983.00     4640.00      280.00
        8.00     1983.00     3900.00      300.00
        9.00     1983.00     4600.00      350.00
       10.00     1983.00     2360.00      400.00
       11.00     1983.00     2023.00      420.00
       12.00     1983.00     2967.00      480.00
        1.00     1984.00     4426.00      500.00
        2.00     1984.00      246.00      520.00
        3.00     1984.00     2526.00      500.00
        4.00     1984.00     1513.00      450.00
        5.00     1984.00      525.00      420.00
        6.00     1984.00     2833.00      380.00
        7.00     1984.00      908.00      350.00
        8.00     1984.00     2029.00      400.00
        9.00     1984.00     4600.00      500.00
       10.00     1984.00     5910.00      550.00
       11.00     1984.00      249.00      420.00
       12.00     1984.00      353.00      480.00
```

WORKED EXAMPLE 6 - DATA FILE: SF5.DAT

```
####2
STREAMFLOW DATA FILE
HISTORICAL MONTHLY STREAMFLOW DATAFILE
TEST DATA
DATE : 20 JUL 1990
( 6F12.2)
   6
SEASON
YEAR
STREAM1
PAN EVAP
LOCAL RAIN
EC_VALUES
        1.00     1982.00      416.00       32.10       33.80     500.00
        2.00     1982.00      288.00       32.40       32.40     600.00
        3.00     1982.00     1025.00       27.60       29.10     500.00
        4.00     1982.00      450.00       21.40      123.90     450.00
        5.00     1982.00     4988.00       16.00      119.60     420.00
        6.00     1982.00     2249.00       12.30      214.60     400.00
        7.00     1982.00     1234.00       11.90      315.50     380.00
        8.00     1982.00     2273.00       17.10      121.40     350.00
        9.00     1982.00     2160.00       17.00       20.60     400.00
       10.00     1982.00     1216.00       22.40       24.00     450.00
       11.00     1982.00     1338.00       30.00       31.50     480.00
       12.00     1982.00     1269.00       30.20       31.40     500.00
        1.00     1983.00      172.00       30.80       31.30     520.00
        2.00     1983.00      160.00       34.40       35.20     600.00
        3.00     1983.00      566.00       28.50      128.90     580.00
        4.00     1983.00     3848.00       19.70      221.10     550.00
        5.00     1983.00     3220.00       16.40      319.40     340.00
        6.00     1983.00     1500.00       11.30      216.00     300.00
        7.00     1983.00     4640.00       11.70      114.80     280.00
        8.00     1983.00     3900.00       13.70       17.50     300.00
        9.00     1983.00     4600.00       16.60       20.30     350.00
       10.00     1983.00     2360.00       20.10      123.20     400.00
       11.00     1983.00     2023.00       22.80       26.80     420.00
       12.00     1983.00     2967.00       29.00       30.80     480.00
        1.00     1984.00     4426.00       27.30       29.00     500.00
        2.00     1984.00      246.00       28.50       32.10     520.00
        3.00     1984.00     2526.00       24.10       26.70     500.00
        4.00     1984.00     1513.00       21.30       22.70     450.00
        5.00     1984.00      525.00       16.80       20.10     420.00
        6.00     1984.00     2833.00       14.60      117.30     380.00
        7.00     1984.00      908.00       11.60      214.40     350.00
        8.00     1984.00     2029.00       14.00      116.90     400.00
        9.00     1984.00     4600.00       15.40       17.80     500.00
       10.00     1984.00     5910.00       20.50       23.90     550.00
       11.00     1984.00      249.00       25.80       27.50     420.00
       12.00     1984.00      353.00       26.50      230.10     480.00
```

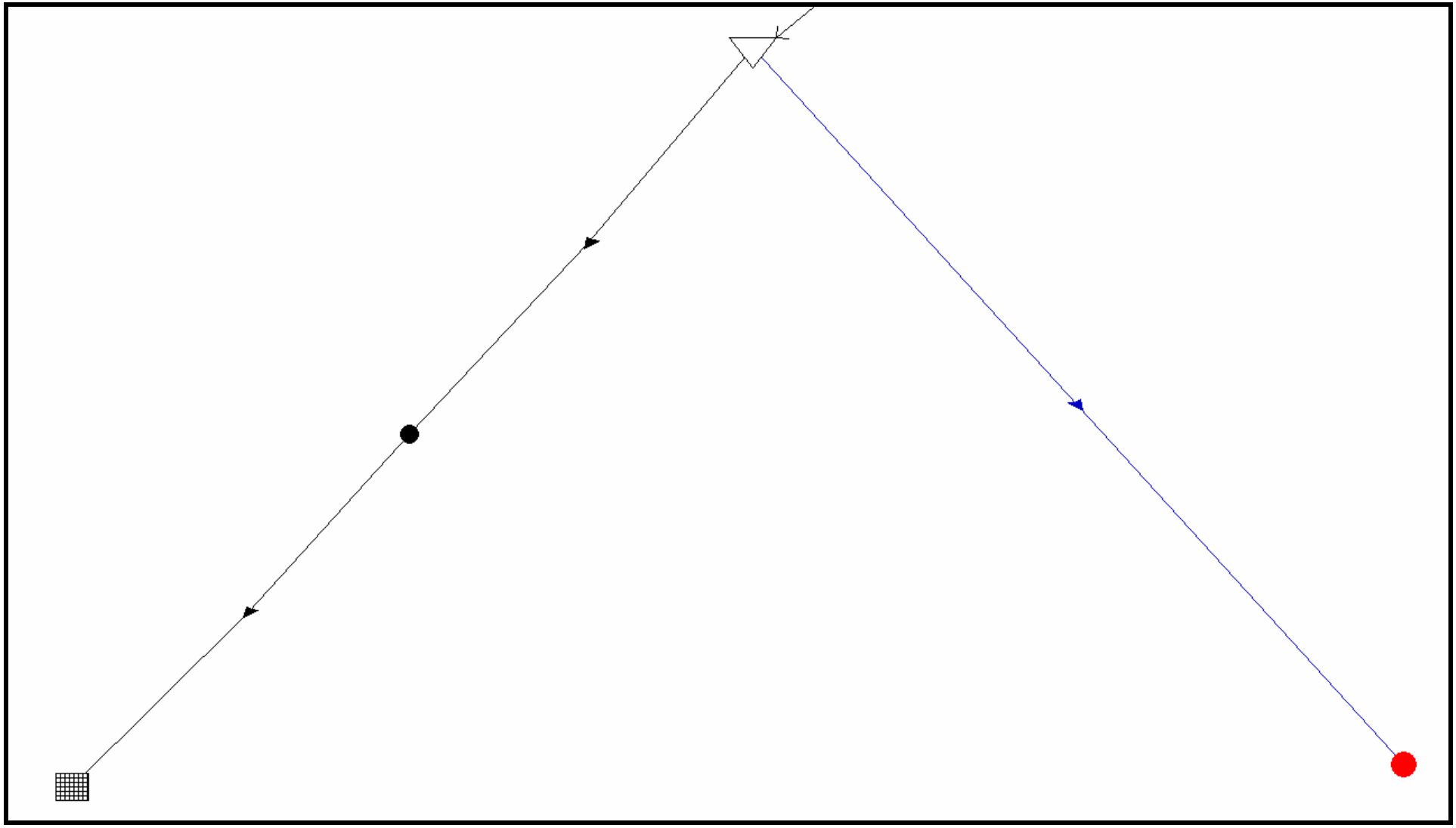

Figure 3.6-1 Worked Example 6 (a) – System Plot

WORKED EXAMPLE 6(a) – SYSTEM LISTING

```
_____________________________________________________________

                R      E      A      L      M
_____________________________________________________________


             ****************************
             *   SYSTEM FILE LISTING    *
             ****************************

 File: C:\REALM\WorkedExamples\EX6A.sys

 Simulation label:
     Tutorial 6 - Sub-Problem (a)



 Date: 16:51:37 12/11/01


-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input          No
-------------------------------------------------------------------------------------------------------------
   1 Reservoir 1          Reservoir          51.01    95.00     0.00     1.00 STREAM1                1
   2 Pipe Junction 1      Pipe junction      27.78    47.99     0.00     1.00                        2
   3 DEMAND 1             Demand              5.00     5.00     0.00     1.00                        3
   4 Stream Terminator    Strm terminator    95.00     7.73     0.00     1.00                        4


 Reservoir data:

      No       Name              Min     Max    No   No     Spill
                                 Cap     Cap  Above Below    Type
    ------------------------------------------------------------------
       1 Reservoir 1               0    20000  1    1     Downstream


      No       Name                              Levels/volume relationships
                                    pt1     pt2     pt3     pt4     pt5     pt6    pt7    pt8     pt9     pt10     pt11   pt12    pt13   pt14    pt15
    ------------------------------------------------------------------------------------------------------------------
       1 Reservoir 1         Vol       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0
                             Lvl    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
```

demand data:

No	Name	No Bypass	S/F Priority		Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					Monthly Factors											
3	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	Carrier 1	Pipe	1	2	0	0	0fix	0		0%	1
2	Carrier 2	Pipe	2	3	0	0	0fix	0		0%	2
3	Carrier 3	River	1	4	1000	0	0fix	0		0%	3

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Carrier 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
3	Carrier 3	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

Functional Capacities

No	Name		pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12
2	Carrier 2	V	0	400	40199999999	0	0	0	0	0	0	0	0	0
	Fn Name:	C	9999999999999999		0	0	0	0	0	0	0	0	0	0

Equation used: '1
' 1 = Reservoir 1 Type: EC

Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2

W/QUALITY INFORMATION

No	Carrier Name	Blocked out to ec	turb	W/qual Reference

1 = blocked out, 0 = still allowed

No	Node Name	W/qual Ref	W/qual S/F Name	W/Qual Fixed	Wqual loss
1	Reservoir 1	ec	EC_VALUES	0.0000	0.0000
		turb		1000.0000	0.0000

WORKED EXAMPLE 6(a) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX6A.log

 Scenario file: scn6a.scn

 Simulation label:
     Tutorial 6 - Sub-Problem (a)




 Streamflow file(s):
     C:\REALM\WorkedExamples\sf4.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
 Water quality calculations are ON
 Water qual start file = startec
 Water qual start file = starturb

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 16:53:44 12/11/01
```

```
Time Step = Monthly

SYSTEM CHANGES:
No    Seas  Year   System File
---------------------------------
  1     1  1982     C:\REALM\WorkedExamples\EX6A.sys
---------------------------------

Total number of seasons:-   36


******** RUN TIME MESSAGES:- ********


 ****INPUT DATA TYPE=  1 ****

1982
 C:\REALM\WorkedExamples\EX6A.sys
1983
1984
******** END RUN TIME MESSAGES ********



 SUMMARY INFORMATION


Reservoir data:

         Name              Start     File       Min      Average    Evapn   Release    Spill      End
                          Storage    Inflow   Storage    Storage            to river            Storage
 1  Reservoir 1             10000.     2083.     4579.     15079.        0.     1061.        0.    20000.
-------------------------------------------------------------------------------------------------------------
                            10000.     2083.        0.    15079.        0.     1061.        0.    20000.
-------------------------------------------------------------------------------------------------------------


Demand data:

         Name            Unrestrict  Restrict  Rationed   Shortfall Supplied
 1  DEMAND 1                1372.     1372.     1372.      628.      744.
-------------------------------------------------------------------------------------------------------------
                            1372.     1372.     1372.      628.      744.
-------------------------------------------------------------------------------------------------------------

         Name                 No       Ave         Max     No       Ave %      Max %   No         Ave %     Max %
                             Rest     Rest lvl    Rest lvl  Ration   Ration     Ration  Short      Short     Short
 1  DEMAND 1                 0.0       0.0       0.0       0.0       0.0       0.0      17.0     100.0     100.0
-------------------------------------------------------------------------------------------------------------
```

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	Carrier 1	744.4	99999999.0	0.0	2700.0	0.0
2	Carrier 2	744.4	50000000.0	0.0	2700.0	0.0
3	Carrier 3	1060.6	99999999.0	0.0	5910.0	0.0
						0.

Reservoir water quality summary (averages)

	Name	ec	turb
1	Reservoir 1	387.0	1000.0
		387.0	1000.0

Reservoir water quality summary (maximums)

	Name	ec	turb
1	Reservoir 1	458.0	1000.0

Carrier water quality summary (averages)

	Name	ec	turb
1	Carrier 1	174.0	500.0
2	Carrier 2	174.0	500.0
3	Carrier 3	196.4	472.2
		544.4	1472.2

Carrier water quality summary (maximums)

	Name	ec	turb
1	Carrier 1	412.4	1000.0
2	Carrier 2	412.4	1000.0
3	Carrier 3	458.0	1000.0

End run

WORKED EXAMPLE 6(a)

```
####4
EX6A.log                          Time :16:53:44 Date :12/11/01
Tutorial 6 - Sub-Problem (a)


(  9f12.2              )
   9
SEASON
YEAR
Reservoir 1     ec
Carrier 1       FLOW
Carrier 2       FLOW
Carrier 3       FLOW
Carrier 1       CAPC
Carrier 2       CAPC
Carrier 3       CAPC
        1.00     1982.00      212.00     2700.00     2700.00        0.00100000000.00100000000.00100000000.00
        2.00     1982.00      226.00     1300.00     1300.00        0.00100000000.00100000000.00100000000.00
        3.00     1982.00      262.00     2100.00     2100.00        0.00100000000.00100000000.00100000000.00
        4.00     1982.00      276.00     1500.00     1500.00        0.00100000000.00100000000.00100000000.00
        5.00     1982.00      351.00     1600.00     1600.00        0.00100000000.00100000000.00100000000.00
        6.00     1982.00      362.00      700.00      700.00        0.00100000000.00100000000.00100000000.00
        7.00     1982.00      364.00     1200.00     1200.00        0.00100000000.00100000000.00100000000.00
        8.00     1982.00      361.00     1800.00     1800.00        0.00100000000.00100000000.00100000000.00
        9.00     1982.00      368.00     2200.00     2200.00        0.00100000000.00100000000.00100000000.00
       10.00     1982.00      377.00     1300.00     1300.00        0.00100000000.00100000000.00100000000.00
       11.00     1982.00      389.00     1400.00     1400.00        0.00100000000.00100000000.00100000000.00
       12.00     1982.00      402.00     1400.00     1400.00        0.00100000000.00100000000.00100000000.00
        1.00     1983.00      404.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        2.00     1983.00      407.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        3.00     1983.00      416.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        4.00     1983.00      452.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        5.00     1983.00      432.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        6.00     1983.00      421.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        7.00     1983.00      394.00        0.00        0.00     3812.00100000000.00        0.00100000000.00
        8.00     1983.00      378.00      300.00      300.00     3600.00100000000.00100000000.00100000000.00
        9.00     1983.00      373.00      600.00      600.00     4000.00100000000.00100000000.00100000000.00
       10.00     1983.00      376.00     1400.00     1400.00      960.00100000000.00100000000.00100000000.00
       11.00     1983.00      380.00     2100.00     2100.00        0.00100000000.00100000000.00100000000.00
       12.00     1983.00      393.00     2100.00     2100.00      790.00100000000.00100000000.00100000000.00
        1.00     1984.00      412.00     1100.00     1100.00     3326.00100000000.00100000000.00100000000.00
        2.00     1984.00      414.00        0.00        0.00      246.00100000000.00        0.00100000000.00
        3.00     1984.00      423.00        0.00        0.00     2526.00100000000.00        0.00100000000.00
        4.00     1984.00      425.00        0.00        0.00     1513.00100000000.00        0.00100000000.00
        5.00     1984.00      425.00        0.00        0.00      525.00100000000.00        0.00100000000.00
        6.00     1984.00      419.00        0.00        0.00     2833.00100000000.00        0.00100000000.00
        7.00     1984.00      416.00        0.00        0.00      908.00100000000.00        0.00100000000.00
        8.00     1984.00      415.00        0.00        0.00     2029.00100000000.00        0.00100000000.00
        9.00     1984.00      431.00        0.00        0.00     4600.00100000000.00        0.00100000000.00
       10.00     1984.00      458.00        0.00        0.00     5910.00100000000.00        0.00100000000.00
       11.00     1984.00      458.00        0.00        0.00      249.00100000000.00        0.00100000000.00
       12.00     1984.00      458.00        0.00        0.00      353.00100000000.00        0.00100000000.00
```

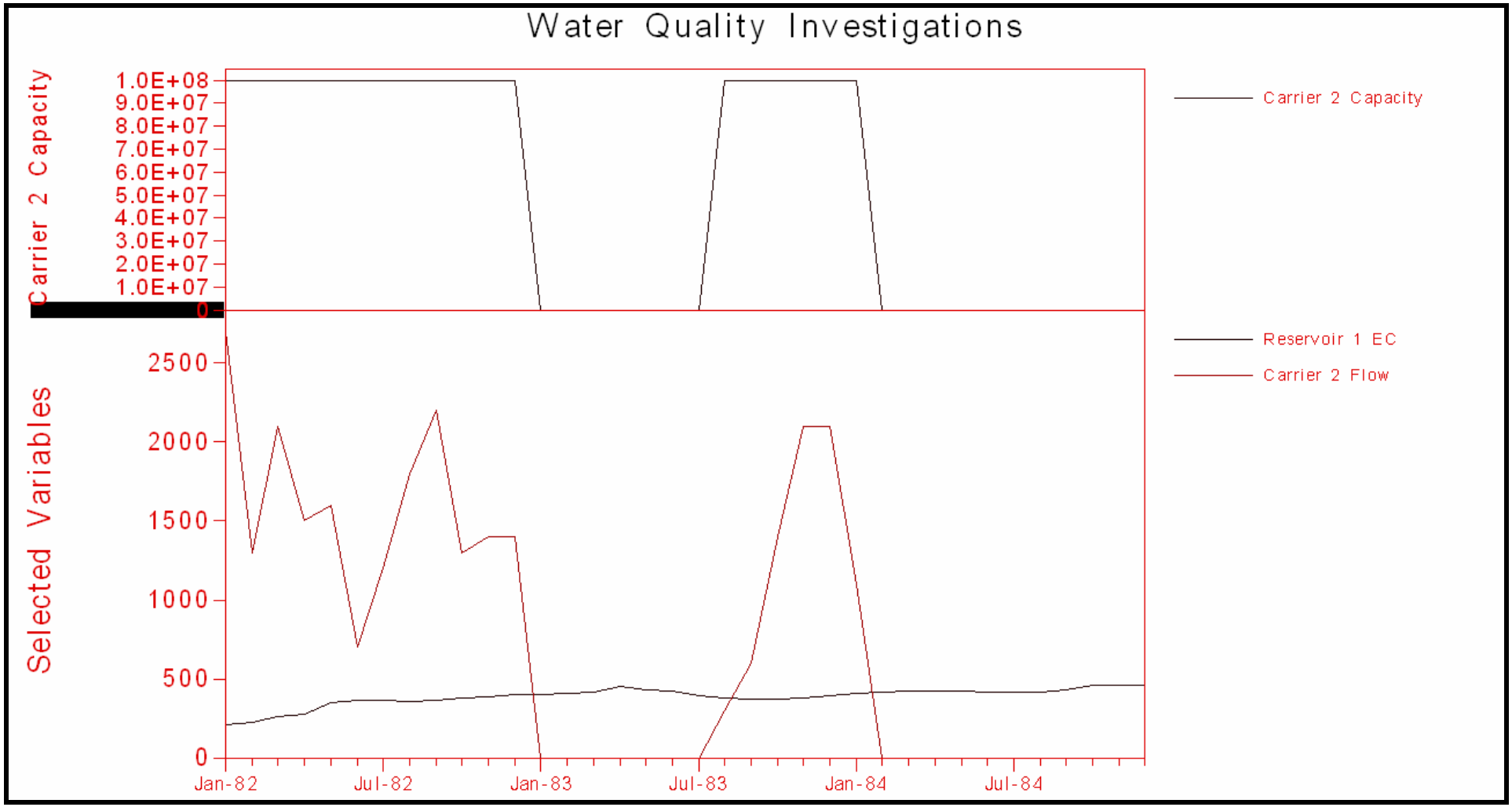

Figure 3.6-2 Worked Example 6(a) – Water Quality Investigations

WORKED EXAMPLE 6(b) – SYSTEM LISTING

```
_____________________________________________________________

              R      E      A      L      M
_____________________________________________________________


            ****************************
            *   SYSTEM FILE LISTING    *
            ****************************

 File: C:\REALM\WorkedExamples\EX6B.sys

 Simulation label:
     Tutorial 6 - Sub-Problem (b)



 Date: 10:14:19 12/18/01


-------------------------------
|  NODE INFORMATION           |
-------------------------------

-------------------------------------------------------------------------------------------------------------
 No          Name              Type           X         Y        Z        Size     Aux Input          No
-------------------------------------------------------------------------------------------------------------
   1 Reservoir 1          Reservoir          51.01    95.00     0.00     1.00 STREAM1                1
   2 Pipe Junction 1      Pipe junction      27.78    47.99     0.00     1.00                        2
   3 DEMAND 1             Demand              5.00     5.00     0.00     1.00                        3
   4 Stream Terminator    Strm terminator    95.00     7.73     0.00     1.00                        4


 Reservoir data:

      No       Name              Min     Max    No   No     Spill
                                 Cap     Cap  Above Below    Type
     ------------------------------------------------------------------
        1 Reservoir 1               0    20000  1    1     Downstream
```

Reservoir evaps: (if A=B=0 evaps not calculated!)

No	Name	NET EVAP =	(A	+	B	*	EVAPORATION)	-	RAINFALL
1	Reservoir 1		0.500	3.000	PAN EVAP				LOCAL RAIN

No	Name	Surface area/volume relationships	pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10
1	Reservoir 1	Vol	0	500	1000	4000	6000	8000	9000	10000	11000	12000
		Area	0	10	30	40	50	60	70	80	90	100

No	Name	Levels/volume relationships	pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	Reservoir 1	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	DEMAND 1	1	1	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	Carrier 1	Pipe	1	2	0	0	0fix	0		0%	1
2	Carrier 2	Pipe	2	3	0	0	0fix	0		0%	2
3	Carrier 3	River	1	4	1000	0	0fix	0		0%	3

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Carrier 1	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
3	Carrier 3	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

Functional Capacities

No	Name		pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12
2	Carrier 2	V	0	400	40199999999	0	0	0	0	0	0	0	0	0
	Fn Name:	C	9999999999999999		0	0	0	0	0	0	0	0	0	0

Equation used: '1
' 1 = Reservoir 1 Type: EC

Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2

```
------------------------------
|  W/QUALITY INFORMATION      |
------------------------------

-------------------------------------------------------------------------------------------------------------
 No        Carrier Name                              Blocked out to  W/qual Reference
                                    ec    turb
-------------------------------------------------------------------------------------------------------------

    1 = blocked out, 0 = still allowed


-------------------------------------------------------------------------------------------------------------
 No        Node Name        W/qual Ref    W/qual S/F Name    W/Qual Fixed   Wqual loss
-------------------------------------------------------------------------------------------------------------
   1  Reservoir 1             ec       EC_VALUES               0.0000         0.0000
                              turb                          1000.0000         0.0000
```

WORKED EXAMPLE 6(b) – LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EX6B.log

 Scenario file: scn6b.scn

 Simulation label:
     Tutorial 6 - Sub-Problem (b)




 Streamflow file(s):
     C:\REALM\WorkedExamples\sf5.dat
 Demand file(s):
     C:\REALM\WorkedExamples\Dem.dat

 Restrictions are OFF

 Instream flow requirements NOT limited to natural
 Water quality calculations are ON
 Water qual start file = startec
 Water qual start file = starturb

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 10:19:02 12/18/01
```

```
Time Step = Monthly

SYSTEM CHANGES:
No    Seas  Year   System File
---------------------------------
  1     1  1982     C:\REALM\WorkedExamples\EX6B.sys
---------------------------------

Total number of seasons:-   36


******** RUN TIME MESSAGES:- ********


 ****INPUT DATA TYPE=  1 ****

1982
 C:\REALM\WorkedExamples\EX6B.sys
1983
1984
******** END RUN TIME MESSAGES ********



 SUMMARY INFORMATION



Reservoir data:

         Name              Start     File       Min      Average    Evapn   Release    Spill      End
                          Storage    Inflow   Storage    Storage            to river             Storage
 1  Reservoir 1             10000.     2083.     4492.    14839.      -26.     1034.        0.    20000.
-------------------------------------------------------------------------------------------------------------
                            10000.     2083.        0.    14839.      -26.     1034.        0.    20000.
-------------------------------------------------------------------------------------------------------------



Demand data:

         Name            Unrestrict  Restrict  Rationed   Shortfall Supplied
 1  DEMAND 1                1372.     1372.     1372.      575.      797.
-------------------------------------------------------------------------------------------------------------
                            1372.     1372.     1372.      575.      797.
-------------------------------------------------------------------------------------------------------------


         Name                 No       Ave         Max     No       Ave %      Max %   No         Ave %     Max %
                             Rest     Rest lvl    Rest lvl  Ration   Ration     Ration  Short      Short     Short
 1  DEMAND 1                 0.0       0.0       0.0       0.0       0.0       0.0      16.0     100.0     100.0
-------------------------------------------------------------------------------------------------------------
```

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	Carrier 1	797.2	99999999.0	0.0	2700.0	0.0
2	Carrier 2	797.2	52341630.7	0.0	2700.0	0.0
3	Carrier 3	1034.1	99999999.0	0.0	5839.0	0.0
						0.

Reservoir water quality summary (averages)

	Name	ec	turb
1	Reservoir 1	383.8	991.3
		383.8	991.3

Reservoir water quality summary (maximums)

	Name	ec	turb
1	Reservoir 1	457.0	1011.8

Carrier water quality summary (averages)

	Name	ec	turb
1	Carrier 1	183.2	522.8
2	Carrier 2	183.2	522.8
3	Carrier 3	194.5	467.9
		560.9	1513.4

Carrier water quality summary (maximums)

	Name	ec	turb
1	Carrier 1	410.4	1011.8
2	Carrier 2	410.4	1011.8
3	Carrier 3	457.0	1009.8

End run

WORKED EXAMPLE 6(b) TURBIDITY

```
####4
EX6Aturb.rv + EX6Bturb.rv + EX6Bevap.rv  Time :16:53:44 Date :12/11/01
water quality modelling without evaps - ex6a
water quality modelling with evaps - ex6b

(  5f12.2              )
   5
SEASON
YEAR
Reservoir 1     turb
Reservoir 1     turb
Reservoir 1     EVAP
        1.00     1982.00     1000.00     1005.00       49.00
        2.00     1982.00     1000.00     1009.00       37.00
        3.00     1982.00     1000.00     1012.00       29.00
        4.00     1982.00     1000.00     1006.00      -28.00
        5.00     1982.00     1000.00     1000.00      -30.00
        6.00     1982.00     1000.00      990.00     -105.00
        7.00     1982.00     1000.00      972.00     -209.00
        8.00     1982.00     1000.00      973.00      -54.00
        9.00     1982.00     1000.00      980.00       25.00
       10.00     1982.00     1000.00      985.00       34.00
       11.00     1982.00     1000.00      990.00       47.00
       12.00     1982.00     1000.00      996.00       47.00
        1.00     1983.00     1000.00     1001.00       48.00
        2.00     1983.00     1000.00     1005.00       40.00
        3.00     1983.00     1000.00     1002.00      -25.00
        4.00     1983.00     1000.00      993.00     -107.00
        5.00     1983.00     1000.00      977.00     -289.00
        6.00     1983.00     1000.00      965.00     -259.00
        7.00     1983.00     1000.00      967.00     -125.00
        8.00     1983.00     1000.00      974.00       44.00
        9.00     1983.00     1000.00      981.00       56.00
       10.00     1983.00     1000.00      978.00     -112.00
       11.00     1983.00     1000.00      983.00       76.00
       12.00     1983.00     1000.00      990.00      100.00
        1.00     1984.00     1000.00      996.00       94.00
        2.00     1984.00     1000.00     1001.00       99.00
        3.00     1984.00     1000.00     1004.00       81.00
        4.00     1984.00     1000.00     1007.00       72.00
        5.00     1984.00     1000.00     1010.00       56.00
        6.00     1984.00     1000.00     1003.00     -128.00
        7.00     1984.00     1000.00      988.00     -319.00
        8.00     1984.00     1000.00      983.00     -134.00
        9.00     1984.00     1000.00      988.00       49.00
       10.00     1984.00     1000.00      994.00       71.00
       11.00     1984.00     1000.00      998.00       90.00
       12.00     1984.00     1000.00      985.00     -267.00
```

WORKED EXAMPLE 6(b) ELECTRICAL CONDUCTIVITY

```
####4
EX6Aec.rv + EX6Bec.rv + EX6Bevap.rv      Time :16:53:44 Date :12/11/01
water quality modelling without evap - ex6a
water quality modelling with evap - ex6b

(  5f12.2              )
   5
SEASON
YEAR
Reservoir 1     ec
Reservoir 1     ec
Reservoir 1     EVAP
        1.00     1982.00      212.00      213.00       49.00
        2.00     1982.00      226.00      228.00       37.00
        3.00     1982.00      262.00      266.00       29.00
        4.00     1982.00      276.00      278.00      -28.00
        5.00     1982.00      351.00      352.00      -30.00
        6.00     1982.00      362.00      359.00     -105.00
        7.00     1982.00      364.00      354.00     -209.00
        8.00     1982.00      361.00      352.00      -54.00
        9.00     1982.00      368.00      361.00       25.00
       10.00     1982.00      377.00      371.00       34.00
       11.00     1982.00      389.00      386.00       47.00
       12.00     1982.00      402.00      400.00       47.00
        1.00     1983.00      404.00      404.00       48.00
        2.00     1983.00      407.00      410.00       40.00
        3.00     1983.00      416.00      420.00      -25.00
        4.00     1983.00      452.00      455.00     -107.00
        5.00     1983.00      432.00      425.00     -289.00
        6.00     1983.00      421.00      408.00     -259.00
        7.00     1983.00      394.00      380.00     -125.00
        8.00     1983.00      378.00      367.00       44.00
        9.00     1983.00      373.00      365.00       56.00
       10.00     1983.00      376.00      367.00     -112.00
       11.00     1983.00      380.00      373.00       76.00
       12.00     1983.00      393.00      389.00      100.00
        1.00     1984.00      412.00      410.00       94.00
        2.00     1984.00      414.00      414.00       99.00
        3.00     1984.00      423.00      425.00       81.00
        4.00     1984.00      425.00      428.00       72.00
        5.00     1984.00      425.00      429.00       56.00
        6.00     1984.00      419.00      421.00     -128.00
        7.00     1984.00      416.00      411.00     -319.00
        8.00     1984.00      415.00      408.00     -134.00
        9.00     1984.00      431.00      426.00       49.00
       10.00     1984.00      458.00      455.00       71.00
       11.00     1984.00      458.00      457.00       90.00
       12.00     1984.00      458.00      452.00     -267.00
```

WORKED EXAMPLE 6(b) CARRIER FLOW/CAPACITY

```
####4
EX6Bec.rv + EX6Bflow.ar + EX6Bcapc.ar          Time :10:19:02 Date :12/18/01
water quality modelling - ex6b
Reservoir evaporation considered

(  9f12.2              )
   9
SEASON
YEAR
Reservoir 1     ec
Carrier 1       FLOW
Carrier 2       FLOW
Carrier 3       FLOW
Carrier 1       CAPC
Carrier 2       CAPC
Carrier 3       CAPC
        1.00     1982.00      213.00     2700.00     2700.00        0.00100000000.00100000000.00100000000.00
        2.00     1982.00      228.00     1300.00     1300.00        0.00100000000.00100000000.00100000000.00
        3.00     1982.00      266.00     2100.00     2100.00        0.00100000000.00100000000.00100000000.00
        4.00     1982.00      278.00     1500.00     1500.00        0.00100000000.00100000000.00100000000.00
        5.00     1982.00      352.00     1600.00     1600.00        0.00100000000.00100000000.00100000000.00
        6.00     1982.00      359.00      700.00      700.00        0.00100000000.00100000000.00100000000.00
        7.00     1982.00      354.00     1200.00     1200.00        0.00100000000.00100000000.00100000000.00
        8.00     1982.00      352.00     1800.00     1800.00        0.00100000000.00100000000.00100000000.00
        9.00     1982.00      361.00     2200.00     2200.00        0.00100000000.00100000000.00100000000.00
       10.00     1982.00      371.00     1300.00     1300.00        0.00100000000.00100000000.00100000000.00
       11.00     1982.00      386.00     1400.00     1400.00        0.00100000000.00100000000.00100000000.00
       12.00     1982.00      400.00     1400.00     1400.00        0.00100000000.00100000000.00100000000.00
        1.00     1983.00      404.00     1900.00     1900.00        0.00100000000.00 84298704.00100000000.00
        2.00     1983.00      410.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        3.00     1983.00      420.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        4.00     1983.00      455.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        5.00     1983.00      425.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        6.00     1983.00      408.00        0.00        0.00        0.00100000000.00        0.00100000000.00
        7.00     1983.00      380.00        0.00        0.00     2787.00100000000.00        0.00100000000.00
        8.00     1983.00      367.00      300.00      300.00     3556.00100000000.00100000000.00100000000.00
        9.00     1983.00      365.00      600.00      600.00     3944.00100000000.00100000000.00100000000.00
       10.00     1983.00      367.00     1400.00     1400.00     1072.00100000000.00100000000.00100000000.00
       11.00     1983.00      373.00     2100.00     2100.00        0.00100000000.00100000000.00100000000.00
       12.00     1983.00      389.00     2100.00     2100.00      614.00100000000.00100000000.00100000000.00
        1.00     1984.00      410.00     1100.00     1100.00     3232.00100000000.00100000000.00100000000.00
        2.00     1984.00      414.00        0.00        0.00      147.00100000000.00        0.00100000000.00
        3.00     1984.00      425.00        0.00        0.00     2445.00100000000.00        0.00100000000.00
        4.00     1984.00      428.00        0.00        0.00     1441.00100000000.00        0.00100000000.00
        5.00     1984.00      429.00        0.00        0.00      469.00100000000.00        0.00100000000.00
        6.00     1984.00      421.00        0.00        0.00     2961.00100000000.00        0.00100000000.00
        7.00     1984.00      411.00        0.00        0.00     1227.00100000000.00        0.00100000000.00
        8.00     1984.00      408.00        0.00        0.00     2163.00100000000.00        0.00100000000.00
        9.00     1984.00      426.00        0.00        0.00     4551.00100000000.00        0.00100000000.00
       10.00     1984.00      455.00        0.00        0.00     5839.00100000000.00        0.00100000000.00
       11.00     1984.00      457.00        0.00        0.00      159.00100000000.00        0.00100000000.00
       12.00     1984.00      452.00        0.00        0.00      620.00100000000.00        0.00100000000.00
```

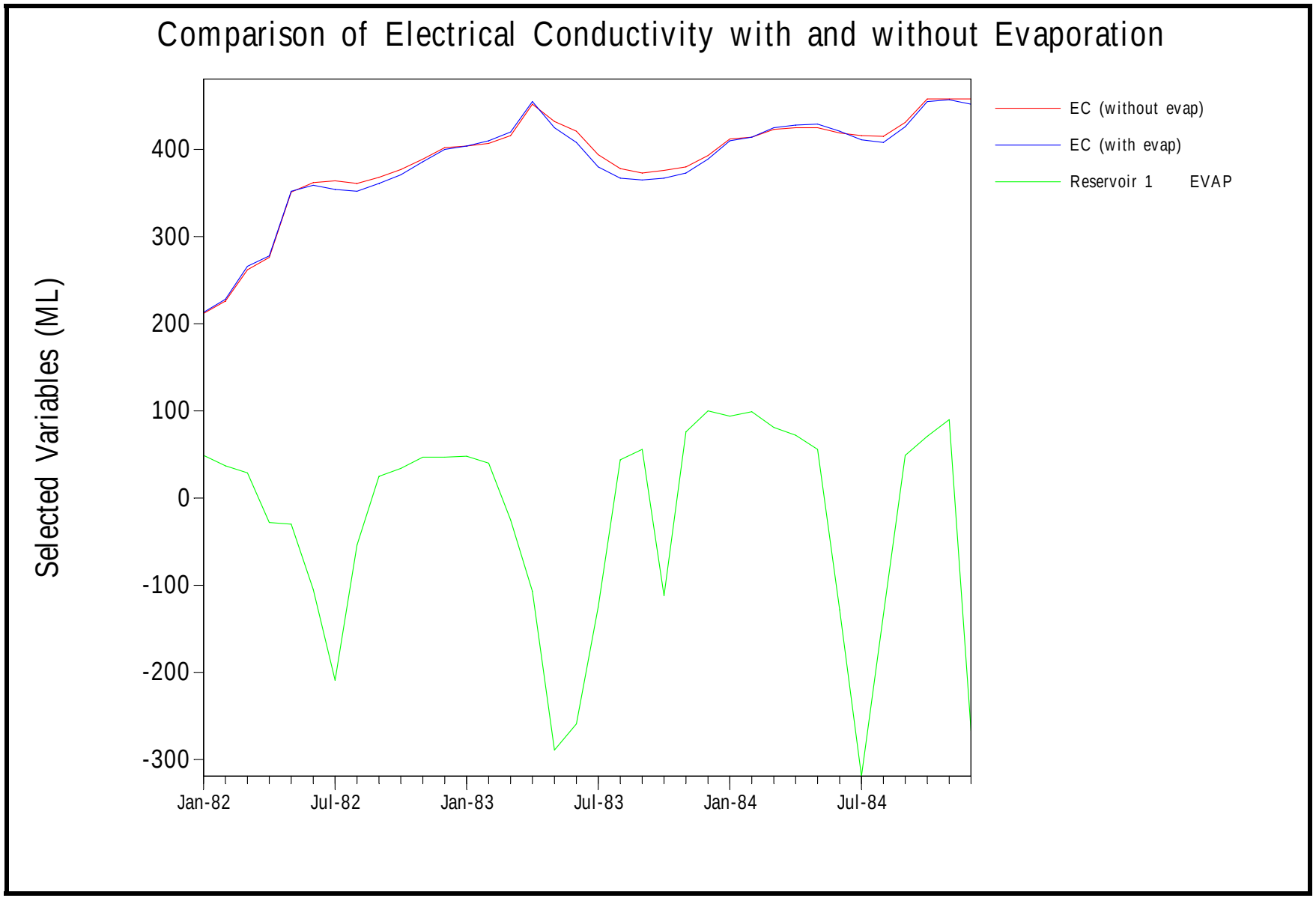

Figure 3.6-3 Worked Example 6(b) Comparison of EC with and without Reservoir Evaporation

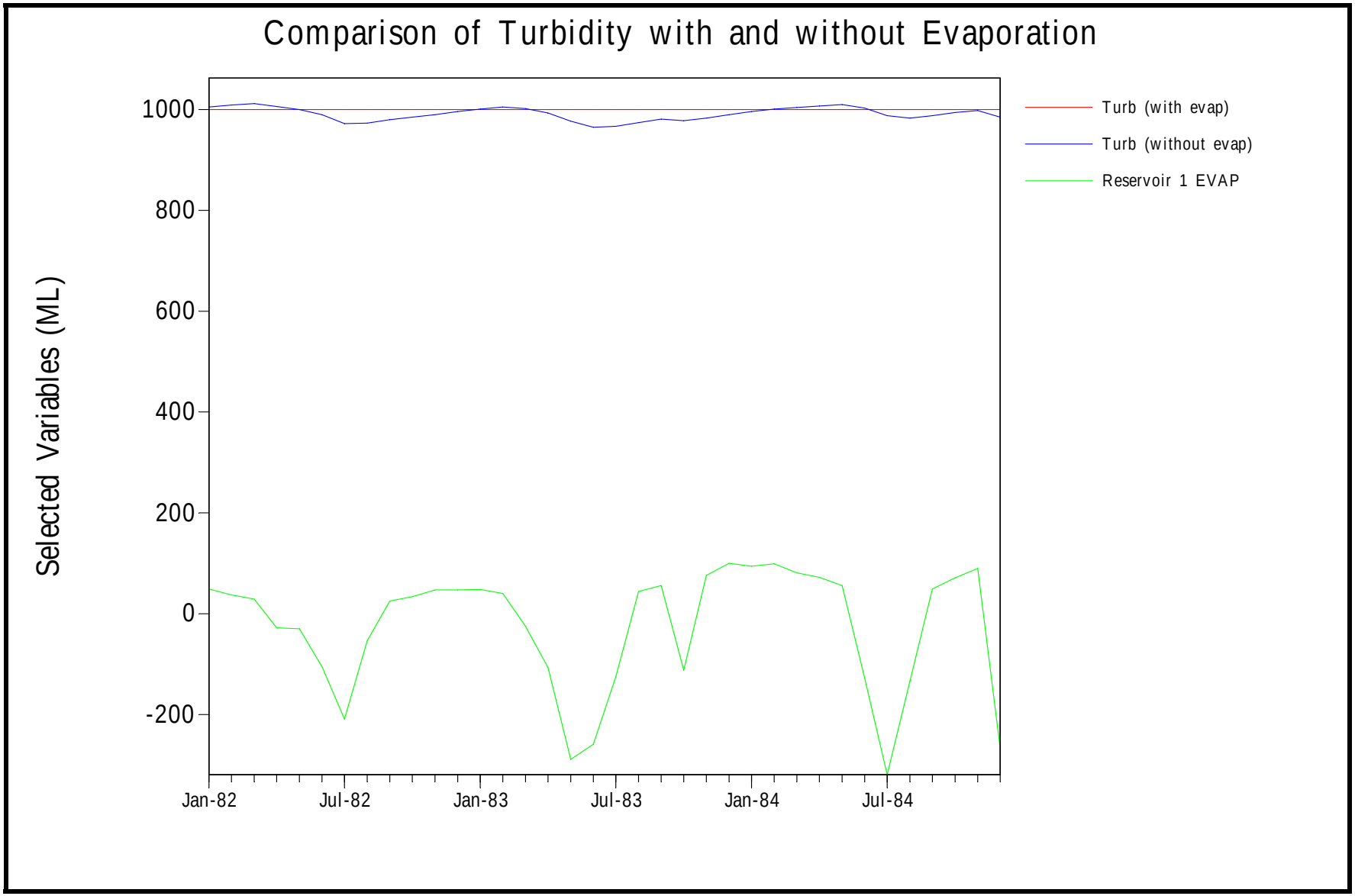

Figure 3.6-4 Worked Example 6(b) Comparison of Turbidity with and without Reservoir Evaporation

3.7 WORKED EXAMPLE 7

MODELLING OF IRRIGATION DEMAND RESTRICTIONS

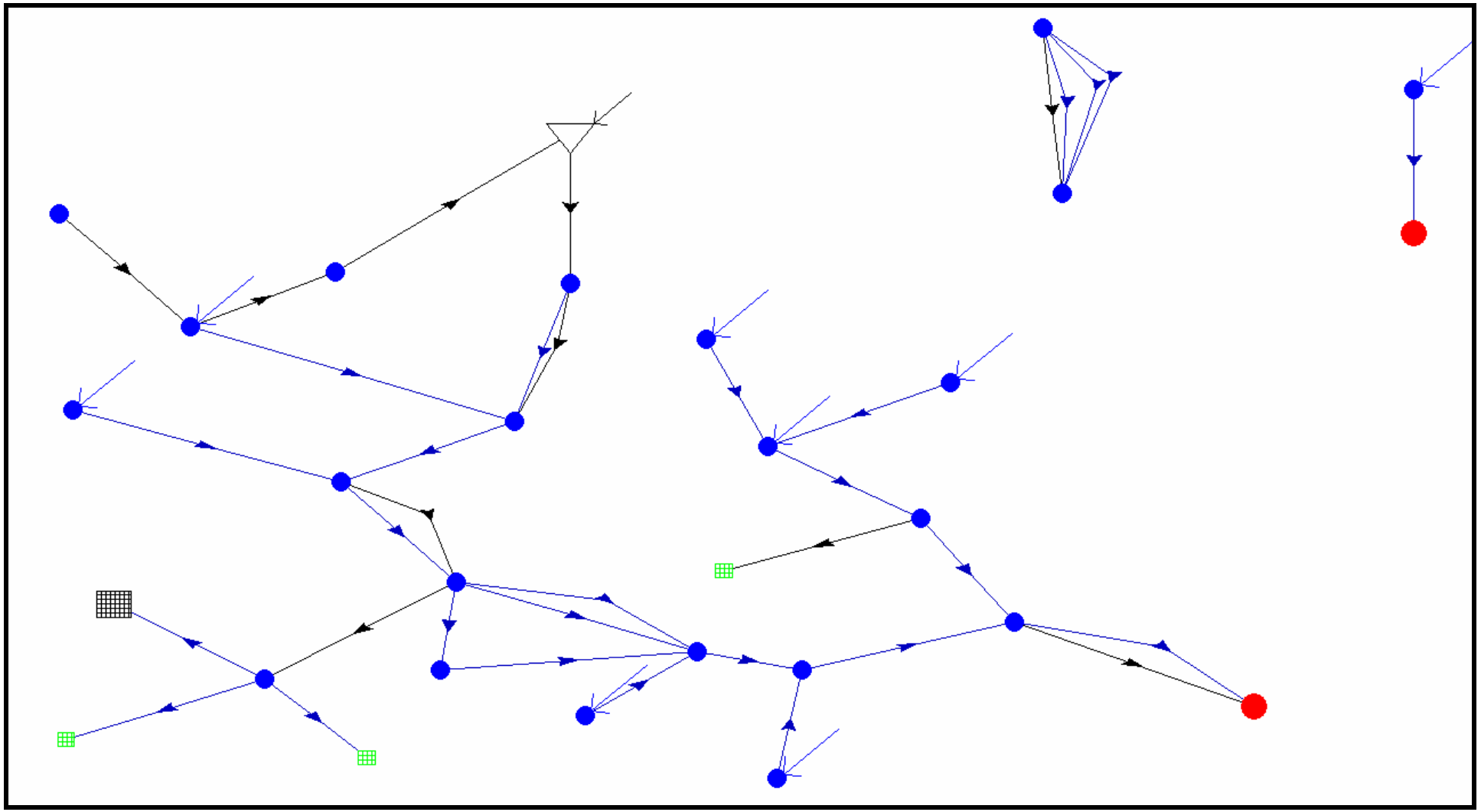

Figure 3.7-1 Worked Example 7 – System Plot

WORKED EXAMPLE 7 - SYSTEM LISTING

R E A L M

****
* SYSTEM FILE LISTING *
****

File: C:\REALM\WorkedExamples\WERRIRRG.sys

Simulation label:
Werribee System: WERR0001.sys; As in WERRK317.SYS but with
system truncated to Werribee R. u/s of Pyrites ck.

Date: 11:17:27 12/18/01

| NODE INFORMATION |

No	Name	Type	X	Y	Z	Size	Aux Input	No
1	PYKES CK RES.	Reservoir	38.93	82.33	0.00	1.00	PYKES CK INFLOWS	1
	Comment: Pykes Creek Reservior							
2	PYKES CK OUTFALL	Strm junction	35.21	47.83	0.00	1.00		2
	Comment: Pykes Creek junction with Werribee River							
3	UPPER WERRIBEE WEIR	Strm junction	13.72	59.22	0.00	1.00	WERRIBEE @ BALLAN	3
	Comment: Upper Werribee Weir.							
4	BM WEIR	Strm junction	31.39	28.58	0.00	1.00		4
	Comment: Bacchus Marsh Weir on the Werribee R.							
5	DIVERSION DECISION	Strm junction	23.30	65.72	0.00	1.00		5
	Comment: Pykes tunnel. Second condition for flow.							
6	BM IRRIGATION	Irr Demand	5.43	9.60	0.00	1.00	B	6
	Comment: BM irrigation supply							
7	CSR FACTORY	Demand	8.63	25.87	0.00	1.00		7
	Comment: CSR factory supply.							
8	BM OFFTAKE	Strm junction	18.62	16.92	0.00	1.00		8
	Comment: Offtake to supply irrigation area demand& other demand supplied from channels.							
9	INFLOW BETWEEN WEIRS	Strm junction	5.86	49.19	0.00	1.00	INFLOW BET.N WEIRS	9
	Comment: Inflow between weirs.							
10	BM OUTSIDE SALES	Irr Demand	25.43	7.44	0.00	1.00	B	10
	Comment: BM outside sales. Excess returns to Werribee River.							
11	INFLOW U/S MELTON	Strm junction	39.90	12.58	0.00	1.00	INFLOW BM TO MELTON	11
	Comment: General inflow upstream Melton Res.							
12	.INFLOW JUNCTION	Strm junction	23.73	40.51	0.00	1.00		12
	Comment: Inflow junction @ Werribee R. upstream Melton Res.							
13	NODE PARWON CK	Strm junction	52.66	5.00	0.00	1.00	PARWON CK	13
	Comment: Parwon Creek.							

14	.PARWON CK OUTFALL	Strm junction	54.37	18.01	0.00	1.00		14
	Comment: Parwon Creek outfall to Werribee River.							
15	.LERDERDERG OUTFALL	Strm junction	68.40	23.70	0.00	1.00		15
	Comment: Lerderderg River to Werribee River.							
16	.INFLOW U/S MELTON	Strm junction	47.34	20.18	0.00	1.00		16
17	NEWLYN RES.	Strm junction	5.00	72.77	0.00	1.00		17
18	.LERD DIV OFFTAKE	Strm junction	62.19	36.12	0.00	1.00		18
19	.GOODMAN CK OUTFALL	Strm junction	52.02	44.85	0.00	1.00	LOWER LERD INFLOWS	19
20	LERDERDERG DIV	Irr Demand	49.15	29.91	0.00	1.00	B	20
	Comment: Lerderderg River diversions.							
21	.EXCESS DEMAND	Strm junction	30.32	18.01	0.00	1.00		21
	Comment: Lower diversions between Werribee Weir and Bay outfall.							
22	SOURCE	Strm junction	70.32	95.00	0.00	1.00		22
23	SINK	Strm junction	71.59	75.21	0.00	1.00		23
24	JUNCTION INFLOW	Strm junction	95.00	87.68	0.00	1.00	INFLOW	24
	Comment: Inflow to counting arcs							
25	OUTFALL SINK	Strm terminator	95.00	70.33	0.00	1.00		25
26	D/S LERD. WEIR	Strm junction	47.96	57.67	0.00	1.00	Lerd317i	26
27	TO MELTON	Strm terminator	84.36	13.67	0.00	1.00		27
28	D/S GOOD WEIR	Strm junction	64.15	52.44	0.00	1.00	Goodman317i	28
	Comment: to accumilate the above this point for irrigation file for vut							
29	BELOW PYKES RES	Strm junction	38.93	64.31	0.00	1.00		29

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
1	PYKES CK RES.	1190	23920	2	10	External

Reservoir evaps: (if A=B=0 evaps not calculated!)

No	Name	NET EVAP =	(A	+	B	*	EVAPORATION)	-	RAINFALL
1	PYKES CK RES.		10.000	0.850			EVAPORATION		RAINFALL(87002)

No	Name		Surface area/volume relationships									
			pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10
1	PYKES CK RES.	Vol	0	995	2503	4618	7354	10834	15209	20409	23920	99999
		Area	2	39	59	80	102	127	159	181	203	203

No	Name		Levels/volume relationships														
			pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
1	PYKES CK RES.	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6	BM IRRIGATION	5	7	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	CSR FACTORY	10	11	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	BM OUTSIDE SALES	5	5	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	LERDERDERG DIV	2	3	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

No	Name		Parameters for demand restriction by limit curves										
6	BM IRRIGATION	% allocation	0	50	100	200	220	220	220	220	0	0	0	0
	Frac (%) = 5;	limit	0	2050	3470	5730	6460	9000	9000	9000	0	0	0	0
No off quota supplies to this demand														
10	BM OUTSIDE SALES	% allocation	0	50	100	200	220	220	220	0	0	0	0	0
	Frac (%) = 5;	limit	0	75	125	200	240	260	260	0	0	0	0	0
No off quota supplies to this demand														
20	LERDERDERG DIV	% allocation	0	50	100	200	220	400	99999	0	0	0	0	0
	Frac (%) = 5;	limit	0	100	140	190	300	350	350	0	0	0	0	0
No off quota supplies to this demand														

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	PYKES DIV1	Pipe	3	5	10	0	0fix	0		0%	1
	Comment: Diversions to Pykes Res from Werribee River.										
2	PYKES DIV2	Pipe	5	1	10	0	0fix	0		0%	2
	Comment: Pykes tunnel diversion 2 from Werribee River.										
3	UPPER WEIR OVERFLOW	River	3	2	100	0	0fix	0		0%	3
	Comment: Spill over upper Werribee Weir.										
4	PYKES CK SPILL	River	29	2	10	0	0fix	0		0%	4
	Comment: Pykes Ck spills below Reservior.										
5	WERRIBEE D/S PYKES	River	2	12	10	0	1%	0		0%	5
	Comment: Werribee River downstream of Pykes Ck junction.										
6	TO BM IRRIGATION	River	8	6	10	0	15%	0		0%	6
	Comment: Supply channel to BM irrigation area										
7	TO CSR FACTORY	River	8	7	10	0	15%	0		0%	7
	Comment: Supply channel to CSR factory										
8	BM-OFFTAKE	Pipe	4	8	10	0	0fix	0		0%	8
	Comment: Irrigation offtake from above BM weir.										
9	WERRIBEE U/S BM WEIR	River	12	4	10	0	1%	0		0%	9
	Comment: Werribee River upstream Bacchus Marsh weir. Min. operational flow 5 ML/d										
10	FROM INFL BTWN WEIRS	River	9	12	10	0	0fix	0		0%	10
	Comment: Inflows between weirs to the werribee river.										
11	TO BM OUTSIDE SALES	River	8	10	10	0	15%	0		0%	11

```
    Comment: Bacchus Marsh outside district sales of irrigation water.
 12 WERRIBEE D/S BM        River          4         16         10          0          0fix                  0     0%       12
    Comment: Werribee downstream of BM weir & u/s of 'Above Melton' inflow.
 13 WERRIBEE U/S PARWON    River         16         14         10          0          0fix                  0     0%       13
    Comment: Werribee River upstream of Parwon Creek
 14 WERRIBEE U/S LERD      River         14         15         10          0          0fix                  0     0%       14
    Comment: Werribee River upstream of Lerderderg   River junction.
 15 FROM INFL U/S MELTON   River         11         16         10          0          0fix                  0     0%       15
    Comment: Inflow upstream Melton
 16 FROM PARWON CK         River         13         14         10          0          0fix                  0     0%       16
    Comment: Parwon Creek
 17 LERD D/S GOOD.         River         19         18         10          0          0fix                  0     0%       17
    Comment: Lerderderg River below Goodman's Creek  junction. Min. 80 ML/d (Aug-Oct)
 18 LOWER LERD             River         18         15         10          0          0fix                  0     0%       18
    Comment: Lerderderg River d/s of Goodman Ck. confto confl. Werr R. Section Environ flows
 19 UPPER DIVERSIONS       Pipe          18         20         10          0          0fix                  0     0%       19
    Comment: Diversions off Lerderderg River.
 20 NEWLYN SUPPLY          Pipe          17          3         10          0          0fix                  0     0%       20
    Comment: Goodman's diversion tunnel
 21 PYKES CK REL           Pipe          29          2         50          1          4%                    0     0%       21
    Comment: Pykes Creek releases.
 22 BM OPER SPILL          River          4         21   -5000000          0          0fix                  0     0%       22
 23 LIMIT OPER SPILL       River         21         16        -10          0          0fix                  0     0%       23
 24 EXCESS RELIEF          River         24         25         10          0          0fix                  0     0%       24
 25 ENV SECTION 1          River         22         23         -1          4          0fix                  0     0%       25
    Comment: SECTION 1 - Recommended Env. min. flows d/s LERDERDERG WEIR
 26 SPILLS+MIN ENV FLOWS   River         26         19          1          0          0fix                  0     0%       26
    Comment: Carrier to tranship spills & min. env.  flows
 27 ENV SECTION 2          River         22         23          1         -1          0fix                  0     0%       27
    Comment: Recommended env. min. flow d/s Lerderderweir - Section 2.
 28 ENV FLOW 2 ML/D        River         22         23          0         -3          0fix                  0     0%       28
    Comment: Env. flow of 2 ML/d
 29 #1 D/S BM WEIR ENV     River          4         16   -5000000         -2          0fix                  0     0%       29
    Comment: Werr R. d/s BM weir & u/s of 'Above Meltinflows; Env. flow = 12 ML/d
 30 NAT FLOW U/S BM        Pipe          22         23          1          0          0fix                  0     0%       30
    Comment: Sum of natural inflows u/s of BM weir
 31 GOODMANS D/S WEIR      River         28         19         10          0          0fix                  0     0%       31
 32 ENV D/S PYKES CK       Pipe          12          4  -50000000          2          0fix                  0     0%       32
    Comment: Minimum env. flow in Werribee R. d/s    Pykes Ck. (forces thro' high -ve penalty
 33 WERRIBEE U/S PYRITES   River         15         27  -50000000         -2          0fix                  0     0%       33
 34 EXCESS FLOW            Pipe          15         27        100          0          0fix                  0     0%       34
    Comment: Discharge excess
 35 RELEASES FROM PYKES    Pipe           1         29          0          0          0fix                  0     0%       35
    Comment: to model the dead storage explicitly

-------------------------------------------------------------------------------------------------------------------------
 Minimum Flows
  No        Name               Jan     Feb     Mar     Apl     May     Jun     Jul     Aug     Sep     Oct     Nov     Dec
-------------------------------------------------------------------------------------------------------------------------
  17 LERD D/S GOOD.              0       0       0       0       0       0       0    2480    2400    2480       0       0
  18 LOWER LERD               1178    1074    1178    1140    1178    1140    1178    3100    3000    3100    1800    1178
  25 ENV SECTION 1             930     848     930     900     930     900    1550    1550    1500    1550    1500     930
  27 ENV SECTION 2            1178    1074    1178    1140    1178    1140    1178    3100    3000    3100    1800    1178
```

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	UPPER WEIR OVERFLOW	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
4	PYKES CK SPILL	0	0	0	0	0	0	0	0	0	0	0	0
5	WERRIBEE D/S PYKES	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
6	TO BM IRRIGATION	3255	3045	3255	3150	3255	3150	3255	3255	3150	3255	3150	3255
7	TO CSR FACTORY	3255	3040	3255	3150	3255	3150	3255	3150	3150	3255	3150	3255
8	BM-OFFTAKE	3255	3045	3255	3150	3255	3150	3255	3255	3150	3255	3150	3255
9	WERRIBEE U/S BM WEIR	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
10	FROM INFL BTWN WEIRS	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
11	TO BM OUTSIDE SALES	3255	3045	3255	3150	3255	3150	3255	3255	3150	3255	3150	3255
12	WERRIBEE D/S BM	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
13	WERRIBEE U/S PARWON	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
14	WERRIBEE U/S LERD	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
15	FROM INFL U/S MELTON	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
16	FROM PARWON CK	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
17	LERD D/S GOOD.	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
18	LOWER LERD	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
19	UPPER DIVERSIONS	200	200	200	200	200	200	200	200	200	200	200	200
20	NEWLYN SUPPLY	820	820	820	820	820	820	820	820	820	820	820	820
21	PYKES CK REL	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
23	LIMIT OPER SPILL	200	200	200	0	0	0	0	500	500	500	500	200
24	EXCESS RELIEF	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
25	ENV SECTION 1	930	848	930	900	930	900	1550	1550	1500	1550	1500	930
26	SPILLS+MIN ENV FLOWS	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
27	ENV SECTION 2	1178	1074	1178	1140	1178	1140	1178	3100	3000	3100	1800	1178
28	ENV FLOW 2 ML/D	62	56	62	60	62	60	62	62	60	62	60	62
31	GOODMANS D/S WEIR	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
32	ENV D/S PYKES CK	155	142	155	150	155	150	155	155	150	155	150	155
34	EXCESS FLOW	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999

Functional Capacities

No	Name		pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12
1	PYKES DIV1	V	0	900	1500	5700	10000	20000	9999999	0	0	0	0	0
	Fn Name:	C	0	900	1400	4700	7500	9600	9600	0	0	0	0	0

Equation used: '1
' 1 = WERRIBEE @ BALLAN Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2

2	PYKES DIV2	V	-999999	-23920	-20000	-15000	-10000	-5000	0	9999999	0	0	0	0
	Fn Name:	C	0	0	3920	8920	13920	18920	23920	23920	0	0	0	0

Equation used: ('2-'1-'3)
' 1 = PYKES CK RES. Type: STOR
' 2 = PYKES CK REL Type: FLOW(# 21)
' 3 = PYKES CK INFLOWS Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2 Feb=2 Mar=2 Apl=2 May=2 Jun=2 Jul=2 Aug=2 Sep=2 Oct=2 Nov=2 Dec=2

22	BM OPER SPILL	V	0	100	1000	10000	0	0	0	0	0	0	0	0
	Fn Name:	C	0	30	230	2000	0	0	0	0	0	0	0	0

Equation used: ('1+'2+'3)
' 1 = BM IRRIGATION Type: SUPP
' 2 = CSR FACTORY Type: SUPP
' 3 = BM OUTSIDE SALES Type: SUPP

```
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

  29 #1 D/S BM WEIR ENV           V        0     100  999999       0       0       0       0       0       0       0       0       0
    Fn Name:                      C        0     100  999999       0       0       0       0       0       0       0       0       0
   Equation used: IF(('3-('1*2.5)),'3,'3,(MIN(('3-'2),(('1*6.0)-'2))))
    ' 1 = ENV FLOW 2 ML/D          Type: CAPC(# 28)
    ' 2 = BM OPER SPILL            Type: FLOW(# 22)
    ' 3 = NAT FLOW U/S BM          Type: CAPC(# 30)
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

  30 NAT FLOW U/S BM              V  -999999       0  999999       0       0       0       0       0       0       0       0       0
    Fn Name:                      C  -999999       0  999999       0       0       0       0       0       0       0       0       0
   Equation used: ('1+'2+'3)
    ' 1 = WERRIBEE @ BALLAN        Type: STRM
    ' 2 = PYKES CK INFLOWS         Type: STRM
    ' 3 = INFLOW BET.N WEIRS       Type: STRM
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

  33 WERRIBEE U/S PYRITES         V        0********       0       0       0       0       0       0       0       0       0       0
    Fn Name:                      C        0********       0       0       0       0       0       0       0       0       0       0
   Equation used: '1
    ' 1 = DISCHARGE               Type: STRM
 Capacity set option (0-off 1-prev 2-recalc) Jan=0   Feb=0   Mar=0   Apl=0   May=0   Jun=0   Jul=0   Aug=0   Sep=0   Oct=0   Nov=0   Dec=0

  35 RELEASES FROM PYKES          V  -999999       0  999999       0       0       0       0       0       0       0       0       0
    Fn Name:                      C  -999999       0  999999       0       0       0       0       0       0       0       0       0
   Equation used: '1-'2
    ' 1 = PYKES CK RES.            Type: ESTO
    ' 2 = 1190                     Type: NUMB
          Previous flow solution is added to new capacity
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2



--------------------------------
|  TARGET INFORMATION          |
--------------------------------

 Number of target sets:  1

-------------------------------------------------------------------------------------------------------------------------------
 Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)
 Name                Draw Pri                                    Targets
-------------------------------------------------------------------------------------------------------------------------------
PYKES CK RES.          1       1190      3716      6241      8767     11292     13818     16343     18869     21394     23920

 totals                        1190      3716      6241      8767     11292     13818     16343     18869     21394     23920
```

```
------------------------------
|  RESTRICTION INFORMATION    |
------------------------------

 Number of restriction groups:  1

 NB. Each restriction group is treated separately
     with its own rule curve definitions;
     for irrigation demand groups by its allocations functions.

-----------------------------------------------------------------------
Restriction Group:  1     Type: Irrigation demand centers
-----------------------------------------------------------------------

      Reservoirs/               Demands
    Carriers in Group           in Group
      ----------               --------
     PYKES CK RES.            BM IRRIGATION
                              BM OUTSIDE SALES

 Allocation period from  8 to  4
 Only +ve midseasonal changes in allocation allowed
 The unrestricted allocation reference is       220
The average efficiency of deliveries from Headworks to the farm gate is assumed to be  72% for seasonal allocation purposes.


  1 year planning period of   1 planning periods to be considered.
 The group reserve (addtional to common reserve) is          0
 The trigger for special accounting is          0
 The trigger for group reserve reduction is          0

  Factor                                FIXED FACTORS
     No       Jan      Feb      Mar      Apl      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
     1          0       41        0       21        0        0        0      105      420      400      125       21
     2          0        0        0        0        0        0        0        0        0        0        0        0
     3          0        0        0        0        0        0        0        0        0        0        0        0
     4          0        0        0        0        0        0        0        0        0        0        0        0

 Allocation function: pt1      pt2      pt3      pt4      pt5      pt6      pt7      pt8      pt9      pt10     pt11     pt12
                       938     8047     8905     9576     9798    10671    11310    12181    12763    15740    16816 99999999
                         0      100      110      120      130      150      160      180      200      220      220      220



------------------------------
|  MULTI SYSTEM INFORMATION   |
------------------------------

-------------------------------------------------------------------------------------------------------------------------
 Reservoirs
-------------------------------------------------------------------------------------------------------------------------
 PYKES CK RES.     1
```

WORKED EXAMPLE 7 - LOG FILE

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : IRRG.log

 Scenario file: scn7.scn

 Simulation label:
     Tutorial 7 - Irrigation Demand Modelling




 Streamflow file(s):
     C:\REALM\WorkedExamples\WERRFLOW.SF
 Demand file(s):
     C:\REALM\WorkedExamples\WERRIRR.DEM

 Restrictions are ON

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 11:26:49 12/18/01
```

```
Time Step = Monthly

SYSTEM CHANGES:
No    Seas  Year   System File
---------------------------------
  1     7  1920     C:\REALM\WorkedExamples\WERRIRRG.sys
---------------------------------

Total number of seasons:-  840









******** RUN TIME MESSAGES:- ********


 ****INPUT DATA TYPE=  1 ****

1920
 C:\REALM\WorkedExamples\WERRIRRG.sys
1921
1922
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1990
******** END RUN TIME MESSAGES ********
```

SUMMARY INFORMATION

Reservoir data:

	Name	Start Storage	File Inflow	Min Storage	Average Storage	Evapn	Release to river	Spill	End Storage
1	PYKES CK RES.	20000.	1263.	3206.	20549.	103.	0.	0.	23920.
		20000.	1263.	0.	20549.	103.	0.	0.	23920.

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	BM IRRIGATION	426.	424.	424.	0.	424.
2	CSR FACTORY	44.	44.	44.	0.	44.
3	BM OUTSIDE SALES	17.	16.	16.	0.	16.
4	LERDERDERG DIV	21.	21.	21.	1.	20.
		508.	505.	505.	1.	504.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	BM IRRIGATION	630.0	217.9	80.0	0.0	0.0	0.0	0.0	0.0	0.0
2	CSR FACTORY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	BM OUTSIDE SALES	630.0	217.9	80.0	0.0	0.0	0.0	0.0	0.0	0.0
4	LERDERDERG DIV	0.0	0.0	1000.0	0.0	0.0	0.0	39.0	35.5	90.0

Stream Junc:

	Name	file inflow
1	PYKES CK OUTFALL	0.
2	UPPER WERRIBEE WEIR	1701.
3	BM WEIR	0.
4	DIVERSION DECISION	0.
5	BM OFFTAKE	0.
6	INFLOW BETWEEN WEIRS	408.
7	INFLOW U/S MELTON	1320.
8	.INFLOW JUNCTION	0.
9	NODE PARWON CK	753.
10	.PARWON CK OUTFALL	0.
11	.LERDERDERG OUTFALL	0.

12	.INFLOW U/S MELTON	0.
13	NEWLYN RES.	0.
14	.LERD DIV OFFTAKE	0.
15	.GOODMAN CK OUTFALL	152.
16	.EXCESS DEMAND	0.
17	SOURCE	0.
18	SINK	0.
19	JUNCTION INFLOW	100000.
20	D/S LERD. WEIR	2353.
21	D/S GOOD WEIR	134.
22	BELOW PYKES RES	0.
		106821.

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	PYKES DIV1	324.8	1399.9	0.0	6003.0	0.0
2	PYKES DIV2	324.8	3691.3	0.0	6003.0	0.0
3	UPPER WEIR OVERFLOW	1376.0	99999999.0	0.0	21434.0	0.0
4	PYKES CK SPILL	0.0	0.0	0.0	0.0	0.0
5	WERRIBEE D/S PYKES	2797.8	99999999.0	0.0	40269.0	27.5
6	TO BM IRRIGATION	497.7	3202.5	0.0	1737.0	74.0
7	TO CSR FACTORY	51.5	3193.3	29.0	62.0	7.2
8	BM-OFFTAKE	568.0	3202.5	49.0	1824.0	0.0
9	WERRIBEE U/S BM WEIR	3026.1	99999999.0	0.0	46269.0	29.8
10	FROM INFL BTWN WEIRS	408.0	99999999.0	0.0	6986.0	0.0
11	TO BM OUTSIDE SALES	18.8	3202.5	0.0	75.0	2.3
12	WERRIBEE D/S BM	2273.9	99999999.0	0.0	45548.0	0.0
13	WERRIBEE U/S PARWON	3900.9	99999999.0	0.0	67124.0	0.0
14	WERRIBEE U/S LERD	4653.8	99999999.0	0.0	78102.0	0.0
15	FROM INFL U/S MELTON	1320.3	99999999.0	0.0	22535.0	0.0
16	FROM PARWON CK	752.9	99999999.0	0.0	10978.0	0.0
17	LERD D/S GOOD.	2639.0	99999999.0	5.0	42256.0	0.0
18	LOWER LERD	2619.2	99999999.0	0.0	42254.0	0.0
19	UPPER DIVERSIONS	19.8	200.0	2.0	57.0	0.0
20	NEWLYN SUPPLY	0.0	820.0	0.0	0.0	0.0
21	PYKES CK REL	1480.4	99999999.0	0.0	19619.0	58.6
22	BM OPER SPILL	93.2	113.6	0.0	297.0	0.0
23	LIMIT OPER SPILL	93.2	233.3	0.0	297.0	0.0
24	EXCESS RELIEF	100000.0	99999999.0	100000.0	100000.0	0.0
25	ENV SECTION 1	0.0	1168.2	0.0	0.0	0.0
26	SPILLS+MIN ENV FLOWS	2353.2	99999999.0	0.0	37055.0	0.0
27	ENV SECTION 2	0.0	1687.0	0.0	0.0	0.0
28	ENV FLOW 2 ML/D	0.0	60.8	0.0	0.0	0.0
29	#1 D/S BM WEIR ENV	213.5	213.5	0.0	372.0	0.0
30	NAT FLOW U/S BM	0.0	3371.6	0.0	0.0	0.0
31	GOODMANS D/S WEIR	134.1	99999999.0	0.0	4070.0	0.0
32	ENV D/S PYKES CK	152.3	152.3	142.0	155.0	0.0

33	WERRIBEE U/S PYRITES	0.0	0.0	0.0	0.0	0.0
34	EXCESS FLOW	7273.0	99999999.0	3.0	120356.0	0.0
35	RELEASES FROM PYKES	1480.4	20839.4	0.0	19619.0	0.0

199.

End run

3.8 WORKED EXAMPLE 8

MODELLING OF A CAPACITY SHARED SYSTEM

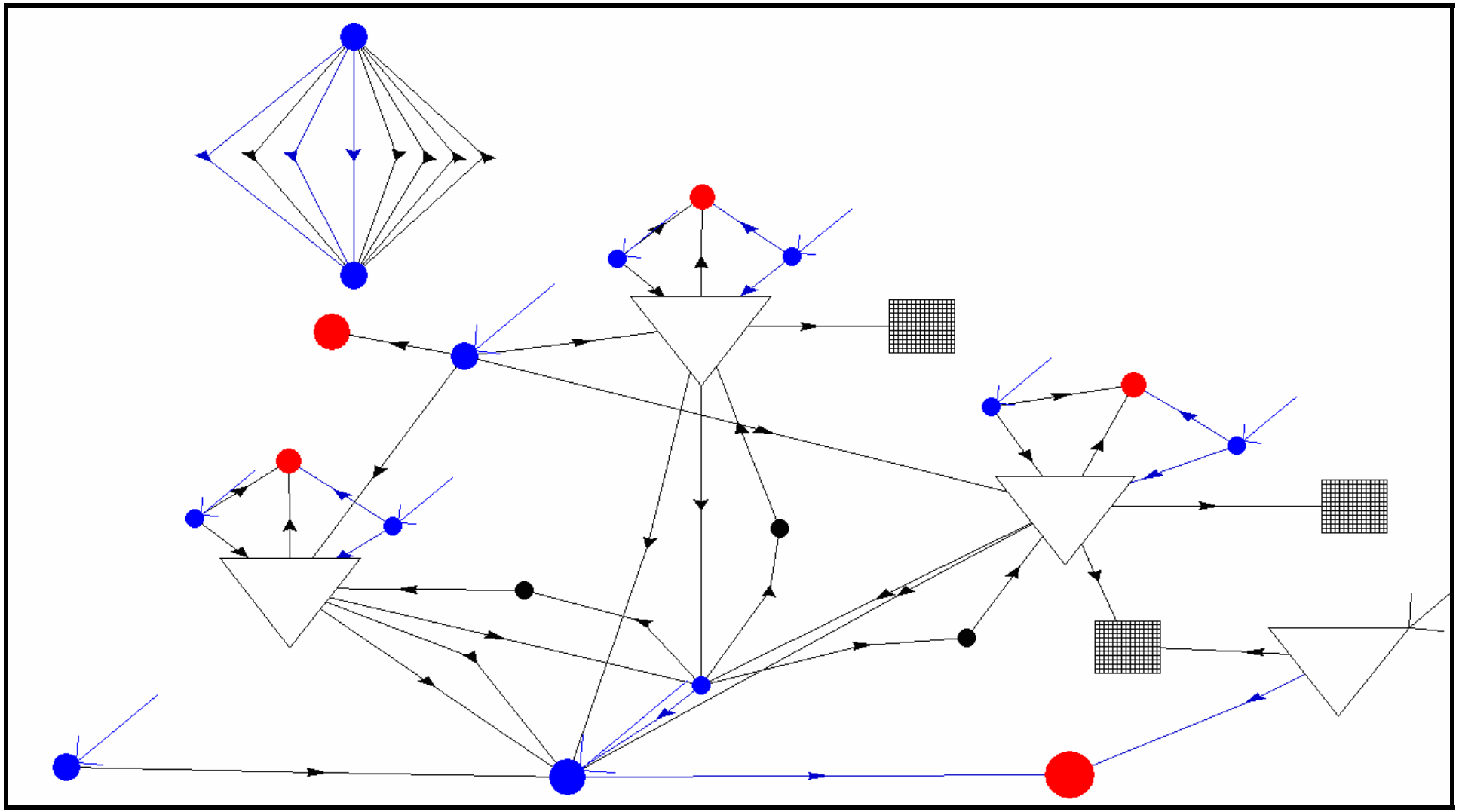

Figure 3.8-1 Worked Example 8(a) – System Plot

WORKED EXAMPLE 8(a) - SYSTEM LISTING (EXPLICIT CAPACITY SHARING)

R E A L M

****
* SYSTEM FILE LISTING *
****

File: C:\REALM\WorkedExamples\WERREXPL.SYS

Simulation label:
Werribee System: Merrimu 3 cap shares WERREXPL.sys; As in
run 0320 with a third capacity share for surplus resource
but without Pyrites Ck Res and Melton Res.; explicit share

Date: 05:04 21/03/2005

| NODE INFORMATION |

No	Name	Type	X	Y	Z	Size	Aux Input	No
1	.PYRITES CK OUTFALL	Strm junction	39.31	5.00	0.00	2.00	W_usPyrites	1
	Comment: Pyrities Creek outfall to Werribee R.							
2	MERR_IRR	Reservoir	20.32	27.93	0.00	3.00		2
	Comment: Merrimu Reservior.							
3	BM URBAN	Demand	93.27	37.92	0.00	2.00		3
	Comment: Bacchus Marsh urban supply from Merrimu Res.							
4	DJERRIWARRH RES	Reservoir	92.20	19.56	0.00	3.00	DJERRIWARRH INFLOWS	4
	Comment: Djerriwarrh Reservior.							
5	MELTON URBAN	Demand	77.74	20.78	0.00	2.00		5
	Comment: Melton urban supply from Merrimu Res.							
6	MERR_URB	Reservoir	73.44	37.92	0.00	3.00		6
	Comment: MERRIMU URBAN STORAGE							
7	IRR INFLOW SHARE	Strm junction	27.31	35.50	0.00	1.00	INFLOW	7
8	NODE 52	Strm junction	48.47	16.11	0.00	1.00		8
9	MERR RAIN#1	Strm junction	13.77	36.41	0.00	1.00	INFLOW	9
10	NODE 54	Strm terminator	20.20	43.41	0.00	1.00		10
11	NODE 55	Strm terminator	78.15	52.72	0.00	1.00		11
12	DUMMYAREA1	Strm junction	24.67	95.00	0.00	1.50		12
13	DUMMYAREA2	Strm junction	24.67	65.94	0.00	1.50		13
14	MERR RAIN#2	Strm junction	68.33	49.99	0.00	1.00	INFLOW	14
15	NOTIONAL DEMAND	Demand	63.60	59.73	0.00	2.00		15
16	MERR_UNK	Reservoir	48.47	59.73	0.00	3.00		16
	Comment: Share of Merrimu - unallocated after urban & irrigation committments							
17	URB INFLOW SHARE	Strm junction	85.22	45.32	0.00	1.00	INFLOW	17
18	UNK INFLOW SHARE	Strm junction	54.69	68.22	0.00	1.00	INFLOW	18
19	MERR RAIN#3	Strm junction	42.72	67.92	0.00	1.00	INFLOW	19

20	NODE 71	Strm terminator	48.56	75.49	0.00	1.00		20
21	NODE IRR BLOW SHR	Pipe junction	36.33	27.63	0.00	1.00		21
22	NODE URB BLO SHR	Pipe junction	66.65	21.86	0.00	1.00		22
23	NODE UNK BLOW SHR	Pipe junction	53.85	35.19	0.00	1.00		23
24	TO MELTON RESV	Strm terminator	73.76	5.32	0.00	2.00		24
25	GOODMAN TUNNEL INFLO	Strm junction	32.27	56.12	0.00	1.50	GOOD TUNNEL	25
26	LOWER LERD INFLOW	Strm junction	5.00	6.15	0.00	1.50	LOWER LERD	26
27	GOODMAN END	Strm terminator	23.14	59.11	0.00	1.50		27

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
2	MERR_IRR	0	35000	1	10	External
4	DJERRIWARRH RES	0	980	1	5	Downstream
6	MERR_URB	0	35000	1	10	External
16	MERR_UNK	0	35000	1	10	External

Reservoir evaps: (if A=B=0 evaps not calculated!)

No	Name	NET EVAP =	(A	+	B	*	EVAPORATION)	-	RAINFALL
4	DJERRIWARRH RES		15.000		0.800		EVAPORATION		RAINFALL(87002)

No	Name		Surface area/volume relationships pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10
4	DJERRIWARRH RES	Vol	0	200	400	600	800	950	1100	9999	0	0
		Area	0	3	5	7	9	10	11	11	0	0

No	Name		Levels/volume relationships pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
2	MERR_IRR	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	DJERRIWARRH RES	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	MERR_URB	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	MERR_UNK	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Demand data:

No	Name	No Bypass	S/F Priority		Monthly Factors Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	BM URBAN	10	10	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	MELTON URBAN	10	9	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	NOTIONAL DEMAND	10	8	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	WERRIBEE U/S MELTON	River	1	24	10	0	0fix		0	0%	1
	Comment: Werribee River upstream of Melton Res.										
2	MERRIMU SPILLS	River	8	1	-5000000	-2	0fix		0	0%	2
	Comment: Merrimu Res. spills into Pyrites Creek.										
3	DJERRIWARRH CK	River	4	24	1000	2	0fix		0	0%	3
	Comment: Djerriwarrh Creek below Reservior.										
4	MERRIMU TO MELT URB	Pipe	6	5	100	0	0fix		0	0%	4
	Comment: Melton urban supply from Merrimu Res.										
5	MERRIMU TO BM URBAN	Pipe	6	3	100	0	0fix		0	0%	5
	Comment: Bacchus Marsh urban supply from Merrimu Reservior.										
6	DJERR TO MELTON URB	Pipe	4	5	200	0	0fix		0	0%	6
	Comment: Melton urban supply from Djerriwarrh Reservior. Transfer capacity = 19 ML/d										
7	MERR_IRR ABOVE SHARE	Pipe	2	8	-5000000	0	0fix		0	0%	7
	Comment: Prevents MERR_IRR going ABOVE its capacity share										
8	MERR_IRR BELOW SHARE	Pipe	21	2	10	0	0fix		0	0%	8
	Comment: Allows int. spill from MERR_URB to MERR_IRR										
9	MERR_URB ABOVE SHARE	Pipe	6	8	-5000000	0	0fix		0	0%	9
	Comment: Prevents MERR_URB going .g.t. its capacity share										
10	MERR_URB BELOW SHARE	Pipe	22	6	10	0	0fix		0	0%	10
	Comment: Allows int. spills from MERR_IRR to MERR_URB										
11	MERRIMU AREA	Pipe	12	13	0	5	0fix		0	0%	11
	Comment: Accounting arc to calculate area of main merrimu reservoir										
12	MERR_IRR RAIN	Pipe	9	2	0	0	0fix		0	0%	12
	Comment: Adds share of Merrimu rain to MERR_IRR										
13	MIRR XS RAINFALL	Pipe	9	10	1000	0	0fix		0	0%	13
14	MERR_URB RAIN	Pipe	14	6	0	0	0fix		0	0%	14
	Comment: Adds share of Merrimu rain to MERR_URB										
15	EVAP MERR_URB	Pipe	6	11	-53000000	0	0fix		0	0%	15
	Comment: Takes share of evap out of MERR_URB										
16	MURB XS RAINFALL	Pipe	14	11	1000	0	0fix		0	0%	16
17	MERR_URB INFLOWS	River	17	6	0	0	0fix		0	0%	17
	Comment: Merr Urb share of inflows										
18	MERR_IRR INFLOWS	River	7	2	0	0	0fix		0	0%	18
19	EVAP MER_IRR	Pipe	2	10	-53000000	0	0fix		0	0%	19
	Comment: Takes out the irrigation share of evaporation from merrimu reservoir										
20	MERR_IRR ENVIRON REL	Pipe	2	1	-53000000	-3	0fix		0	0%	20
	Comment: Merrimu irrigation share of env. flow										
21	MERR_IRR RELEASES	Pipe	2	1	100000	0	3%		0	0%	21
22	MERR_URB ENVIRON REL	Pipe	6	1	-53000000	6	3%		0	0%	22
	Comment: Merrimu urban share of environ. flow										
23	MERR_UNK TO NOTIONAL	Pipe	16	15	0	0	0fix		0	0%	23
24	ENV SECTION 1	River	12	13	-1	-9	0fix		0	0%	24
	Comment: SECTION 1 - Recommended Env. min. flows d/s LERDERDERG WEIR										
25	ENV SECTION 2	River	12	13	1	0	0fix		0	0%	25
	Comment: Recommended env. min. flow d/s Lerderderweir - Section 2.										
26	DJERR ENV REL	River	4	24	-5000000	-2	0fix		0	0%	26
	Comment: Min. env. flow of 1.5 ML/d or natural inflow in Djerriwarrh (lesser of)										

27	ENV FLOW 2 ML/D	River	12	13	0	3	0fix	0	0%	27
	Comment: Env. flow of 2 ML/d									
28	MERR_UNK INFLOWS	River	18	16	0	0	0fix	0	0%	28
29	MERR_UNK RAIN	Pipe	19	16	0	0	0fix	0	0%	29
	Comment: Share of Merrimu rainfall to unallocatedwater store									
30	MUNK XS RAINFALL	Pipe	19	20	1000	0	0fix	0	0%	30
31	EVAP MERR_UNK	Pipe	16	20	-53000000	0	0fix	0	0%	31
	Comment: Take share of evap out of MERR_UNK									
32	MIRR XS INFLOW	River	7	10	1000	0	0fix	0	0%	32
	Comment: Surplus Merrimu irr inflow									
33	MURB XS INFLOW	River	17	11	1000	0	0fix	0	0%	33
	Comment: Excess Merrimu urb inflow									
34	MUNK XS INFLOW	River	18	20	1000	0	0fix	0	0%	34
	Comment: Excess Merrimu unk inflow									
35	MERR_UNK ABOVE SHARE	Pipe	16	8	-5000000	0	0fix	0	0%	35
	Comment: Prevents MERR_UNK going above share									
36	MERR_UNK BELOW SHARE	Pipe	23	16	10	0	0fix	0	0%	36
	Comment: Allows internal spills from MERR_IRR and/or MERR_URB									
37	IRR_URB SHARE	Pipe	8	22	10	2	0fix	-1	75%	37
	Comment: Share of above share internal spill fromMERR_IRR to MERR_URB									
38	UNK_URB SHARE	Pipe	8	22	10	-2	0fix	-2	75%	38
	Comment: Share of internal spill from MERR_UNK toMERR_URB									
39	IRR_UNK SHARE	Pipe	8	23	10	-2	0fix	1	25%	39
	Comment: Share of internal spill from MERR_IRR toMERR_UNK									
40	URB_UNK SHARE	Pipe	8	23	10	2	0fix	-3	50%	40
	Comment: Share of internal spill from MERR_URB toMERR_UNK									
41	URB_IRR SHARE	Pipe	8	21	10	2	0fix	3	50%	41
	Comment: Share of internal spill from MERR_URB toMERR_IRR									
42	UNK_IRR SHARE	Pipe	8	21	10	-2	0fix	2	25%	42
	Comment: Share of internal spill from MERR_UNK toMERR_IRR									
43	MERR_UNK ENVIRON REL	Pipe	16	1	-53000000	1	0fix	0	0%	43
	Comment: Share of flow from MERR_UNK to meet env flows in Pyrites ; 2 ML/d									
44	EXCESS OF MERR_IRR	Pipe	2	1	-50000000	3	0fix	0	0%	44
	Comment: TO FORCE OUT FLOW SENT TO MELTON URBAN DEMAND TO USE IN AN IMPLICIT DEMAND									
45	MERR IRR TUNL SHARE	Pipe	25	2	0	0	3%	0	0%	45
46	MERR URB TUNL SHARE	Pipe	25	6	0	0	0fix	0	0%	46
47	MERR UNK TUNL SHARE	Pipe	25	16	0	0	0fix	0	0%	47
48	LOWER LERD FLOW ARC	Pipe	26	1	0	0	0fix	0	0%	48
49	EXCESS FLOW ARC	Pipe	25	27	1000	0	0fix	0	0%	49
50	TOT INFLOW	Pipe	13	12	0	9	0fix	0	0%	50
51	TOT EVAP	Pipe	13	12	0	-5	0fix	0	0%	51
52	TOT RAIN	Pipe	12	13	0	-3	0fix	0	0%	52
53	TOT RELEASES	Pipe	13	12	0	7	0fix	0	0%	53

Maximum Flows

No	Name	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	WERRIBEE U/S MELTON	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999	99999999
3	DJERRIWARRH CK	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999
4	MERRIMU TO MELT URB	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
5	MERRIMU TO BM URBAN	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300
6	DJERR TO MELTON URB	590	540	590	570	590	570	590	590	570	590	570	590
13	MIRR XS RAINFALL	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999
16	MURB XS RAINFALL	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999
21	MERR_IRR RELEASES	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999
23	MERR_UNK TO NOTIONAL	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999	9999999

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 24 ENV SECTION 1              930      848      930      900      930      900     1550     1550     1500     1550     1500      930
 25 ENV SECTION 2             1178     1074     1178     1140     1178     1140     1178     3100     3000     3100     1800     1178
 27 ENV FLOW 2 ML/D             62       56       62       60       62       60       62       62       60       62       60       62
 30 MUNK XS RAINFALL       9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
 32 MIRR XS INFLOW         9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
 33 MURB XS INFLOW         9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
 34 MUNK XS INFLOW         9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
 39 IRR_UNK SHARE                0        0        0        0        0        0        0        0        0        0        0        0
 41 URB_IRR SHARE                0        0        0        0        0        0        0        0        0        0        0        0
 42 UNK_IRR SHARE                0        0        0        0        0        0        0        0        0        0        0        0
 48 LOWER LERD FLOW ARC   99999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999
 49 EXCESS FLOW ARC        99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999

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 Functional Capacities
  No        Name                        pt1     pt2     pt3     pt4     pt5     pt6     pt7     pt8     pt9     pt10    pt11    pt12
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   2 MERRIMU SPILLS               V  -999999       0  999999       0       0       0       0       0       0       0       0       0
    Fn Name:                      C  -999999       0  999999       0       0       0       0       0       0       0       0       0
   Equation used: '1+'2+'3-35000
   ' 1 = MERR_IRR                  Type: ESTO
   ' 2 = MERR_URB                  Type: ESTO
   ' 3 = MERR_UNK                  Type: ESTO
          Previous flow solution is added to new capacity
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

   7 MERR_IRR ABOVE SHARE         V   -99999       0   99999       0       0       0       0       0       0       0       0       0
    Fn Name:                      C   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Equation used: '1-'2-7500
   ' 1 = MERR_IRR                  Type: ESTO
   ' 2 = MERR_IRR BELOW SHARE      Type: FLOW(#  8)
          Previous flow solution is added to new capacity
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

   8 MERR_IRR BELOW SHARE         V   -99999       0  999990       0       0       0       0       0       0       0       0       0
    Fn Name:                      C   -99999       0  999990       0       0       0       0       0       0       0       0       0
   Equation used: 7500-'1
   ' 1 = MERR_IRR                  Type: ESTO
          Previous flow solution is added to new capacity
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

   9 MERR_URB ABOVE SHARE         V   -99999       0   99999       0       0       0       0       0       0       0       0       0
    Fn Name:                      C   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Equation used: '1-'2-21000
   ' 1 = MERR_URB                  Type: ESTO
   ' 2 = MERR_URB BELOW SHARE      Type: FLOW(# 10)
          Previous flow solution is added to new capacity
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

  10 MERR_URB BELOW SHARE         V   -99999       0   99999       0       0       0       0       0       0       0       0       0
    Fn Name:                      C   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Equation used: 21000-'1
   ' 1 = MERR_URB                  Type: ESTO
          Previous flow solution is added to new capacity
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

  11 MERRIMU AREA                 V       0    1326    4150   10115   19100   21100   37830   99999       0       0       0       0
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   Fn Name:                     C        0      30      64     140     211     226     326     326       0       0       0       0
  Equation used: ('1+'2+'3)
  ' 1 = MERR_IRR                Type: STOR
  ' 2 = MERR_URB                Type: STOR
  ' 3 = MERR_UNK                Type: STOR
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 12 MERR_IRR RAIN               V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*'2*0.01*0.30
  ' 1 = MERRIMU AREA            Type: CAPC(# 11)
  ' 2 = RAINFALL(87002)         Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 14 MERR_URB RAIN               V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*'2*0.01*0.60
  ' 1 = MERRIMU AREA            Type: CAPC(# 11)
  ' 2 = RAINFALL(87002)         Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 15 EVAP MERR_URB               V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*(('2*0.85)+5)*0.01*0.60
  ' 1 = MERRIMU AREA            Type: CAPC(# 11)
  ' 2 = EVAPORATION             Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 17 MERR_URB INFLOWS            V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: ('1*0.60)
  ' 1 = MERRIMU RES INFLOWS     Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 18 MERR_IRR INFLOWS            V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: ('1*0.30)
  ' 1 = MERRIMU RES INFLOWS     Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 19 EVAP MER_IRR                V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*(('2*0.85)+5)*0.01*0.30
  ' 1 = MERRIMU AREA            Type: CAPC(# 11)
  ' 2 = EVAPORATION             Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 20 MERR_IRR ENVIRON REL        V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: ((MIN('1,'2))*0.3)
  ' 1 = ENV FLOW 2 ML/D         Type: CAPC(# 27)
  ' 2 = MERRIMU RES INFLOWS     Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=0   Sep=0   Oct=0   Nov=0   Dec=2

 22 MERR_URB ENVIRON REL        V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: ((MIN('1,'2))*0.6)
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  ' 1 = ENV FLOW 2 ML/D           Type: CAPC(# 27)
  ' 2 = MERRIMU RES INFLOWS       Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=0   Sep=0   Oct=0   Nov=0   Dec=2

 26 DJERR ENV REL               V        0     100 9999999       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0     100 9999999       0       0       0       0       0       0       0       0       0
  Equation used: MIN('1*0.75,'2)
  ' 1 = ENV FLOW 2 ML/D           Type: CAPC(# 27)
  ' 2 = DJERRIWARRH INFLOWS       Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 28 MERR_UNK INFLOWS            V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: ('1*0.1)
  ' 1 = MERRIMU RES INFLOWS       Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 29 MERR_UNK RAIN               V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*'2*0.01*0.1
  ' 1 = MERRIMU AREA              Type: CAPC(# 11)
  ' 2 = RAINFALL(87002)           Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 31 EVAP MERR_UNK               V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*(('2*0.85)+5)*0.01*0.1
  ' 1 = MERRIMU AREA              Type: CAPC(# 11)
  ' 2 = EVAPORATION               Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 35 MERR_UNK ABOVE SHARE        V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                     C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: '1-'2-6500
  ' 1 = MERR_UNK                  Type: ESTO
  ' 2 = MERR_UNK BELOW SHARE      Type: FLOW(# 36)
         Previous flow solution is added to new capacity
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 36 MERR_UNK BELOW SHARE        V   -99999       0  999999       0       0       0       0       0       0       0       0       0
   Fn Name:                     C   -99999       0  999999       0       0       0       0       0       0       0       0       0
  Equation used: 6500-'1
  ' 1 = MERR_UNK                  Type: ESTO
         Previous flow solution is added to new capacity
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 37 IRR_URB SHARE               V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                     C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: '1*1.0
  ' 1 = MERR_IRR ABOVE SHARE      Type: CAPC(#  7)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 38 UNK_URB SHARE               V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                     C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: '1*1.0
  ' 1 = MERR_UNK ABOVE SHARE      Type: CAPC(# 35)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2
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 40 URB_UNK SHARE                V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                      C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: '1*1.0
  ' 1 = MERR_URB ABOVE SHARE      Type: CAPC(#  9)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 43 MERR_UNK ENVIRON REL         V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: (MIN('1,'2))*0.1
  ' 1 = ENV FLOW 2 ML/D           Type: CAPC(# 27)
  ' 2 = MERRIMU RES INFLOWS       Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=0   Sep=0   Oct=0   Nov=0   Dec=2

 44 EXCESS OF MERR_IRR           V        099999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C        099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1
  ' 1 = TOTAL FLOW                Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 45 MERR IRR TUNL SHARE          V        0  999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C        0  999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*0.3
  ' 1 = GOOD TUNNEL               Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 46 MERR URB TUNL SHARE          V        0  999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C        0  999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*0.6
  ' 1 = GOOD TUNNEL               Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 47 MERR UNK TUNL SHARE          V        0  999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C        0  999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*0.1
  ' 1 = GOOD TUNNEL               Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 50 TOT INFLOW                   V        099999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C        099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1+'2+'3+'4+'5+'6
  ' 1 = MERR IRR TUNL SHARE       Type: FLOW(# 45)
  ' 2 = MERR URB TUNL SHARE       Type: FLOW(# 46)
  ' 3 = MERR UNK TUNL SHARE       Type: FLOW(# 47)
  ' 4 = MERR_IRR INFLOWS          Type: FLOW(# 18)
  ' 5 = MERR_URB INFLOWS          Type: FLOW(# 17)
  ' 6 = MERR_UNK INFLOWS          Type: FLOW(# 28)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 51 TOT EVAP                     V        0********       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C        0********       0       0       0       0       0       0       0       0       0       0
  Equation used: '1+'2+'3
  ' 1 = EVAP MERR_UNK             Type: FLOW(# 31)
  ' 2 = EVAP MERR_URB             Type: FLOW(# 15)
  ' 3 = EVAP MER_IRR              Type: FLOW(# 19)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2
```

```
 52 TOT RAIN                   V       0********       0       0       0       0       0       0       0       0       0       0
   Fn Name:                    C       099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1+'2+'3
  ' 1 = MERR_IRR RAIN            Type: FLOW(# 12)
  ' 2 = MERR_URB RAIN            Type: FLOW(# 14)
  ' 3 = MERR_UNK RAIN            Type: FLOW(# 29)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 53 TOT RELEASES               V       099999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                    C       099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1+'2+'3+'4+'5+'6+'7+'8
  ' 1 = MERR_UNK TO NOTIONAL     Type: FLOW(# 23)
  ' 2 = MERRIMU TO BM URBAN      Type: FLOW(#  5)
  ' 3 = MERRIMU TO MELT URB      Type: FLOW(#  4)
  ' 4 = MERR_IRR RELEASES        Type: FLOW(# 21)
  ' 5 = MERR_URB ENVIRON REL     Type: FLOW(# 22)
  ' 6 = MERR_UNK ENVIRON REL     Type: FLOW(# 43)
  ' 7 = MERR_IRR ENVIRON REL     Type: FLOW(# 20)
  ' 8 = EXCESS OF MERR_IRR       Type: FLOW(# 44)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2


-------------------------------
|  TARGET INFORMATION         |
-------------------------------

 Number of target sets:  1

-------------------------------------------------------------------------------------------------------------------------------
 Target set 1 ( Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)
 Name                Draw Pri                                  Targets
-------------------------------------------------------------------------------------------------------------------------------
MERR_IRR               1          0       800      1200      2200      3000      3800      4600      5400      7000     35000
DJERRIWARRH RES        1          0       400       700       900       980       980       980       980       980       980
MERR_URB               1          0      1200      3600      6600      9000     11400     13800     16200     19000     35000
MERR_UNK               1          0       400      1200      2200      3000      3800      4600      5400      7000     35000

 totals                           0      2800      6700     11900     15980     19980     23980     27980     33980    105980
```

```
------------------------------
|  RESTRICTION INFORMATION    |
------------------------------

 Number of restriction groups:  1

 NB. Each restriction group is treated separately
     with its own rule curve definitions for urban demand groups;
     for irrigation demand groups by its allocations functions.

-------------------------------------------------------------------------
Restriction Group:  1     Type: Urban/industrial demand centers
-------------------------------------------------------------------------

      Reservoirs/               Demands
   carriers in Group            in Group
      ----------               --------
     MERR_IRR                 MELTON URBAN
     DJERRIWARRH RES          NOTIONAL DEMAND
     MERR_URB
     MERR_UNK

Restriction  Relative  % of Restrictable                          Storage as % of Average Annual Demand
       Level  Position  Demand Restricted       Jan       Feb       Mar       Apl       May       Jun       Jul       Aug       Sep       Oct       Nov
Dec
           0       0.0       0.0            -9000.00  -7000.00  -6000.00  -4000.00  -2500.00  -3000.00  -4000.00  -7000.00  -7500.00  -8000.00  -9000.00 -
10000.00
           1      25.0      30.0            -7375.00  -5750.00  -5000.00  -3450.00  -2125.00  -2500.00  -3500.00  -6000.00  -6500.00  -6875.00  -7650.00  -
8275.00
           2      50.0      50.0            -5750.00  -4500.00  -4000.00  -2900.00  -1750.00  -2000.00  -3000.00  -5000.00  -5500.00  -5750.00  -6300.00  -
6550.00
           3      75.0      70.0            -4125.00  -3250.00  -3000.00  -2350.00  -1375.00  -1500.00  -2500.00  -4000.00  -4500.00  -4625.00  -4950.00  -
4825.00
           4     100.0      90.0            -2500.00  -2000.00  -2000.00  -1800.00  -1000.00  -1000.00  -2000.00  -3000.00  -3500.00  -3500.00  -3600.00  -
3100.00

 Base levels (% AAD)                        -742.00   -672.00   -601.00   -424.00   -353.00   -300.00   -318.00   -318.00   -353.00   -442.00   -530.00   -
672.00

 NB. Negative values will be interpreted as absolute values


------------------------------
|  MULTI SYSTEM INFORMATION   |
------------------------------

-------------------------------------------------------------------------------------------------------------------------
 Reservoirs
-------------------------------------------------------------------------------------------------------------------------
 MERR_IRR          1
 DJERRIWARRH RES   1
 MERR_URB          1
 MERR_UNK          1
```

```
----------------------------------
|  CAPACITY SHARING INFORMATION   |
----------------------------------

     (a negative represents capacity key for group)


-------------------------------------------------
    Carrier        Name        Group No.  % Share
-------------------------------------------------
      37 IRR_URB SHARE            -1      75 <- capacity key
      39 IRR_UNK SHARE             1      25

      38 UNK_URB SHARE            -2      75 <- capacity key
      42 UNK_IRR SHARE             2      25

      40 URB_UNK SHARE            -3      50 <- capacity key
      41 URB_IRR SHARE             3      50
```

WORKED EXAMPLE 8(a) - LOG FILE (EXPLICIT CAPACITY SHARING)

```
      HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
      H   H     H           H    H    H         H    H   H
      HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHH        HHH    H   HHH       HHH  H   H
      HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


             ***************************
             *    SIMULATION LOG FILE   *
             ***************************

 Log filename : EXPL.log

 Scenario file: scn8e.scn

 Simulation label:
     Tutorial 8 - Explicit Capacity Sharing




 Streamflow file(s):
     C:\REALM\WorkedExamples\WERRCAPC.SF
 Demand file(s):
     C:\REALM\WorkedExamples\WERRIRR.DEM

 Restrictions are ON

 Instream flow requirements NOT limited to natural
  Water quality calculations are OFF

 Number of S/F Sequences:    1


 Convergence tolerance (storage)    1 10th%
 Other convergence tolerance        5 %
 Arc convergence tolerance (abs)  100
 Minimum iteration count            3
 Maximum iteration count           51
 Do convergence twice              No


 Date: 10:03:15 01/14/02
```

```
Time Step = Monthly

SYSTEM CHANGES:
No    Seas  Year   System File
--------------------------------
  1     7  1920     C:\REALM\WorkedExamples\WERREXPL.sys
--------------------------------

Total number of seasons:-  840

_

******** RUN TIME MESSAGES:- ********


 ****INPUT DATA TYPE=  1 ****

1920
 C:\REALM\WorkedExamples\WERREXPL.sys
1921
1922
1923
1924
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1986
1987
1988
1989
1990
******** END RUN TIME MESSAGES ********

SUMMARY INFORMATION

Reservoir data:

	Name	Start Storage	File Inflow	Min Storage	Average Storage	Evapn	Release to river	Spill	End Storage
1	MERR_IRR	5123.	0.	32.	7179.	0.	0.	0.	7500.
2	DJERRIWARRH RES	500.	117.	0.	908.	5.	32.	0.	980.
3	MERR_URB	16314.	0.	0.	17495.	0.	0.	0.	20131.
4	MERR_UNK	5123.	0.	0.	4702.	0.	0.	0.	4830.
		27060.	117.	0.	30284.	5.	32.	0.	33441.

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	BM URBAN	282.	282.	282.	0.	282.
2	MELTON URBAN	394.	393.	393.	0.	393.
3	NOTIONAL DEMAND	212.	211.	211.	3.	208.
		888.	886.	886.	3.	883.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	BM URBAN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	12.0	12.0
2	MELTON URBAN	14.0	2.6	5.0	0.0	0.0	0.0	1.0	19.0	19.0
3	NOTIONAL DEMAND	14.0	2.6	5.0	0.0	0.0	0.0	21.0	73.4	100.0

Stream Junc:

	Name	file inflow
1	.PYRITES CK OUTFALL	7270.
2	IRR INFLOW SHARE	100000.
3	NODE 52	0.
4	MERR RAIN#1	100000.
5	DUMMYAREA1	0.
6	DUMMYAREA2	0.
7	MERR RAIN#2	100000.
8	URB INFLOW SHARE	100000.
9	UNK INFLOW SHARE	100000.
10	MERR RAIN#3	100000.
11	GOODMAN TUNNEL INFLO	803.
12	LOWER LERD INFLOW	2537.
		610610.

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	WERRIBEE U/S MELTON	9986.0	99999999.0	147.0	126663.0	0.0
2	MERRIMU SPILLS	118.1	118.1	0.0	5681.0	0.0
3	DJERRIWARRH CK	32.0	99999999.0	0.0	1757.0	0.0
4	MERRIMU TO MELT URB	335.5	2000.0	0.0	795.0	0.0
5	MERRIMU TO BM URBAN	282.2	1300.0	180.0	555.0	0.0
6	DJERR TO MELTON URB	57.2	579.2	0.0	558.0	0.0
7	MERR_IRR ABOVE SHARE	251.3	256.3	0.0	3591.0	0.0
8	MERR_IRR BELOW SHARE	0.0	326.5	0.0	0.0	0.0
9	MERR_URB ABOVE SHARE	77.9	78.6	0.0	3468.0	0.0
10	MERR_URB BELOW SHARE	103.3	3609.0	0.0	2408.0	0.0
11	MERRIMU AREA	0.0	273.3	0.0	0.0	0.0
12	MERR_IRR RAIN	36.2	36.2	0.0	181.0	0.0

13	MIRR XS RAINFALL	99963.8	99999999.0	99819.0	100000.0	0.0
14	MERR_URB RAIN	72.4	72.4	0.0	363.0	0.0
15	EVAP MERR_URB	153.0	153.0	12.0	391.0	0.0
16	MURB XS RAINFALL	99927.6	99999999.0	99637.0	100000.0	0.0
17	MERR_URB INFLOWS	210.0	210.0	0.0	3478.0	0.0
18	MERR_IRR INFLOWS	105.1	105.1	0.0	1739.0	0.0
19	EVAP MER_IRR	76.5	76.5	6.0	196.0	0.0
20	MERR_IRR ENVIRON REL	7.3	7.3	0.0	19.0	0.0
21	MERR_IRR RELEASES	0.0	99999999.0	0.0	0.0	0.0
22	MERR_URB ENVIRON REL	14.4	14.4	0.0	37.0	0.3
23	MERR_UNK TO NOTIONAL	207.7	99999999.0	0.0	423.0	0.0
24	ENV SECTION 1	1057.0	1168.2	351.0	1550.0	0.0
25	ENV SECTION 2	0.0	1687.0	0.0	0.0	0.0
26	DJERR ENV REL	23.0	23.0	0.0	47.0	0.0
27	ENV FLOW 2 ML/D	0.0	60.8	0.0	0.0	0.0
28	MERR_UNK INFLOWS	35.0	35.0	0.0	580.0	0.0
29	MERR_UNK RAIN	12.1	12.1	0.0	60.0	0.0
30	MUNK XS RAINFALL	99987.9	99999999.0	99940.0	100000.0	0.0
31	EVAP MERR_UNK	25.5	25.5	1.0	65.0	0.0
32	MIRR XS INFLOW	99894.9	99999999.0	98261.0	100000.0	0.0
33	MURB XS INFLOW	99790.0	99999999.0	96522.0	100000.0	0.0
34	MUNK XS INFLOW	99965.0	99999999.0	99420.0	100000.0	0.0
35	MERR_UNK ABOVE SHARE	0.6	0.6	0.0	257.0	0.0
36	MERR_UNK BELOW SHARE	108.4	1906.9	0.0	4574.0	0.0
37	IRR_URB SHARE	103.3	192.3	0.0	2408.0	0.0
38	UNK_URB SHARE	0.0	0.3	0.0	0.0	0.0
39	IRR_UNK SHARE	88.3	115.2	0.0	2580.0	0.0
40	URB_UNK SHARE	20.1	48.4	0.0	1994.0	0.0
41	URB_IRR SHARE	0.0	39.7	0.0	0.0	0.0
42	UNK_IRR SHARE	0.0	0.1	0.0	0.0	0.0
43	MERR_UNK ENVIRON REL	2.4	2.4	0.0	6.0	0.0
44	EXCESS OF MERR_IRR	37.2	37.2	0.0	2969.0	0.0
45	MERR IRR TUNL SHARE	240.9	241.0	0.0	6101.0	7.1
46	MERR URB TUNL SHARE	481.9	481.9	0.0	12202.0	0.0
47	MERR UNK TUNL SHARE	80.3	80.3	0.0	2034.0	0.0
48	LOWER LERD FLOW ARC	2537.0	99999999.0	0.0	41960.0	0.0
49	EXCESS FLOW ARC	0.0	99999999.0	0.0	1.0	0.0
50	TOT INFLOW	358.1	1153.3	0.0	1550.0	0.0
51	TOT EVAP	109.4	255.0	0.0	556.0	0.0
52	TOT RAIN	0.0	120.6	0.0	0.0	0.0
53	tOT RELEASES	589.6	886.5	0.0	1500.0	0.0

7.

End run

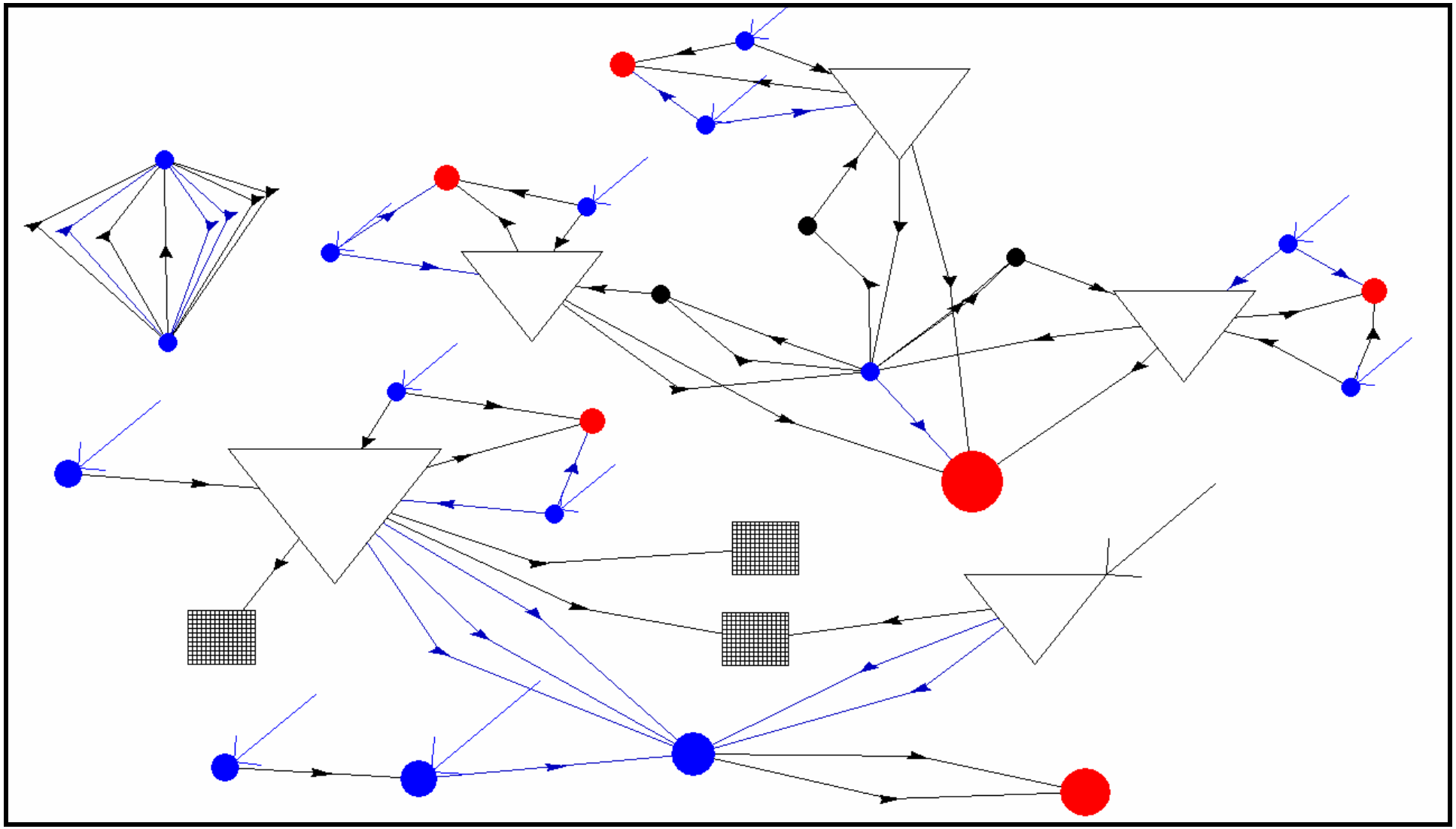

Figure 3.8-2 Worked Example 8(b) – System Plot

WORKED EXAMPLE 8(b) - SYSTEM LISTING (IMPLICIT CAPACITY SHARING)

R E A L M

****
* SYSTEM FILE LISTING *
****

File: C:\REALM\WorkedExamples\WERRIMPL.SYS

Simulation label:
MERRIMU 3 CAPASITY SHARES WERRimpl.SYS (IMPLICIT)
WITHOUT WERRIBE IRRIGATION MELTON RESERVOIR AND PYRITES CK R
ESERVOIR.(FOR VUT)

Date: 05:29 21/03/2005

NODE INFORMATION

No	Name	Type	X	Y	Z	Size	Aux Input	No
1	.PYRITES CK OUTFALL	Strm junction	28.72	6.63	0.00	2.00	W_usPyrites	1
	Comment: Pyrities Creek outfall to Werribee R.							
2	MERR_IRR	Reservoir	36.35	66.17	0.00	3.00		2
	Comment: Merrimu Reservior.							
3	BM URBAN	Demand	15.36	23.57	0.00	2.00		3
	Comment: Bacchus Marsh urban supply from Merrimu Res.							
4	DJERRIWARRH RES	Reservoir	70.44	27.54	0.00	3.00	DJERRIWARRH INFLOWS	4
	Comment: Djerriwarrh Reservior.							
5	MELTON URBAN	Demand	51.51	23.35	0.00	2.00		5
	Comment: Melton urban supply from Merrimu Res.							
6	MERR_URB	Reservoir	80.53	61.40	0.00	3.00		6
	Comment: MERRIMU URBAN STORAGE							
7	MERRIMU INFLOW	Strm junction	37.87	38.38	0.00	1.00	MERRIMU RES INFLOWS	7
8	NODE 52	Strm junction	59.29	55.32	0.00	1.00		8
9	MERR RAIN#4	Strm junction	27.20	52.94	0.00	1.00	INFLOW	9
10	NODE 54	Strm terminator	40.48	49.50	0.00	1.00		10
11	NODE 55	Strm terminator	93.35	65.06	0.00	1.00		11
12	DUMMYAREA1	Strm junction	11.49	80.69	0.00	1.00		12
13	DUMMYAREA2	Strm junction	11.69	58.84	0.00	1.00		13
14	MERR RAIN#2	Strm junction	91.76	53.53	0.00	1.00	INFLOW	14
15	NOTIONAL DEMAND	Demand	52.19	34.21	0.00	2.00		15
16	MERR_UNK	Reservoir	61.22	87.98	0.00	3.00		16
	Comment: Share of Merrimu - unallocated after urban & irrigation committments							
17	URB INFLOW SHARE	Strm junction	87.56	70.66	0.00	1.00	INFLOW	17
18	UNK INFLOW SHARE	Strm junction	48.13	84.94	0.00	1.00	INFLOW	18

19	MERR RAIN#3	Strm junction	50.74	95.00	0.00	1.00	INFLOW	19
20	NODE 71	Strm terminator	42.49	92.09	0.00	1.00		20
21	NODE IRR BLOW SHR	Pipe junction	45.09	64.57	0.00	1.00		21
22	NODE URB BLO SHR	Pipe junction	69.12	69.07	0.00	1.00		22
23	NODE UNK BLOW SHR	Pipe junction	55.05	72.77	0.00	1.00		23
24	MERRIMU RESERVOIR	Reservoir	22.99	40.77	0.00	4.50		24
25	dummy terminator	Strm terminator	66.12	42.19	0.00	2.50		25
26	MERR RAIN#1	Strm junction	40.08	75.16	0.00	1.00	INFLOW	26
27	Node 45	Strm terminator	30.62	78.60	0.00	1.00		27
28	IRR INFLOW SHARE	Strm junction	22.72	69.60	0.00	1.00	INFLOW	28
29	U/S OF MELTON	Strm terminator	73.84	5.00	0.00	2.00		29
30	ABOVE MELTON	Strm junction	47.26	9.55	0.00	2.30		30
31	GOODMANS TUN INFLOW	Strm junction	5.00	43.15	0.00	1.50	GOOD TUNNEL	31
32	LOWER LERD FLOW ARC	Strm junction	15.57	7.96	0.00	1.50	LOWER LERD	32

Reservoir data:

No	Name	Min Cap	Max Cap	No Above	No Below	Spill Type
2	MERR_IRR	0	35000	1	10	External
4	DJERRIWARRH RES	0	980	1	5	Downstream
6	MERR_URB	0	35000	1	10	External
16	MERR_UNK	0	35000	1	10	External
24	MERRIMU RESERVOIR	0	35000	1	10	Downstream

Reservoir evaps: (if A=B=0 evaps not calculated!)

No	Name	NET EVAP =	(A	+	B	*	EVAPORATION)	-	RAINFALL
4	DJERRIWARRH RES		15.000	0.800			EVAPORATION		RAINFALL(87002)

No	Name		Surface area/volume relationships									
			pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10
4	DJERRIWARRH RES	Vol	0	200	400	600	800	950	1100	9999	0	0
		Area	0	3	5	7	9	10	11	11	0	0

No	Name		Levels/volume relationships													
			pt1	pt2	pt3	pt4	pt5	pt6	pt7	pt8	pt9	pt10	pt11	pt12	pt13	pt14	pt15
2	MERR_IRR	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	DJERRIWARRH RES	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	MERR_URB	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	MERR_UNK	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	MERRIMU RESERVOIR	Vol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lvl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Demand data:

No	Name	No Bypass	S/F Priority		Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					Monthly Factors											
3	BM URBAN	10	10	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	MELTON URBAN	10	9	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	NOTIONAL DEMAND	10	8	min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
				max	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARRIER INFORMATION

No	Name	Type	From	To	Cost	Offset	Loss	Ann Vol	Shr Gp	Shr%	No
1	WERRIBEE U/S MELTON	River	1	30	10	0	0fix	0		0%	1
	Comment: Werribee River upstream of Melton Res.										
2	MERRIMU CAPA SPILLS	River	8	25	-5000000	0	0fix	0		0%	2
	Comment: Merrimu Res. spills into Pyrites Creek.										
3	DJERRIWARRH CK	River	4	30	1000	3	0fix	0		0%	3
	Comment: Djerriwarrh Creek below Reservior.										
4	MERRIMU TO MELT URB	Pipe	24	5	100	0	0fix	0		0%	4
	Comment: Melton urban supply from Merrimu Res.										
5	MERRIMU TO BM URBAN	Pipe	24	3	100	0	0fix	0		0%	5
	Comment: Bacchus Marsh urban supply from Merrimu Reservior.										
6	DJERR TO MELTON URB	Pipe	4	5	200	0	0fix	0		0%	6
	Comment: Melton urban supply from Djerriwarrh Reservior. Transfer capacity = 19 ML/d										
7	MERR_IRR ABOVE SHARE	Pipe	2	8	-5000000	2	0fix	0		0%	7
	Comment: Prevents MERR_IRR going ABOVE its capacity share										
8	MERR_IRR BELOW SHARE	Pipe	21	2	10	0	0fix	0		0%	8
	Comment: Allows int. spill from MERR_URB to MERR_IRR										
9	MERR_URB ABOVE SHARE	Pipe	6	8	-5000000	-1	0fix	0		0%	9
	Comment: Prevents MERR_URB going .g.t. its capacity share										
10	MERR_URB BELOW SHARE	Pipe	22	6	10	0	0fix	0		0%	10
	Comment: Allows int. spills from MERR_IRR to MERR_URB										
11	MERR EVAP	Pipe	24	10	-53000000	0	0fix	0		0%	11
	Comment: Takes share of evap out of MERRIMU RESERVOIR										
12	MERR RAIN	Pipe	9	24	0	0	0fix	0		0%	12
	Comment: Adds share of Merrimu rain to MERRIMU RESERVOIR										
13	MER RAIN#4 XS SUPPLY	Pipe	9	10	1000	0	0fix	0		0%	13
14	MERR_URB RAIN	Pipe	14	6	0	0	0fix	0		0%	14
	Comment: Adds share of Merrimu rain to MERR_URB										
15	EVAP MERR_URB	Pipe	6	11	-53000000	0	0fix	0		0%	15
	Comment: Takes share of evap out of MERR_URB										
16	MER RAIN#2 XS SUPPLY	Pipe	14	11	1000	0	0fix	0		0%	16
17	MERR INFLOWS	River	7	24	0	0	0fix	0		0%	17
18	MER_URB INFLOWS	River	17	6	0	0	0fix	0		0%	18
19	MERRIMU AREA	Pipe	13	12	0	-3	0fix	0		0%	19
20	MERR_UNK TO NOTIONAL	Pipe	24	15	0	0	0fix	0		0%	20
21	ENV SECTION 1	River	13	12	-1	-6	0fix	0		0%	21
	Comment: SECTION 1 - Recommended Env. min. flows d/s LERDERDERG WEIR										

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22 ENV SECTION 2          River         12         13          1          3          0fix                0     0%       22
   Comment: Recommended env. min. flow d/s Lerderderweir - Section 2.
23 DJERR ENV REL          River          4         30   -5000000          6          0fix                0     0%       23
   Comment: Min. env. flow of 1.5 ML/d or natural   inflow in Djerriwarrh (lesser of)
24 ENV FLOW 2 ML/D        River         12         13          0         -4          0fix                0     0%       24
   Comment: Env. flow of 2 ML/d
25 MERR_UNK INFLOWS       River         18         16       1000          0          0fix                0     0%       25
26 MERR_UNK RAIN          Pipe          19         16          0          0          0fix                0     0%       26
   Comment: Share of Merrimu rainfall to unallocatedwater store
27 MER RAIN#3 XS SUPPLY   Pipe          19         20       1000          0          0fix                0     0%       27
28 EVAP MERR_UNK          Pipe          16         20  -53000000          0          0fix                0     0%       28
   Comment: Take share of evap out of MERR_UNK
29 MERR XS INFLOW         River          7         10       1000          0          0fix                0     0%       29
   Comment: Surplus Merrimu rain ex irr
30 MERR_URB XS INFLOW     River         17         11       1000          0          0fix                0     0%       30
   Comment: Excess Merrimu rain ex. urb
31 MERR_UNK XS INFLOW     River         18         20       1000          0          0fix                0     0%       31
   Comment: Excess Merrimu rainfall ex unk
32 MERR_UNK ABOVE SHARE   Pipe          16          8   -5000000          1          0fix                0     0%       32
   Comment: Prevents MERR_UNK going above share
33 MERR_UNK BELOW SHARE   Pipe          23         16         10          0          0fix                0     0%       33
   Comment: Allows internal spills from MERR_IRR and/or MERR_URB
34 IRR_URB SHARE          Pipe           8         22         10          1          0fix               -1    75%       34
   Comment: Share of above share internal spill fromMERR_IRR to MERR_URB
35 UNK_URB SHARE          Pipe           8         22         10         -2          0fix               -2    75%       35
   Comment: Share of internal spill from MERR_UNK toMERR_URB
36 IRR_UNK SHARE          Pipe           8         23         10         -2          0fix                1    25%       36
   Comment: Share of internal spill from MERR_IRR toMERR_UNK
37 URB_UNK SHARE          Pipe           8         23         10          2          0fix               -3    50%       37
   Comment: Share of internal spill from MERR_URB toMERR_UNK
38 URB_IRR SHARE          Pipe           8         21         10          2          0fix                3    50%       38
   Comment: Share of internal spill from MERR_URB toMERR_IRR
39 UNK_IRR SHARE          Pipe           8         21         10         -2          0fix                2    25%       39
   Comment: Share of internal spill from MERR_UNK toMERR_IRR
40 MERRIMU SPILL          River         24         30          0          3          0fix                0     0%       40
41 MERRIMU ENV FLOWS      River         24         30   -5000000         -2          0fix                0     0%       41
   Comment: ENV FLOW OF MINIMUM OF 2 ML/D OR NATURALFROM DEC TO JULY
42 MERRIMU IRRIGATION     River         24         30   -4500000          0          3%                  0     0%       42
43 FLOWS ABOVE MELTON     Pipe          30         29     100000         -2          3%                  0     0%       43
44 MERR_IRR ENVIRON REL   Pipe           2         25   -5000000          5          3%                  0     0%       44
   Comment: Merrimu irrigation share of env. flow if spills+irr. rel. lt. env requirement
45 EXCESS FLOWS TO MEL    Pipe          30         29  -50000000          1          0fix                0     0%       45
   Comment: To force out flow required to be sent to Melton
46 MERR_URB ENVIRON REL   Pipe           6         25  -50000000          4          0fix                0     0%       46
   Comment: Merrimu urban share of environ, flow if spills+irr rel lt. env requirement
47 MERR_UNK ENVIRON REL   Pipe          16         25   -5000000         -1          0fix                0     0%       47
   Comment: Share of flow from Merr_unk to meet env flows in Pyrites @ 2 ml/d
48 MER RAIN#1 XS SUPPLY   Pipe          26         27      10000          0          0fix                0     0%       48
49 MERR_IRR XS INFLOW     River         28         27       1000          0          0fix                0     0%       49
50 MERR_IRR INFLOWS       River         28          2          0          0          0fix                0     0%       50
51 MERR_IRR RAIN          Pipe          26          2          0          0          0fix                0     0%       51
52 EVAP MERR_IRR          Pipe           2         27  -53000000          1          0fix                0     0%       52
53 GOODMANS TUNNEL        Pipe          31         24          0          0          0fix                0     0%       53
54 LOWER LERD FLOW ARC    Pipe          32          1          0          0          0fix                0     0%       54
55 TRACK TOT RAIN         Pipe          12         13          0          6          0fix                0     0%       55
56 TRACK TOT EVAP         Pipe          13         12          0          7          0fix                0     0%       56
57 TRACK TOT INFLOWS      Pipe          12         13          0         -7          0fix                0     0%       57
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  58 TOT RELESE             Pipe          13         12          0          0          0fix                 0     0%       58

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 Maximum Flows
  No        Name                  Jan      Feb      Mar      Apl      May      Jun      Jul      Aug      Sep      Oct      Nov      Dec
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   1 WERRIBEE U/S MELTON    99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999
   3 DJERRIWARRH CK          9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
   4 MERRIMU TO MELT URB        2000     2000     2000     2000     2000     2000     2000     2000     2000     2000     2000     2000
   5 MERRIMU TO BM URBAN        1300     1300     1300     1300     1300     1300     1300     1300     1300     1300     1300     1300
   6 DJERR TO MELTON URB         590      540      590      570      590      570      590      590      570      590      570      590
  13 MER RAIN#4 XS SUPPLY    9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
  16 MER RAIN#2 XS SUPPLY    9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
  20 MERR_UNK TO NOTIONAL     999999   999999   999999   999999   999999   999999   999999   999999   999999   999999   999999   999999
  21 ENV SECTION 1              930      848      930      900      930      900     1550     1550     1500     1550     1500      930
  22 ENV SECTION 2             1178     1074     1178     1140     1178     1140     1178     3100     3000     3100     1800     1178
  24 ENV FLOW 2 ML/D             62       56       62       60       62       60       62       62       60       62       60       62
  27 MER RAIN#3 XS SUPPLY    9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
  29 MERR XS INFLOW          9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
  30 MERR_URB XS INFLOW      9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
  31 MERR_UNK XS INFLOW      9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999  9999999
  36 IRR_UNK SHARE                 0        0        0        0        0        0        0        0        0        0        0        0
  38 URB_IRR SHARE                 0        0        0        0        0        0        0        0        0        0        0        0
  39 UNK_IRR SHARE                 0        0        0        0        0        0        0        0        0        0        0        0
  40 MERRIMU SPILL                 0        0        0        0        0        0        0        0        0        0        0        0
  43 FLOWS ABOVE MELTON    999999990999999990999999990999999990999999990999999990999999990999999990999999990999999990999999990999999990
  48 MER RAIN#1 XS SUPPLY   99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999
  49 MERR_IRR XS INFLOW     99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999 99999999
  53 GOODMANS TUNNEL       999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999
  54 LOWER LERD FLOW ARC   999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999999

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 Functional Capacities
  No        Name                       pt1     pt2     pt3     pt4     pt5     pt6     pt7     pt8     pt9     pt10    pt11    pt12
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   2 MERRIMU CAPA SPILLS          V  -999999       0  999999       0       0       0       0       0       0       0       0       0
    Fn Name:                      C  -999999       0  999999       0       0       0       0       0       0       0       0       0
   Equation used: '1+'2+'3-35000
   ' 1 = MERR_IRR                  Type: ESTO
   ' 2 = MERR_URB                  Type: ESTO
   ' 3 = MERR_UNK                  Type: ESTO
          Previous flow solution is added to new capacity
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

   7 MERR_IRR ABOVE SHARE         V   -99999       0   99999       0       0       0       0       0       0       0       0       0
    Fn Name:                      C   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Equation used: '1-'2-7500
   ' 1 = MERR_IRR                  Type: ESTO
   ' 2 = MERR_IRR BELOW SHARE      Type: FLOW(#  8)
          Previous flow solution is added to new capacity
 Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

   8 MERR_IRR BELOW SHARE         V   -99999       0  999990       0       0       0       0       0       0       0       0       0
    Fn Name:                      C   -99999       0  999990       0       0       0       0       0       0       0       0       0
   Equation used: 7500-'1
   ' 1 = MERR_IRR                  Type: ESTO
          Previous flow solution is added to new capacity
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Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

  9 MERR_URB ABOVE SHARE         V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                      C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: '1-'2-21000
  ' 1 = MERR_URB                  Type: ESTO
  ' 2 = MERR_URB BELOW SHARE      Type: FLOW(# 10)
         Previous flow solution is added to new capacity
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 10 MERR_URB BELOW SHARE         V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                      C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: 21000-'1
  ' 1 = MERR_URB                  Type: ESTO
         Previous flow solution is added to new capacity
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 11 MERR EVAP                    V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                      C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: ('1*(('2*0.85)+5)*0.01)
  ' 1 = MERRIMU AREA              Type: CAPC(# 19)
  ' 2 = EVAPORATION               Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 12 MERR RAIN                    V       0   99999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C       0   99999       0       0       0       0       0       0       0       0       0       0
  Equation used: ('1*'2)*0.01
  ' 1 = MERRIMU AREA              Type: CAPC(# 19)
  ' 2 = RAINFALL(87002)           Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 14 MERR_URB RAIN                V       0   99999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C       0   99999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*0.60
  ' 1 = MERR RAIN                 Type: FLOW(# 12)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 15 EVAP MERR_URB                V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                      C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: ('1*0.6)
  ' 1 = MERR EVAP                 Type: FLOW(# 11)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 17 MERR INFLOWS                 V       099999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C       099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1
  ' 1 = MERRIMU RES INFLOWS       Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 18 MER_URB INFLOWS              V       0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                      C       0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: ('1+'2)*0.6
  ' 1 = MERR INFLOWS              Type: FLOW(# 17)
  ' 2 = GOODMANS TUNNEL           Type: FLOW(# 53)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 19 MERRIMU AREA                 V       0    1326    4150   10115   19100   21100   37830   99999       0       0       0       0
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   Fn Name:                    C        0      30      64     140     211     226     326     326       0       0       0       0
  Equation used: '1+'2+'3
  ' 1 = MERR_IRR                Type: STOR
  ' 2 = MERR_URB                Type: STOR
  ' 3 = MERR_UNK                Type: STOR
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 23 DJERR ENV REL              V        0     100 9999999       0       0       0       0       0       0       0       0       0
   Fn Name:                    C        0     100 9999999       0       0       0       0       0       0       0       0       0
  Equation used: MIN('1*0.75,'2)
  ' 1 = ENV FLOW 2 ML/D         Type: CAPC(# 24)
  ' 2 = DJERRIWARRH INFLOWS     Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 25 MERR_UNK INFLOWS           V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                    C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: ('1+'2)*0.1
  ' 1 = MERR INFLOWS            Type: FLOW(# 17)
  ' 2 = GOODMANS TUNNEL         Type: FLOW(# 53)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 26 MERR_UNK RAIN              V        0   99999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                    C        0   99999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1*0.1
  ' 1 = MERR RAIN               Type: FLOW(# 12)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 28 EVAP MERR_UNK              V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                    C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: ('1*0.1)
  ' 1 = MERR EVAP               Type: FLOW(# 11)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 32 MERR_UNK ABOVE SHARE       V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                    C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: '1-'2-6500
  ' 1 = MERR_UNK                Type: ESTO
  ' 2 = MERR_UNK BELOW SHARE    Type: FLOW(# 33)
         Previous flow solution is added to new capacity
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 33 MERR_UNK BELOW SHARE       V   -99999       0  999999       0       0       0       0       0       0       0       0       0
   Fn Name:                    C   -99999       0  999999       0       0       0       0       0       0       0       0       0
  Equation used: 6500-'1
  ' 1 = MERR_UNK                Type: ESTO
         Previous flow solution is added to new capacity
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 34 IRR_URB SHARE              V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                    C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: '1*1.0
  ' 1 = MERR_IRR ABOVE SHARE    Type: CAPC(#  7)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 35 UNK_URB SHARE              V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                    C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: '1*1.0
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  ' 1 = MERR_UNK ABOVE SHARE      Type: CAPC(# 32)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 37 URB_UNK SHARE               V   -99999       0   99999       0       0       0       0       0       0       0       0       0
   Fn Name:                     C   -99999       0   99999       0       0       0       0       0       0       0       0       0
  Equation used: '1*1.0
  ' 1 = MERR_URB ABOVE SHARE      Type: CAPC(#  9)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 41 MERRIMU ENV FLOWS           V        0********       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0********       0       0       0       0       0       0       0       0       0       0
  Equation used: MIN('1,'2)
  ' 1 = ENV FLOW 2 ML/D          Type: CAPC(# 24)
  ' 2 = MERRIMU RES INFLOWS      Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=0   Sep=0   Oct=0   Nov=0   Dec=2

 42 MERRIMU IRRIGATION          V        0  999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0  999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1
  ' 1 = TOTAL FLOW               Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=0   Sep=0   Oct=0   Nov=0   Dec=2

 44 MERR_IRR ENVIRON REL        V -9999999       0 9999999       0       0       0       0       0       0       0       0       0
   Fn Name:                     C -9999999       0 9999999       0       0       0       0       0       0       0       0       0
  Equation used: ('1+('2*0.3))
  ' 1 = MERRIMU IRRIGATION       Type: FLOW(# 42)
  ' 2 = MERRIMU ENV FLOWS        Type: FLOW(# 41)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 45 EXCESS FLOWS TO MEL         V        099999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1
  ' 1 = MELTON U/S FLOW          Type: STRM
Capacity set option (0-off 1-prev 2-recalc) Jan=0   Feb=0   Mar=0   Apl=0   May=0   Jun=0   Jul=0   Aug=0   Sep=0   Oct=0   Nov=0   Dec=0

 46 MERR_URB ENVIRON REL        V -9999999       0 9999999       0       0       0       0       0       0       0       0       0
   Fn Name:                     C -9999999       0 9999999       0       0       0       0       0       0       0       0       0
  Equation used: ('1+('2*0.6)+'3)
  ' 1 = MERRIMU TO MELT URB      Type: FLOW(#  4)
  ' 2 = MERRIMU ENV FLOWS        Type: FLOW(# 41)
  ' 3 = MERRIMU TO BM URBAN      Type: FLOW(#  5)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 47 MERR_UNK ENVIRON REL        V -9999999       0 9999999       0       0       0       0       0       0       0       0       0
   Fn Name:                     C ********       0 9999999       0       0       0       0       0       0       0       0       0
  Equation used: (('1*0.1)+'2)
  ' 1 = MERRIMU ENV FLOWS        Type: FLOW(# 41)
  ' 2 = MERR_UNK TO NOTIONAL     Type: FLOW(# 20)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 50 MERR_IRR INFLOWS            V        099999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: ('1+'2)*0.3
  ' 1 = MERR INFLOWS             Type: FLOW(# 17)
  ' 2 = GOODMANS TUNNEL          Type: FLOW(# 53)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2
```

```
 51 MERR_IRR RAIN               V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: (0.3*'1)
  ' 1 = MERR RAIN                Type: FLOW(# 12)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 52 EVAP MERR_IRR               V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        0 9999999       0       0       0       0       0       0       0       0       0       0
  Equation used: (0.3*'1)
  ' 1 = MERR EVAP                Type: FLOW(# 11)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 55 TRACK TOT RAIN              V        099999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1+'2+'3
  ' 1 = MERR_IRR RAIN            Type: FLOW(# 51)
  ' 2 = MERR_UNK RAIN            Type: FLOW(# 26)
  ' 3 = MERR_URB RAIN            Type: FLOW(# 14)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 56 TRACK TOT EVAP              V        099999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1+'2+'3
  ' 1 = EVAP MERR_IRR            Type: FLOW(# 52)
  ' 2 = EVAP MERR_URB            Type: FLOW(# 15)
  ' 3 = EVAP MERR_UNK            Type: FLOW(# 28)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 57 TRACK TOT INFLOWS           V        0 9999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1+'2+'3
  ' 1 = MERR_IRR INFLOWS         Type: FLOW(# 50)
  ' 2 = MER_URB INFLOWS          Type: FLOW(# 18)
  ' 3 = MERR_UNK INFLOWS         Type: FLOW(# 25)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2

 58 TOT RELESE                  V        099999999       0       0       0       0       0       0       0       0       0       0
   Fn Name:                     C        099999999       0       0       0       0       0       0       0       0       0       0
  Equation used: '1+'2+'3
  ' 1 = MERR_IRR ENVIRON REL     Type: FLOW(# 44)
  ' 2 = MERR_UNK ENVIRON REL     Type: FLOW(# 47)
  ' 3 = MERR_URB ENVIRON REL     Type: FLOW(# 46)
  ' 4 = MERRIMU IRRIGATION       Type: FLOW(# 42)
Capacity set option (0-off 1-prev 2-recalc) Jan=2   Feb=2   Mar=2   Apl=2   May=2   Jun=2   Jul=2   Aug=2   Sep=2   Oct=2   Nov=2   Dec=2
```

```
------------------------------
|  TARGET INFORMATION         |
------------------------------

 Number of target sets:  1
```

Target set 1 (Jan Feb Mar Apl May Jun Jul Aug Sep Oct Nov Dec)

Name	Draw	Pri									
			Targets								
MERR_IRR	1	0	60	60	60	60	60	60	60	60	35000
DJERRIWARRH RES	2	0	400	700	900	980	980	980	980	980	980
MERR_URB	1	0	180	180	180	180	180	180	180	180	35000
MERR_UNK	1	0	60	60	60	60	60	60	60	60	35000
MERRIMU RESERVOIR	2	0	2400	6000	11000	15000	19000	23000	27000	33000	35000
totals		0	3100	7000	12200	16280	20280	24280	28280	34280	140980

```
------------------------------
|  RESTRICTION INFORMATION    |
------------------------------

 Number of restriction groups:  1

 NB. Each restriction group is treated separately
     with its own rule curve definitions for urban demand groups;
     for irrigation demand groups by its allocations functions.

----------------------------------------------------------------------
Restriction Group:  1     Type: Urban/industrial demand centers
----------------------------------------------------------------------
```

Reservoirs/ carriers in Group	Demands in Group
DJERRIWARRH RES	MELTON URBAN
MERRIMU RESERVOIR	NOTIONAL DEMAND

Restriction Level	Relative Position	% of Restrictable Demand Restricted	Storage as % of Average Annual Demand Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0.0	0.0	-9000.00	-7000.00	-6000.00	-4000.00	-2500.00	-3000.00	-4000.00	-7000.00	-7500.00	-8000.00	-9000.00	-10000.00
1	25.0	30.0	-7375.00	-5750.00	-5000.00	-3450.00	-2125.00	-2500.00	-3500.00	-6000.00	-6500.00	-6875.00	-7650.00	-8275.00
2	50.0	50.0	-5750.00	-4500.00	-4000.00	-2900.00	-1750.00	-2000.00	-3000.00	-5000.00	-5500.00	-5750.00	-6300.00	-6550.00
3	75.0	70.0	-4125.00	-3250.00	-3000.00	-2350.00	-1375.00	-1500.00	-2500.00	-4000.00	-4500.00	-4625.00	-4950.00	-4825.00
4	100.0	90.0	-2500.00	-2000.00	-2000.00	-1800.00	-1000.00	-1000.00	-2000.00	-3000.00	-3500.00	-3500.00	-3600.00	-3100.00

```
 Base levels (% AAD)                        -742.00   -672.00   -601.00   -424.00   -353.00   -300.00   -318.00   -318.00   -353.00   -442.00   -530.00   -
672.00

 NB. Negative values will be interpreted as absolute values



------------------------------
|  MULTI SYSTEM INFORMATION   |
------------------------------

-------------------------------------------------------------------------------------------------------------------------------------
 Reservoirs
-------------------------------------------------------------------------------------------------------------------------------------
 MERR_IRR          2
 DJERRIWARRH RES   1
 MERR_URB          2
 MERR_UNK          2
 MERRIMU RESERVO   1




-----------------------------------
|  CAPACITY SHARING INFORMATION   |
-----------------------------------

     (a negative represents capacity key for group)


-------------------------------------------------
    Carrier        Name        Group No.  % Share
-------------------------------------------------
      34 IRR_URB SHARE            -1      75 <- capacity key
      36 IRR_UNK SHARE             1      25

      35 UNK_URB SHARE            -2      75 <- capacity key
      39 UNK_IRR SHARE             2      25

      37 URB_UNK SHARE            -3      50 <- capacity key
      38 URB_IRR SHARE             3      50
```

WORKED EXAMPLE 8(b) - LOG FILE (IMPLICIT CAPACITY SHARING)

```
     HHHHH     HHHHHHHH    HHHHHH    H         HHHHHHHHHH
     H   H     H           H    H    H         H    H   H
     HHHHHHHH  HHHHHH     HHHHHHHH   HHH       HHH  H   H
     HHH    H  HHH        HHH    H   HHH       HHH  H   H
     HHH    H  HHH        HHH    H   HHH       HHH  H   H
     HHH    H  HHHHHHHH   HHH    H   HHHHHHHH  HHH  H   H


           ***************************
           *    SIMULATION LOG FILE   *
           ***************************

Log filename : IMPL.log

Scenario file: scn8i.scn

Simulation label:
    Tutorial 8 - Implicit Capacity Sharing



Streamflow file(s):
    C:\REALM\WorkedExamples\WERRCAPC.SF
Demand file(s):
    C:\REALM\WorkedExamples\WERRIRR.DEM

Restrictions are ON

Instream flow requirements NOT limited to natural
 Water quality calculations are OFF

Number of S/F Sequences:    1


Convergence tolerance (storage)    1 10th%
Other convergence tolerance        5 %
Arc convergence tolerance (abs)  100
Minimum iteration count            3
Maximum iteration count           51
Do convergence twice              No


Date: 10:35:09 01/14/02
```

```
Time Step = Monthly

SYSTEM CHANGES:
No    Seas  Year   System File
--------------------------------
  1     7  1920     C:\REALM\WorkedExamples\WERRIMPL.sys
--------------------------------

Total number of seasons:-  840


_




******** RUN TIME MESSAGES:- ********


 ****INPUT DATA TYPE=  1 ****

1920
 C:\REALM\WorkedExamples\WERRIMPL.sys
1921
1922
1923
1924
1925
1926
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1933
1934
1935
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1988
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1990
******** END RUN TIME MESSAGES ********

SUMMARY INFORMATION

Reservoir data:

	Name	Start Storage	File Inflow	Min Storage	Average Storage	Evapn	Release to river	Spill	End Storage
1	MERR_IRR	5123.	0.	2461.	7265.	0.	0.	0.	7596.
2	DJERRIWARRH RES	500.	117.	303.	922.	5.	0.	34.	980.
3	MERR_URB	16314.	0.	0.	17541.	0.	0.	0.	20087.
4	MERR_UNK	5123.	0.	0.	4846.	0.	0.	0.	4819.
5	MERRIMU RESERVOIR	2000.	0.	1849.	25274.	0.	0.	66.	32504.
		29060.	117.	0.	55848.	5.	0.	100.	65986.

Demand data:

	Name	Unrestrict	Restrict	Rationed	Shortfall	Supplied
1	BM URBAN	282.	282.	282.	0.	282.
2	MELTON URBAN	394.	392.	392.	0.	392.
3	NOTIONAL DEMAND	212.	210.	210.	0.	210.
		888.	884.	884.	0.	884.

	Name	No Rest	Ave Rest lvl	Max Rest lvl	No Ration	Ave % Ration	Max % Ration	No Short	Ave % Short	Max % Short
1	BM URBAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MELTON URBAN	29.0	2.7	5.0	0.0	0.0	0.0	0.0	0.0	0.0
3	NOTIONAL DEMAND	29.0	2.7	5.0	0.0	0.0	0.0	0.0	0.0	0.0

Stream Junc:

	Name	file inflow
1	.PYRITES CK OUTFALL	7270.
2	MERRIMU INFLOW	350.
3	NODE 52	0.
4	MERR RAIN#4	100000.
5	DUMMYAREA1	0.
6	DUMMYAREA2	0.
7	MERR RAIN#2	100000.
8	URB INFLOW SHARE	100000.
9	UNK INFLOW SHARE	100000.
10	MERR RAIN#3	100000.
11	MERR RAIN#1	100000.
12	IRR INFLOW SHARE	100000.
13	ABOVE MELTON	0.
14	GOODMANS TUN INFLOW	803.
15	LOWER LERD FLOW ARC	2537.
		710960.

Pipe/River flows:

	Name	flow	Capacity	Min	Max	Loss
1	WERRIBEE U/S MELTON	9806.9	99999999.0	26.0	125653.0	0.0
2	MERRIMU CAPA SPILLS	98.3	98.3	0.0	5624.0	0.0
3	DJERRIWARRH CK	34.0	99999999.0	0.0	1757.0	0.0
4	MERRIMU TO MELT URB	336.6	2000.0	0.0	795.0	0.0
5	MERRIMU TO BM URBAN	282.2	1300.0	180.0	555.0	0.0
6	DJERR TO MELTON URB	55.0	579.2	0.0	552.0	0.0
7	MERR_IRR ABOVE SHARE	256.8	269.7	0.0	3955.0	0.0

8	MERR_IRR BELOW SHARE	0.0	256.9	0.0	0.0	0.0
9	MERR_URB ABOVE SHARE	57.3	57.3	0.0	3484.0	0.0
10	MERR_URB BELOW SHARE	104.5	3563.3	0.0	2482.0	0.0
11	MERR EVAP	257.1	257.1	23.0	652.0	0.0
12	MERR RAIN	112.9	121.5	0.0	521.0	0.0
13	MER RAIN#4 XS SUPPLY	99887.1	99999999.0	99479.0	100000.0	0.0
14	MERR_URB RAIN	67.7	67.7	0.0	313.0	0.0
15	EVAP MERR_URB	154.2	154.2	14.0	391.0	0.0
16	MER RAIN#2 XS SUPPLY	99932.3	99999999.0	99687.0	100000.0	0.0
17	MERR INFLOWS	324.0	350.1	0.0	5178.0	0.0
18	MER_URB INFLOWS	676.4	676.4	0.0	13102.0	0.0
19	MERRIMU AREA	0.0	275.3	0.0	0.0	0.0
20	MERR_UNK TO NOTIONAL	210.3	99999999.0	111.0	423.0	0.0
21	ENV SECTION 1	1153.0	1168.2	62.0	1550.0	0.0
22	ENV SECTION 2	214.5	1687.0	0.0	1488.0	0.0
23	DJERR ENV REL	23.0	23.0	0.0	47.0	0.0
24	ENV FLOW 2 ML/D	49.0	60.8	0.0	62.0	0.0
25	MERR_UNK INFLOWS	112.8	112.8	0.0	2184.0	0.0
26	MERR_UNK RAIN	11.3	11.3	0.0	52.0	0.0
27	MER RAIN#3 XS SUPPLY	99988.7	99999999.0	99948.0	100000.0	0.0
28	EVAP MERR_UNK	25.7	25.8	2.0	65.0	0.0
29	MERR XS INFLOW	26.1	99999999.0	0.0	2999.0	0.0
30	MERR_URB XS INFLOW	99323.6	99999999.0	86898.0	100000.0	0.0
31	MERR_UNK XS INFLOW	99887.2	99999999.0	97816.0	100000.0	0.0
32	MERR_UNK ABOVE SHARE	0.7	0.7	0.0	261.0	0.0
33	MERR_UNK BELOW SHARE	112.0	1765.8	0.0	3741.0	0.0
34	IRR_URB SHARE	104.5	200.4	0.0	2482.0	0.0
35	UNK_URB SHARE	0.0	0.5	0.0	0.0	0.0
36	IRR_UNK SHARE	88.4	109.4	0.0	2332.0	0.0
37	URB_UNK SHARE	23.6	39.5	0.0	3484.0	0.0
38	URB_IRR SHARE	0.0	28.6	0.0	0.0	0.0
39	UNK_IRR SHARE	0.0	0.2	0.0	0.0	0.0
40	MERRIMU SPILL	65.6	0.0	0.0	5622.0	0.0
41	MERRIMU ENV FLOWS	24.1	24.1	0.0	62.0	0.0
42	MERRIMU IRRIGATION	27.9	27.9	0.0	2969.0	0.8
43	FLOWS ABOVE MELTON	9980.8	99999999.0	148.0	127418.0	298.9
44	MERR_IRR ENVIRON REL	35.2	35.2	0.0	2988.0	0.8
45	EXCESS FLOWS TO MEL	0.0	0.0	0.0	0.0	0.0
46	MERR_URB ENVIRON REL	632.5	633.2	0.0	1352.0	0.0
47	MERR_UNK ENVIRON REL	209.9	212.6	0.0	423.0	0.0
48	MER RAIN#1 XS SUPPLY	99966.1	99999999.0	99844.0	100000.0	0.0
49	MERR_IRR XS INFLOW	99661.8	99999999.0	93449.0	100000.0	0.0
50	MERR_IRR INFLOWS	338.2	338.2	0.0	6551.0	0.0
51	MERR_IRR RAIN	33.9	33.9	0.0	156.0	0.0
52	EVAP MERR_IRR	77.2	77.2	7.0	196.0	0.0
53	GOODMANS TUNNEL	803.2	99999999.0	0.0	20337.0	0.0
54	LOWER LERD FLOW ARC	2537.0	99999999.0	0.0	41960.0	0.0
55	TRACK TOT RAIN	23.2	107.5	0.0	287.0	0.0
56	TRACK TOT EVAP	0.0	251.1	0.0	0.0	0.0
57	TRACK TOT INFLOWS	866.4	11273.7	0.0	1550.0	0.0
58	TOT RELESE	0.0	878.1	0.0	0.0	0.0

301.

End run