

# K-MODSIM DSS EXERCISE

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## Getting Started

### ● Installation

- Microsoft .NET framework 1.1 or higher version has to be installed in your computer before the K-MODSIM installation.
  - Ex) dotnetfx.exe
- Double-click the “ModsimV8Setup.msi” file to install K-MODSIM version 8.





## Getting Started

### ● Short-cut Icon

- After the installation, you can see the short-cut icon on your wallpaper of Windows.



### ● Execution of K-MODSIM

- Just double-click the Modsim 8.0 Beta icon to run the K-MODSIM.
- Or Start menu-Modsim 8.0 Beta



## Getting Started

**K-MODSIM: River Basin Management Decision Support System**

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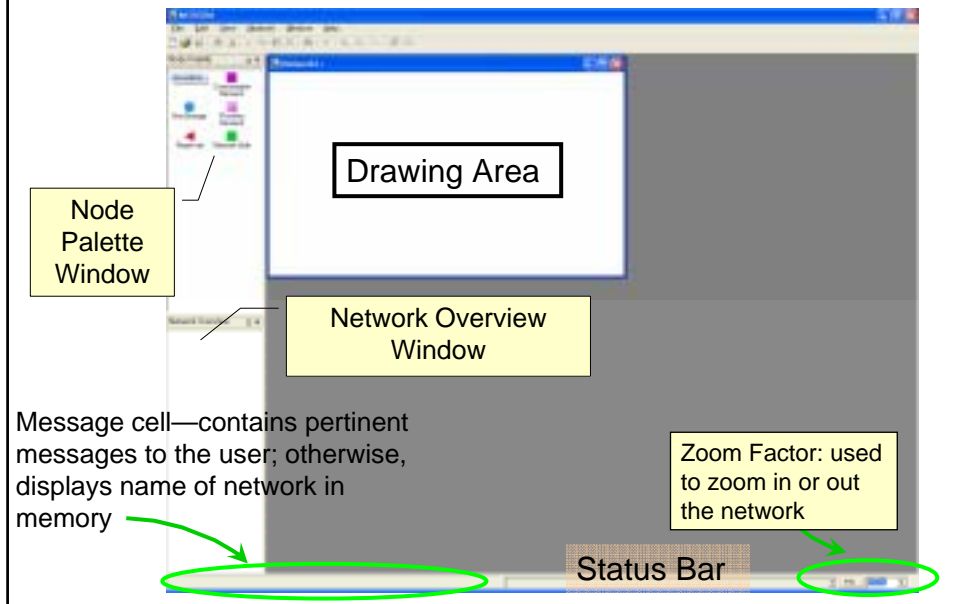
한국수자원공사  
KOREA WATER RESOURCES CORPORATION

Version 8.0 Built: Nov. 2, 2005

Click here to execute K-MODSIM



## Explore K-MODSIM GUI



## Before Starting Exercise

- Make a new folder with Windows Explorer to proceed the exercise.
  - C://Program Files/CSU/Modsim 8.0 Beta/**Example**
  - The **Example** folder is going to be a working directory for K-MODSIM exercise.
- Move the given "K-Modsim\_Exercise.xy" file to the Example folder.



## K-MODSIM Network Creation

- We will now construct a network in the K-MODSIM GUI.
- Select **New** under the **File** menu, then you can see a new empty canvas where you can draw a new network.



## Creation of Nodes

- We will create all the nodes first, and then the links.
  - Reservoir Node
  - NonStorage Node
  - NetworkSink Node
  - Demand Node
- Left click on the desired node in the Node Palette.
- Click on the canvas where node to be located or drag & drop the node.
- If you make a mistake, right click & choose “delete” or left click the node & press “delete” key.





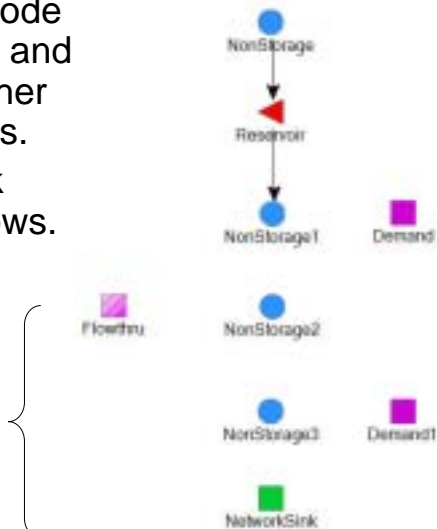
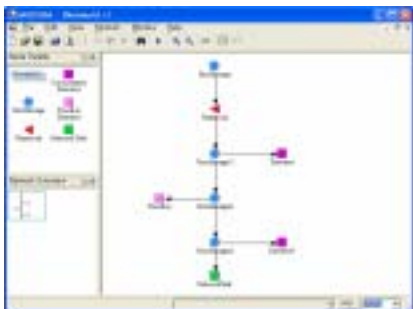
## Reposition or Moving the Nodes

- To reposition a node, click on the node then drag to new position
  - Selected node are highlighted with yellow rectangle
- To move multiple objects at same time, left click the node with the shift button pressed.



## Connecting Nodes with Links

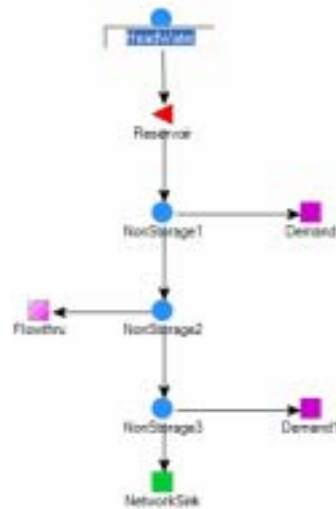
- Point the cursor near a node and you can see a finger and then drag down to the other node to connect with links.
- The arrow-end of the link shows the direction of flows.





## Renaming the Nodes

- K-MODSIM has 5 types of nodes.
- Left click a node name then you can enter the new node name – No Spaces!
- After creating a network, data and properties for each node and link should be entered.



## Exercise Cases

- Case 1: Explicit Target
- Case 2: Explicit Target + Groundwater
- Case 3: Explicit Target + Groundwater + Reservoir Balancing
- Case 4: Conditional Rules (Hydrologic States) + Groundwater
- Case 5: Conditional Rules (Hydrologic States) + Groundwater + Reservoir Balancing



## Opening a Network

The screenshot shows the K-MODSIM software interface. The 'File' menu is open, and the 'Open' option is highlighted. A file selection dialog is also open, showing a list of files. The file 'KMOD\_simulation\_explicit.xy' is selected. A green circle highlights the 'File' menu, and another green circle highlights the selected file in the dialog. A green arrow points from the 'File' menu to the 'Open' option, and another green arrow points from the selected file to the 'Select file to analyze' text box.

Click File\Open

Select file to analyze

- To open a K-MODSIM network (.xy file), select **open** under the **file** menu and choose a network.



## Case 1 Problem

- Purposes
  - To calibrate the basin-wide water allocation model using historical data and historical reservoir target
- Problem Description
  - Use the Results of RRFS (Natural Inflow Data)
  - Use Explicit Reservoir Target Storage
  - Consider Transbasin Water, Municipal and Agricultural Demand and Instream Flow Demand
  - Consider Return Flows
    - Municipal Demand: 0.6
    - Agricultural Demand: 0.3
  - Evaluate Reservoir Storage, Hydropower, and Shortages of Demand Nodes







## Network Settings

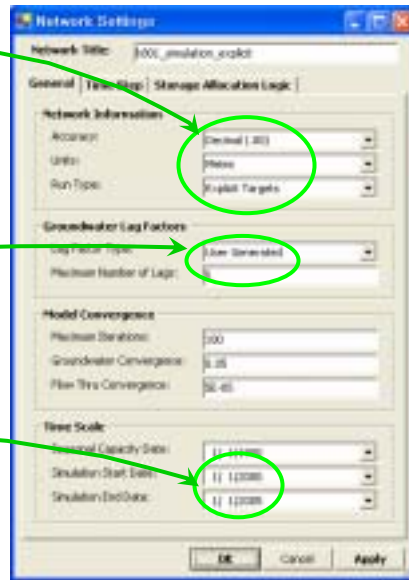
### Network Information

- Accuracy
- Unit
- Run Type

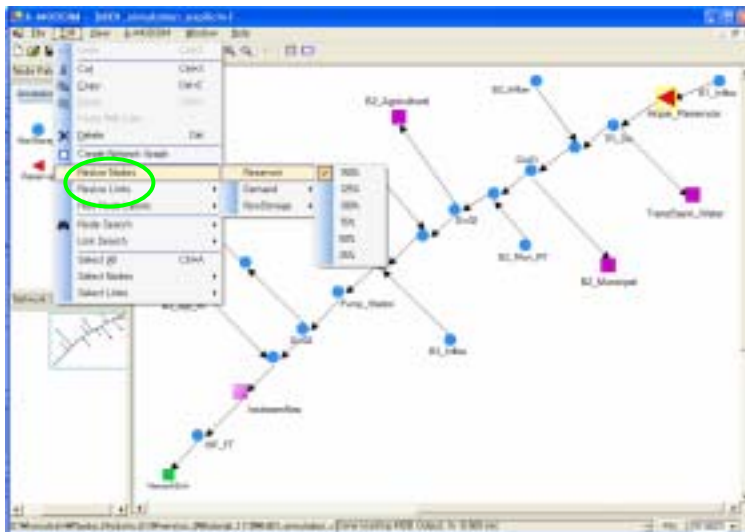
### Groundwater Lag Factors

### Time Scale

- Simulation Start Date: 1/1/2000
- Simulation End Date: 1/1/2005



## Resize Nodes and Links





## Hide or View Label

Click Right Mouse Button on Any Node or Link



## Data Input

● Double-click on a node or right click on a node and select “properties”; pop-up window appears for inputting or editing data for that node.



## Inflow Data Input

Start Date	End Date	Volume (M3/yr)
1/1/2000	1/31/2000	1139
2/1/2000	2/29/2000	2188
3/1/2000	3/31/2000	3676
4/1/2000	4/30/2000	3385
5/1/2000	5/31/2000	1807
6/1/2000	6/30/2000	2787
7/1/2000	7/31/2000	4288
8/1/2000	8/31/2000	17158
9/1/2000	9/30/2000	8820
10/1/2000	10/31/2000	9470
11/1/2000	11/30/2000	9870
12/1/2000	12/31/2000	3707
1/1/2001	1/31/2000	1289

Below the table is a 'Use the Results of RRFs' checkbox, which is checked. The background shows a network diagram with nodes like 'Inflow', 'Reservoir', and 'Transfer'.



## Reservoir Volumes & Priority

The 'Reservoir Information' section contains the following fields:

- Maximum Volume: 1000
- Minimum Volume: 0
- Initial Volume: 0
- Reservoir Type: Reservoir

The 'Priority' section contains the following field:

- Priority: 100



## Reservoir Target Setting

The screenshot shows the 'Reservoir Node Properties' dialog box for a node named 'Jagan\_Reservoir'. The 'Reservoir Layer Properties' tab is active, showing 'Reservoir Capacity' as 100. The 'Reservoir Target Manager' tab is also visible, showing a table with columns for 'Date' and 'Target'. A green circle highlights the 'Date' column header, and another green circle highlights the 'Target' column header. A red arrow points to the 'Jagan\_Reservoir' node in the network diagram on the right.

- Reservoir Targets can be set by month.



## Hydropower

The screenshot shows the 'Reservoir Node Properties' dialog box for a node named 'Jagan\_Reservoir'. The 'Power Plant Information' tab is active, showing 'Reservoir Power' as 10000, 'Reservoir Type' as 'Constant', and 'Head Elevation' as 100. The 'Power Plant Efficiency' tab is also visible, showing a 'Power Plant Efficiency Table' with columns for 'Head (m)' and 'Efficiency (%)'. A green circle highlights the 'Power' tab in the 'General' section, and another green circle highlights the 'Jagan\_Reservoir' node in the network diagram on the right.

Head (m)	Efficiency (%)	Head (m)	Efficiency (%)	Head (m)	Efficiency (%)
0	0.00	0.00	0	0	0
100	0.00	0.00	0	0	0



## Area-Capacity-Elevation

Reservoir Node Properties (118)

Node Name: Page\_Reservoir

Description:

General | Capacity | Elevation | Groundwater | Scopepage | Power | Runoff Forecast

**K1,K2,Hydraulic Capacity**

Area	Capacity	Elevation	Hydraulic Capacity
0	0	2.00	0
3224000	440	2.00	0000000
3660000	1368	2.00	0000000
5000000	4467	2.00	0000000
7400000	8878	2.00	0000000
8173000	7218	2.00	0000000
1.119E+07	13780	2.00	0000000
1.402E+07	18930	2.00	0000000
1.747E+07	27480	2.00	0000000
2.11E+07	38550	2.00	0000000
2.478E+07	52270	2.00	0000000
2.82E+07	69620	2.00	0000000
3.146E+07	78600	2.00	0000000
3.456E+07	92740	2.00	0000000
3.758E+07	10260	2.00	0000000

OK Cancel Apply



## Demand Node Type & Priority

E-MODSIM - (HWI\_simulation\_application)

Sub-Station

Demand Node Properties (114)

Node Name: Capa\_Reservoir

Description:

General | New Series | Groundwater

Demand Node Type: **Consumptive**

Demand Definition Type: New Series

Priority: **100**

Priority Number: **100**

General Information

Start Flow Forecast: [ ]

End Flow Forecast: [ ]

OK Cancel Apply







## Agricultural Demand Setting

Demand Node Properties (1)

Node Name: [92\_Agricultural]

Description:

General | Time Series | Constraints

Demand Node Type: [Consumption]

Demand Definition Type: [Time Series]

Priority

Priority Number: **100**

Demand Information

Direct Flow Time Unit: [ ]

Forecasting Time Series: [ ]

OK Cancel Apply

Demand Node Properties (2)

Node Name: [92\_Agricultural]

Description:

General | Time Series | Constraints

Demand Node Type: [Consumption]

Demand Definition Type: [Time Series]

Priority

Priority Number: **100**

Demand Information

Direct Flow Time Unit: [ ]

Forecasting Time Series: [ ]

OK Cancel Apply

● Priority

■ Municipal > Industrial > Agricultural



## Agricultural Demand Input

Demand Node Properties (1)

Node Name: [92\_Agricultural]

Description:

General | Time Series | Constraints

Data File

Values by Year: [ ]

Time Series Data (x, y)

Start Date	End Date	Value/Mark
01/01	3/31	0
04/01	4/30	100
05/01	5/31	300
06/01	6/30	450
07/01	7/31	630
08/01	8/31	550
09/01	9/30	360
10/01	10/31	0

OK Cancel Apply

Demand Node Properties (2)

Node Name: [92\_Agricultural]

Description:

General | Time Series | Constraints

Data File

Values by Year: [ ]

Time Series Data (x, y)

Start Date	End Date	Value/Mark
01/01	3/31	0
04/01	4/30	290
05/01	5/31	790
06/01	6/30	5620
07/01	7/31	2712
08/01	8/31	3220
09/01	9/30	2250
10/01	10/31	0

OK Cancel Apply

● Usually from April to September



## Return Flow

Node Name: 01\_Agricultural

Description:

General | Time Series | Groundwater

Groundwater Pumping

Pumping Rate: Pumping Month:

Create Table: Deposition Lag Table List

Groundwater Infiltration

Create Table: Infiltration Lag Table List

Number	Location	Fraction
1	01_Ag_FT	

Data | Plot

Values By Year: Tools

Start Date	End Date	Rate/Month
1/1/01	1/31/01	0.3

OK Cancel Apply

Node Name: 01\_Agricultural

Description:

General | Time Series | Groundwater

Groundwater Infiltration

Create Table: Infiltration Lag Table List

Number	Location	Fraction
1	01_Ag_FT	

Data | Plot

Values By Year: Tools

Start Date	End Date	Rate/Month
1/1/01	1/31/01	0.3

OK Cancel Apply

- Return Flow Calculation
  - User Generated: Direct Fraction
  - Model Generated: Physical Parameters



## Flowthru Demand Setting

Node Name: Instreamflow

Description:

General | Time Series | Flow thru

Demand Node Type: Flow thru

Demand Definition Type: Flow Series

Priority

Priority Number: 11

Demand Information

Direct Flow Parameter:

Penetration: Turbidity:

OK Cancel Apply

- Used for Instream Flow, Navigation etc.

Node Name: Instreamflow

Description:

General | Time Series | Flow thru

Data | Plot

Values By Year: Tools

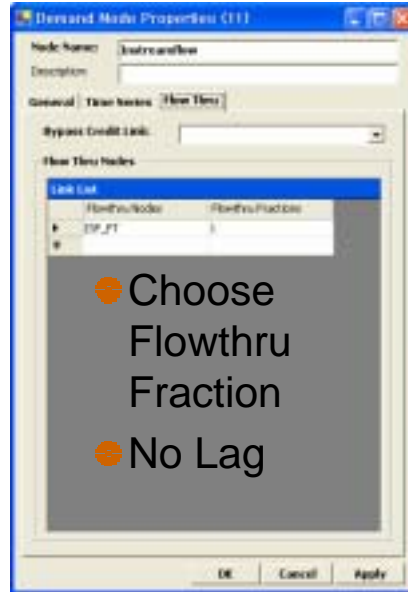
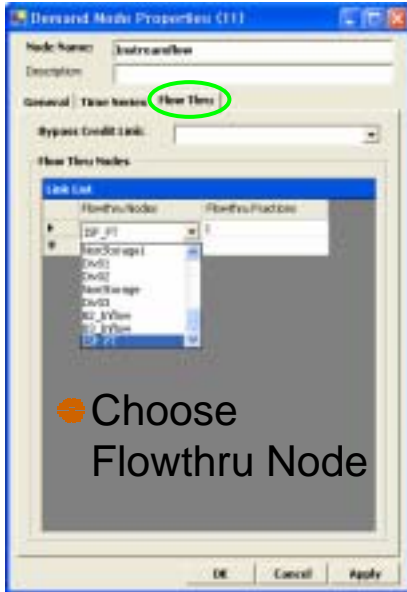
Start Date	End Date	Value/Month
01/01	3/31	2000
04/01	4/30	3000
05/01	5/31	4000
06/01	6/30	3000
07/01	7/31	2000

OK Cancel Apply

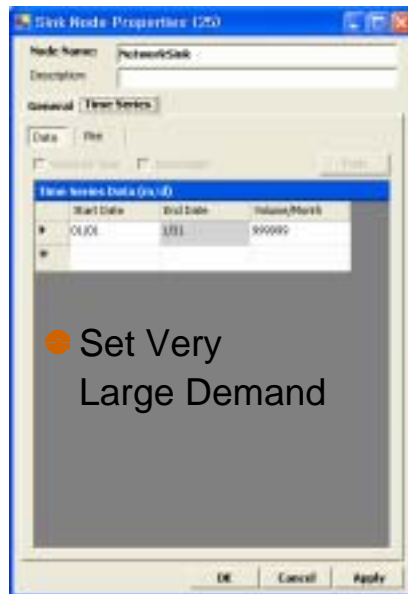
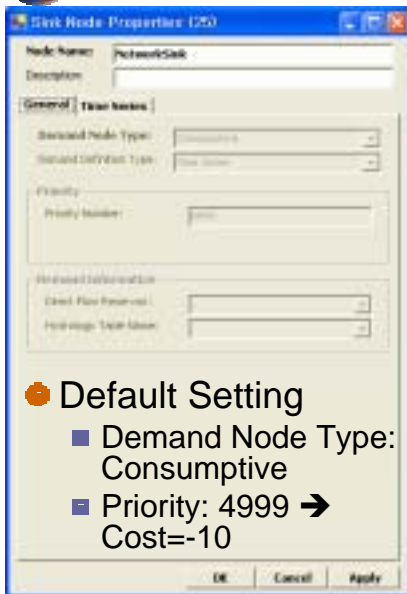




## Destination & Fractions



## Network Sink Node Setting





## K-MODSIM Run

● Run Type

- Run MODSIM
- Custom Runs



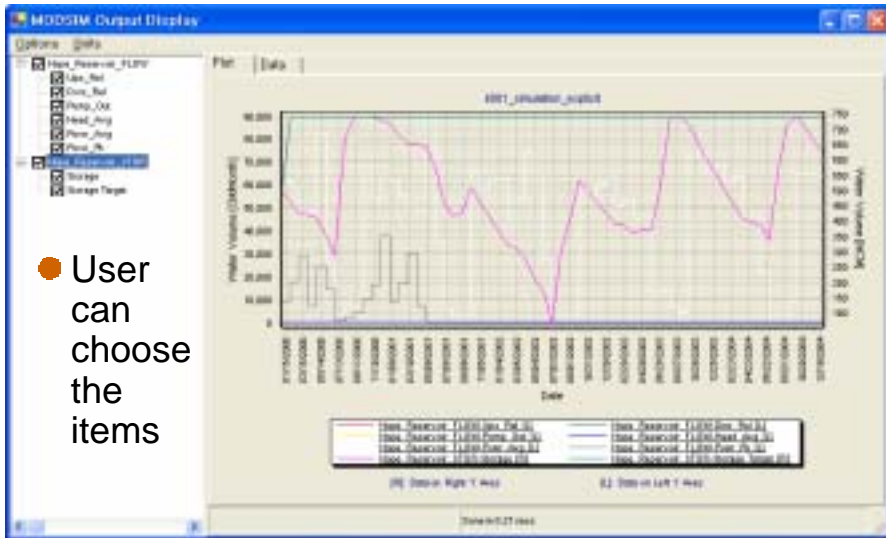
## Graphical Display of Output

● Click Right Mouse Button



## Case 1 Results: Reservoir(Graphs)

- User can choose the items



## Case 1 Results: Reservoir(Data)

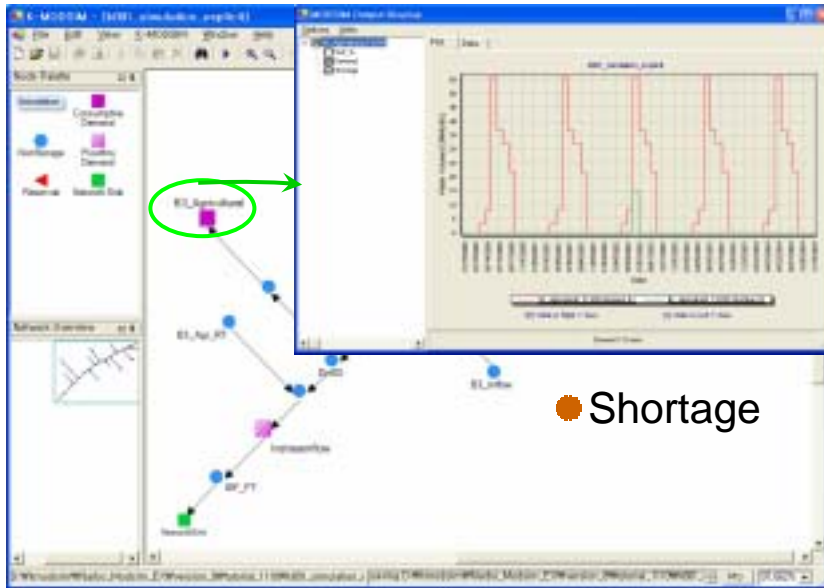
The screenshot shows the MODSIM Output Display window with the 'Data' tab selected. A 'New DataSet' dialog box is open, displaying a table of reservoir data. The table has three columns: 'Date', 'Storage', and 'Storage Tar'. The data points are as follows:

Date	Storage	Storage Tar
1/1/2000	412	143
2/1/2000	350	143
3/1/2000	296	143
4/1/2000	671	143
5/1/2000	743	143
6/1/2000	743	143
7/1/2000	743	143
8/1/2000	739	143
9/1/2000	719	143
10/1/2000	652	143
11/1/2000	652	143
12/1/2000	650	143
1/1/2001	644	143
2/1/2001	577	143
3/1/2001	463	143
4/1/2001	419	143
5/1/2001	427	143
6/1/2001	508	143
7/1/2001	462	143
8/1/2001	419	143
9/1/2001	372	143
10/1/2001	325	143

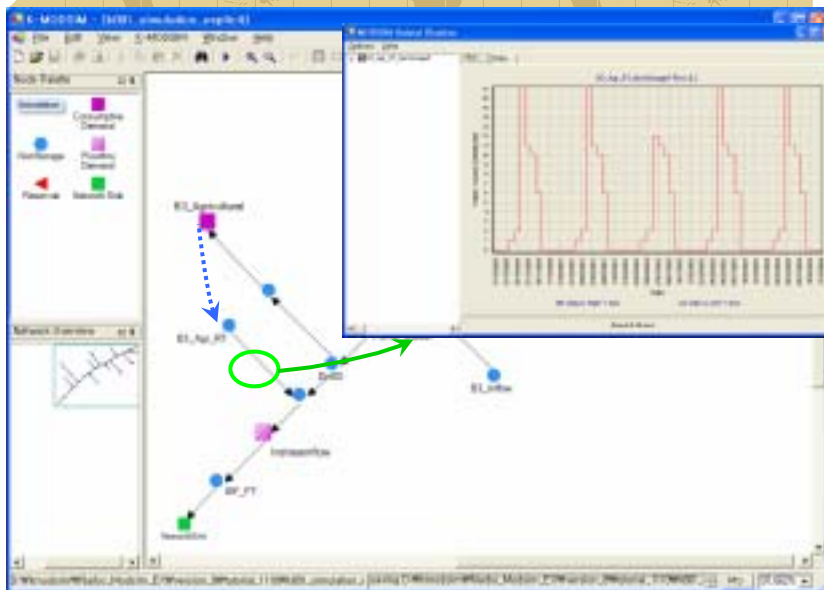




## Case 1 Result: Agricultural Dem.



## Case 1 Result: Return Flow





## Case 2 Problem

### ● Purposes

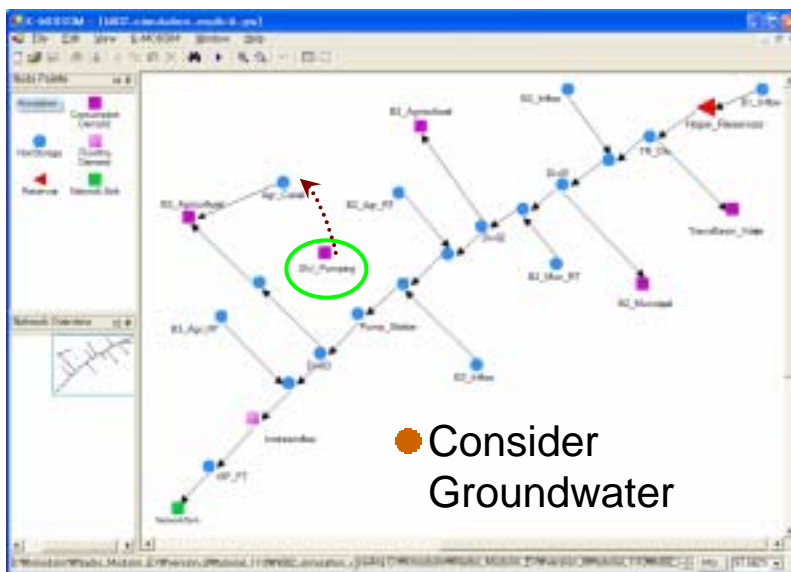
- To simulate the basin-wide water allocation model using conjunctive use option

### ● Problem Description

- Use the Results of RRFS (Natural Inflow Data)
- Use Explicit Reservoir Target Storage
- Consider Transbasin Water, Municipal and Agricultural Demand and Instream Flow Demand
- Consider Return Flows (0.6, 0.3)
- Consider Groundwater Pumping
- Evaluate Reservoir Storage, Hydropower, and Shortages of Demand Nodes



## Case 2 Network





# Groundwater Pumping Node

The screenshot shows the ArcSWAT interface with a network diagram. A node labeled 'GW\_Pumping' is highlighted with a green circle. The 'Demand Node Properties (24)' dialog box is open, showing the following settings:

- Node Name: GW\_Pumping
- Description:
- General | Time Series | Consumption
- Demand Node Type: Consumption
- Demand Definition Type: Flow Series
- Priority: Priority Number: 100
- Demand Information: Direct Flow Parameter: [dropdown], Indirect Flow Series: [dropdown]



# Groundwater Pumping Node

The screenshot shows the same network diagram with the 'GW\_Pumping' node highlighted. The 'Demand Node Properties (24)' dialog box is open, showing the 'Time Series Data (0x,0)' table:

Start Date	End Date	Volume (M3/D)
01/01	1/1/1	0
04/01	4/30	200
07/01	6/30	2000
09/01	7/31	1000
08/01	8/31	400
09/01	9/30	0





## Groundwater Pumping Node

The screenshot displays the ArcSWAT interface with a network diagram and a 'Demand Node Properties (24)' dialog box. The network diagram shows a central node labeled 'GW\_Pumping' circled in green, connected to various other nodes like 'Ag\_Canal', 'Ag\_P1', and 'Pump\_Station'. The dialog box is titled 'Demand Node Properties (24)' and has 'Node Name: GW\_Pumping' and 'Description:'. It is divided into 'General' and 'Greenwater' tabs. The 'Greenwater' tab is active, showing 'Greenwater Pumping' settings: 'Pumping Rate: 2000' and 'Pumping Priority:'. Below this are two tables: 'Greenwater Lag Table List' and 'Greenwater Infiltration Lag Table List'. The 'Greenwater Lag Table List' has one entry: '1 Pump\_Station'. The 'Greenwater Infiltration Lag Table List' has one entry: '1 Ag\_Canal'. At the bottom, there is an 'Infiltration Rate (m/d)' table with one entry: '1 1/1 1/1 1'. The dialog box has 'OK', 'Cancel', and 'Apply' buttons.



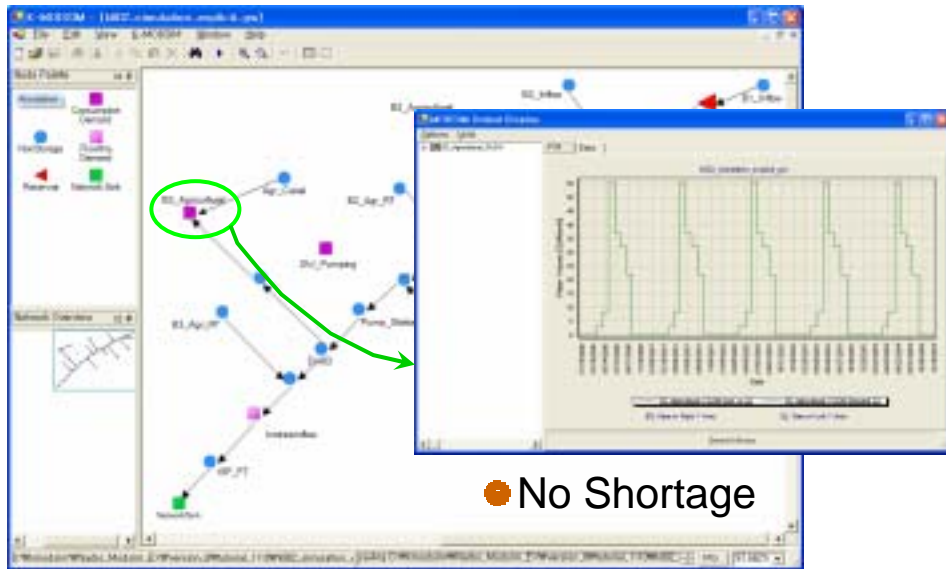
## Case 2 Result: GW Pumping

The screenshot shows the ArcSWAT interface with the same network diagram as the previous image, but with the 'GW\_Pumping' node circled in green. A 'SWAT Output Graphing' dialog box is open, displaying a graph of 'SWAT Output Graphing'. The graph shows a series of vertical bars representing the output of the 'GW\_Pumping' node over time. The x-axis is labeled 'Date' and the y-axis is labeled 'Value (m3/d)'. The graph shows a series of vertical bars, indicating the output of the 'GW\_Pumping' node over time. The dialog box has 'OK' and 'Cancel' buttons.





## Case 2 Result: Agricultural Dem.

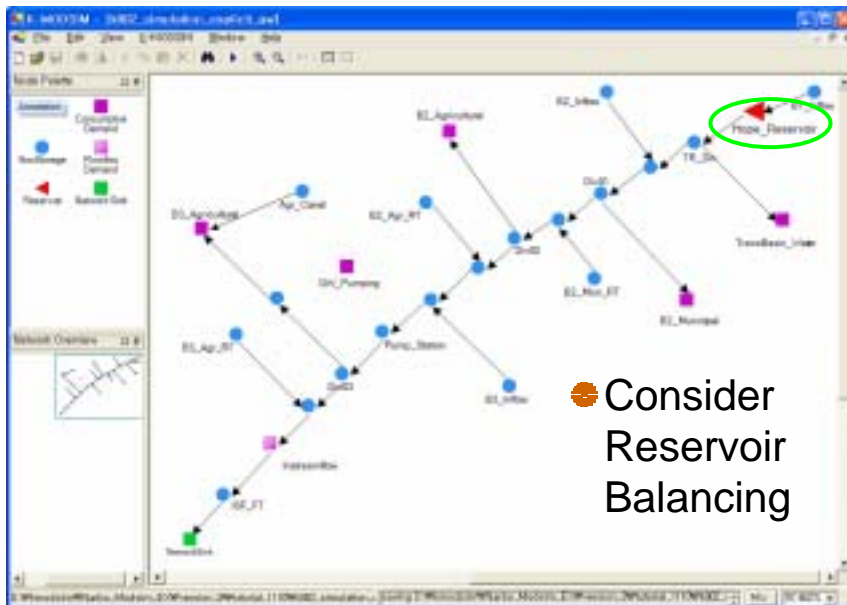


## Case 3 Problem

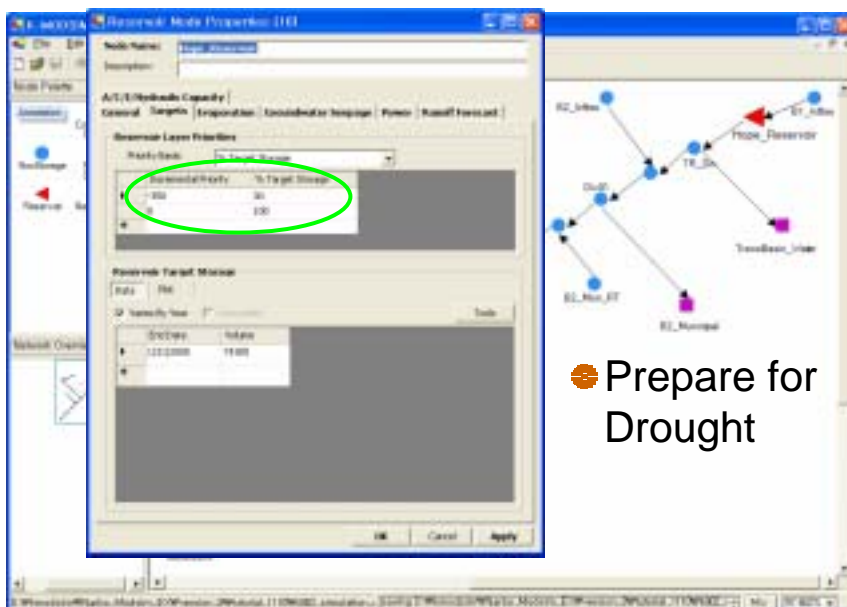
- Purposes
  - To simulate the basin-wide water allocation model considering uncertainties of reservoir operation rule
- Problem Description
  - Use the Results of RRFs (Natural Inflow Data)
  - Use Explicit Reservoir Target Storage
  - Consider Transbasin Water, Municipal and Agricultural Demand and Instream Flow Demand
  - Consider Return Flows (0.6, 0.3)
  - Consider Groundwater Pumping
  - Consider Reservoir Balancing in Operation
    - Reservoir Zoning & Change the Priorities of Zones
  - Evaluate Reservoir Storage, Hydropower, and Shortages of Demand Nodes



## Case 3 Network

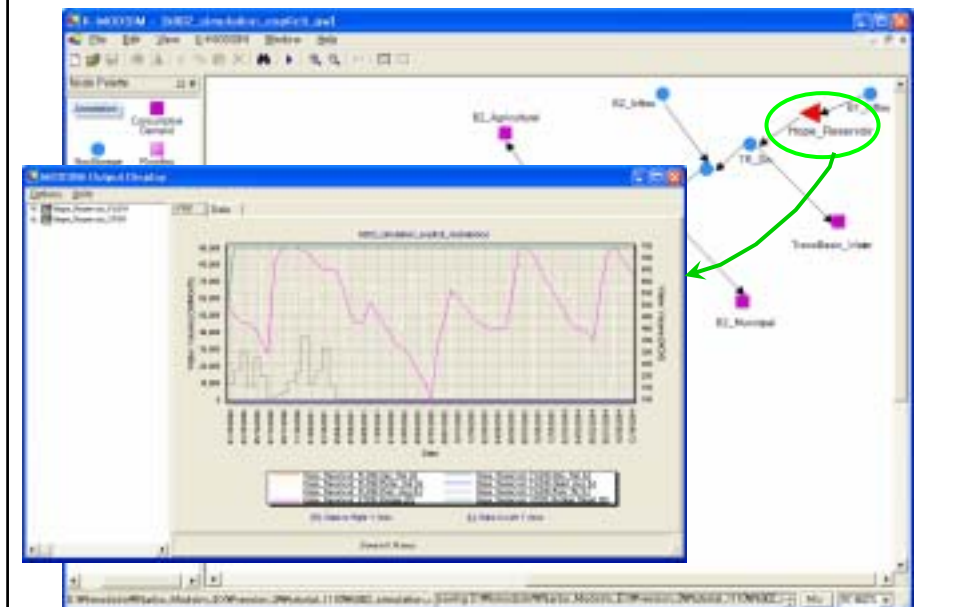


## Reservoir Balancing Setting





## Case 3 Result: Reservoir Storage



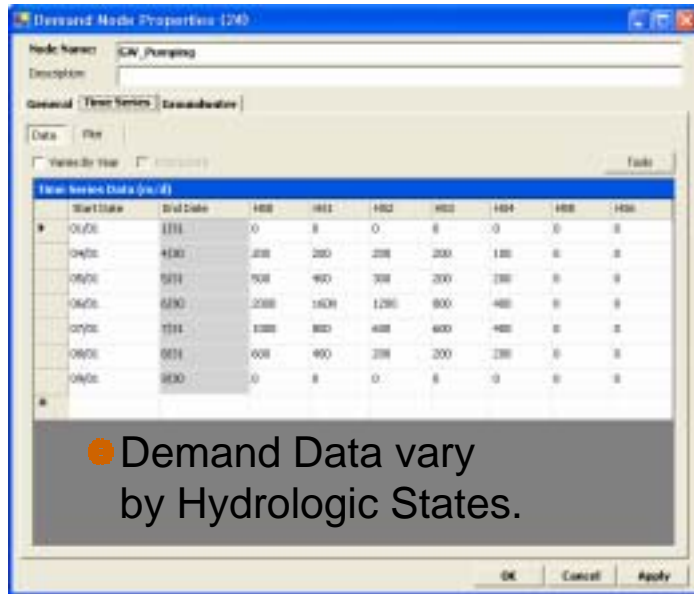
## Case 4 Problem

- Purposes
  - To demonstrate the real operation of the basin-wide water allocation using hydrologic state condition
- Problem Description
  - Use the Results of RRFs (Natural Inflow Data)
  - Use Explicit Reservoir Target Storage
  - Consider Transbasin Water, Municipal and Agricultural Demand and Instream Flow Demand
  - Consider Return Flows (0.6, 0.3) and Groundwater Pumping
  - Consider Hydrologic States in Operation
    - Use Conditional Rules
  - Evaluate Reservoir Storage, Hydropower, and Shortages of Demand Nodes





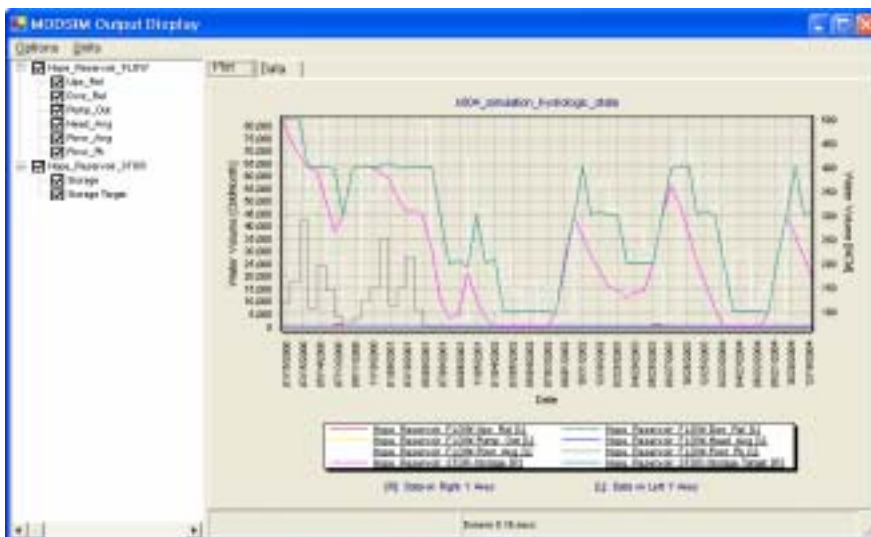
## GW Pumping Input



- Demand Data vary by Hydrologic States.

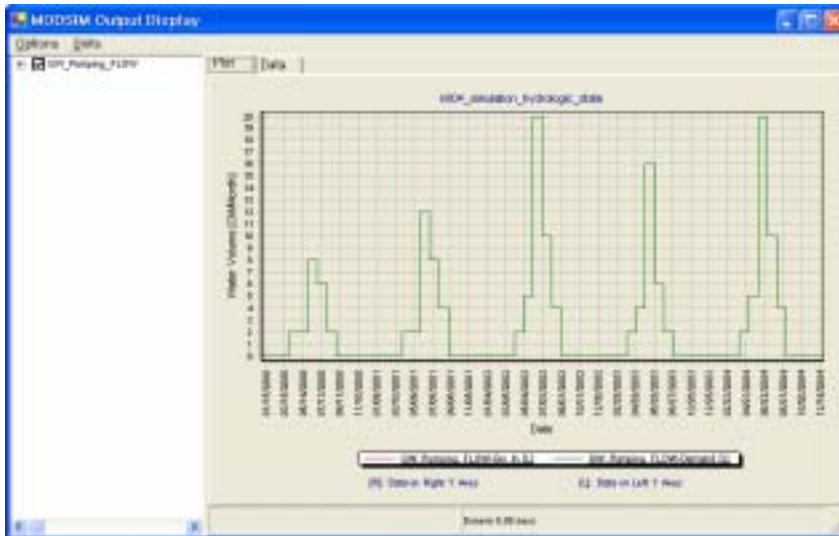


## Case 4 Result: Reservoir Storage

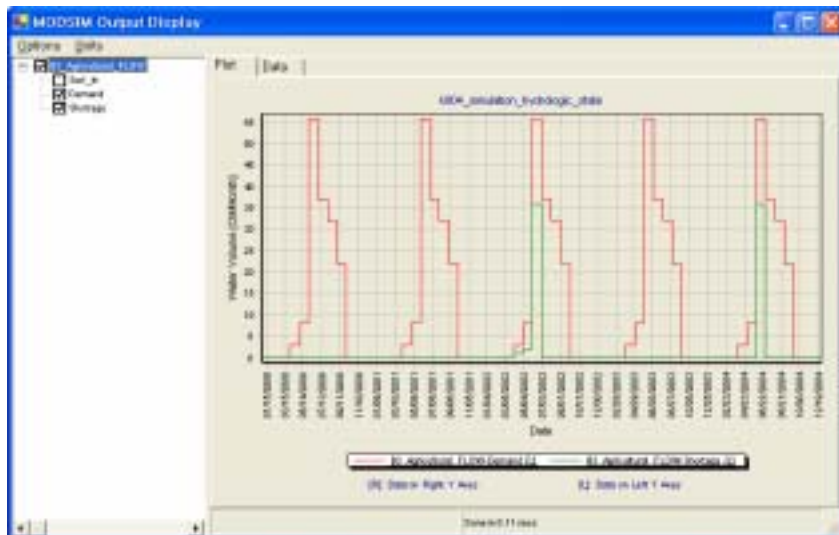




## Case 4 Result: GW Pumping



## Case 4 Result: Agricultural Dem.





## Case 5 Problem

### • Purposes

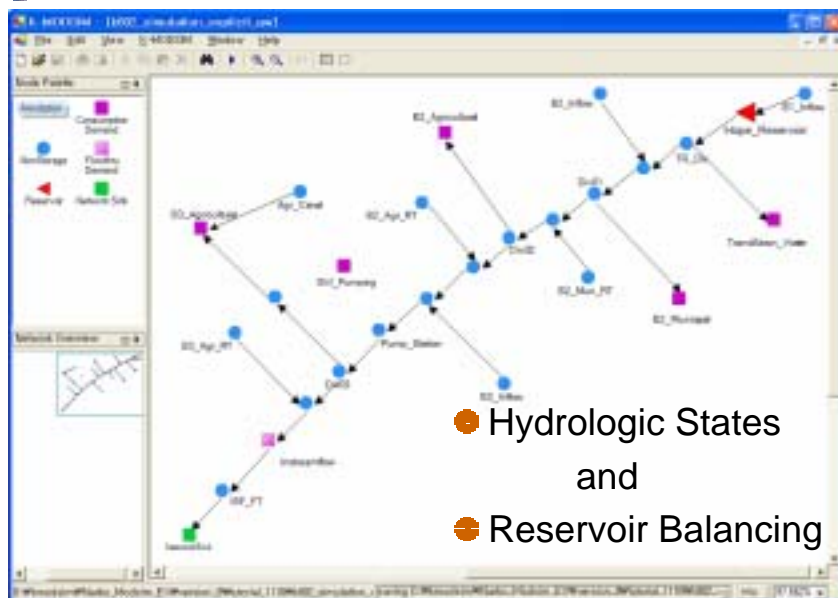
- To demonstrate the real operation of the basin-wide water allocation considering uncertainties of reservoir operation rule

### • Problem Description

- Use the Results of RRFs (Natural Inflow Data)
- Use Explicit Reservoir Target Storage
- Consider Transbasin Water, Municipal and Agricultural Demand and Instream Flow Demand
- Consider Return Flows (0.6, 0.3) and Groundwater Pumping
- Consider Hydrologic States in Operation
  - Use Conditional Rules
- Consider Reservoir Balancing in Operation
  - Reservoir Zoning & Change the Priorities of Zones
- Evaluate Reservoir Storage, Hydropower, and Shortages of Demand Nodes



## Case 5 Network







## Reservoir Balancing & Target

The screenshot shows the 'Reservoir Balancing' dialog box with the 'Reservoir Layer Position' table and a network diagram. The table lists reservoir targets for various hydrologic states.

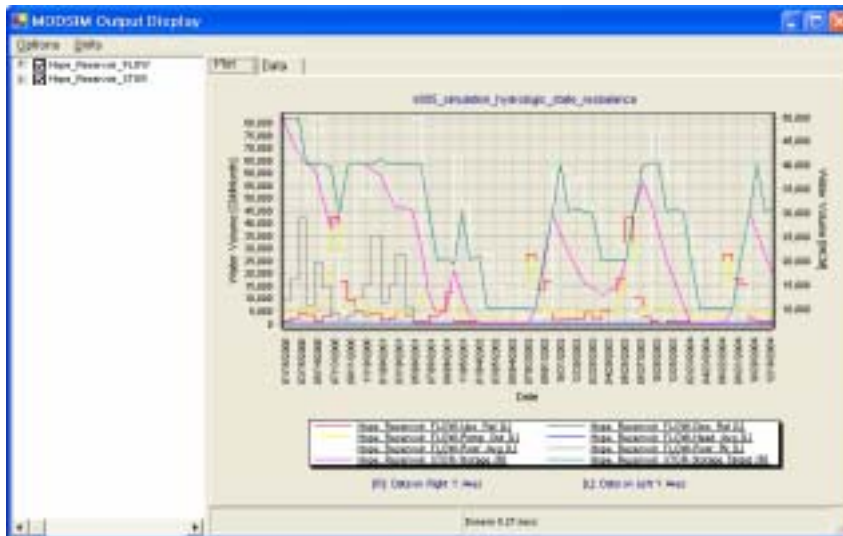
Hydrologic State	Target Storage
Wet	90
Normal	100
Dry	110

The network diagram shows a series of reservoirs and connections, with a red arrow pointing to a reservoir node.

- Reservoir Targets vary by Hydrologic States.



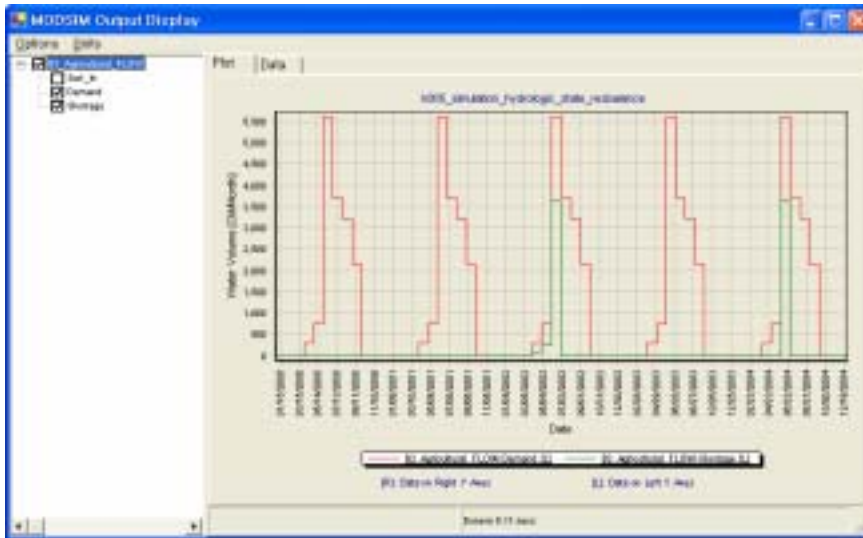
## Case 5 Result: Reservoir Storage







## Case 5 Result: Agricultural Dem.



Thank You  
Very Much!