LAKE KEMP REALLOCATION AND YIELD DETERMINATION WITH RIVERWARE'S MRM

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Corps of Engineers, Tulsa District

Contributors:

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Allen Avance, Corps of Engineers, Ft Worth

David Neumann & CADSWES Staff

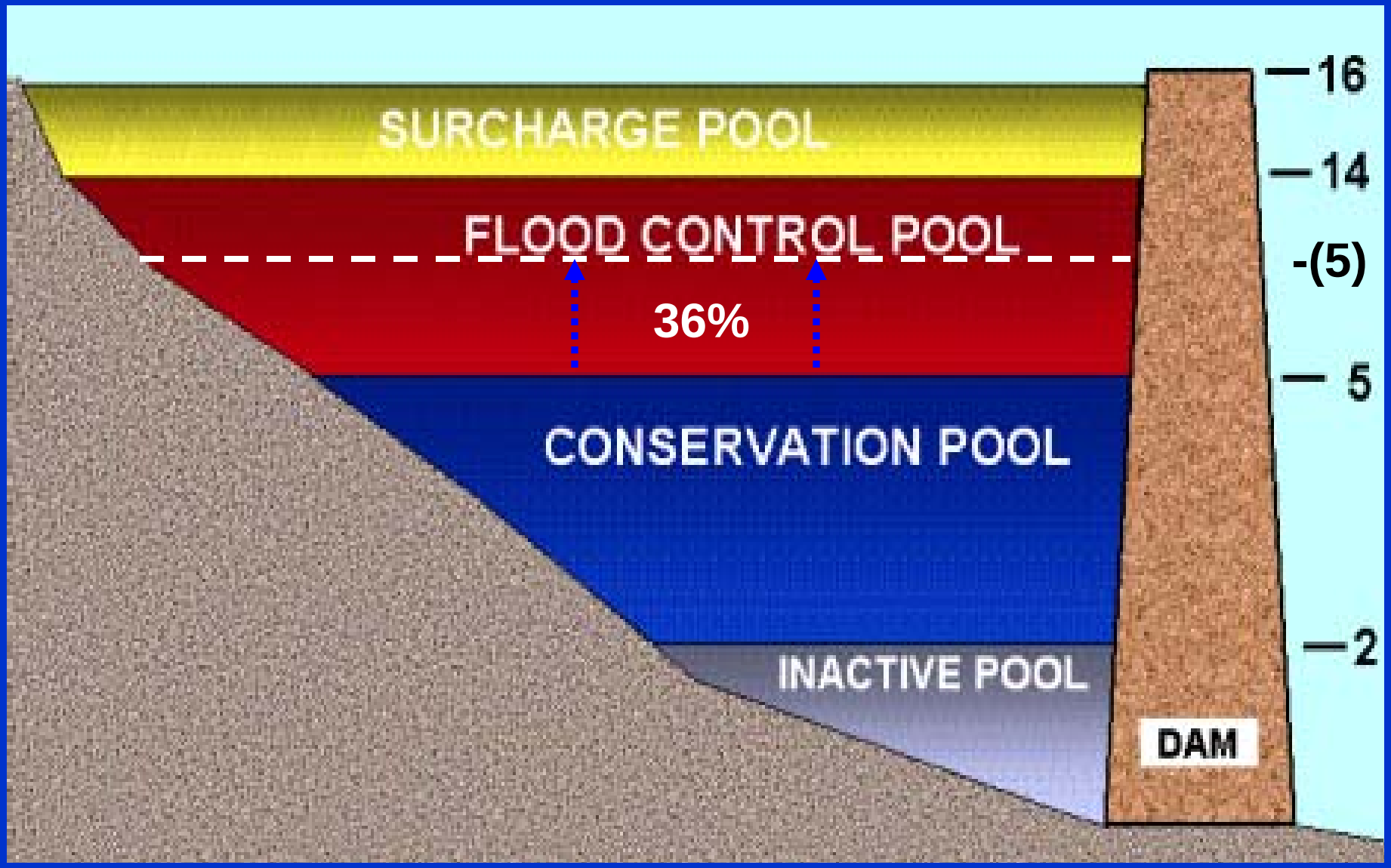
REALLOCATION STUDY ONGOING

TODAY'S DISCUSSION: CONCENTRATE ON PROCESS , NOT RESULT No's

NET YET INCORPORATED:

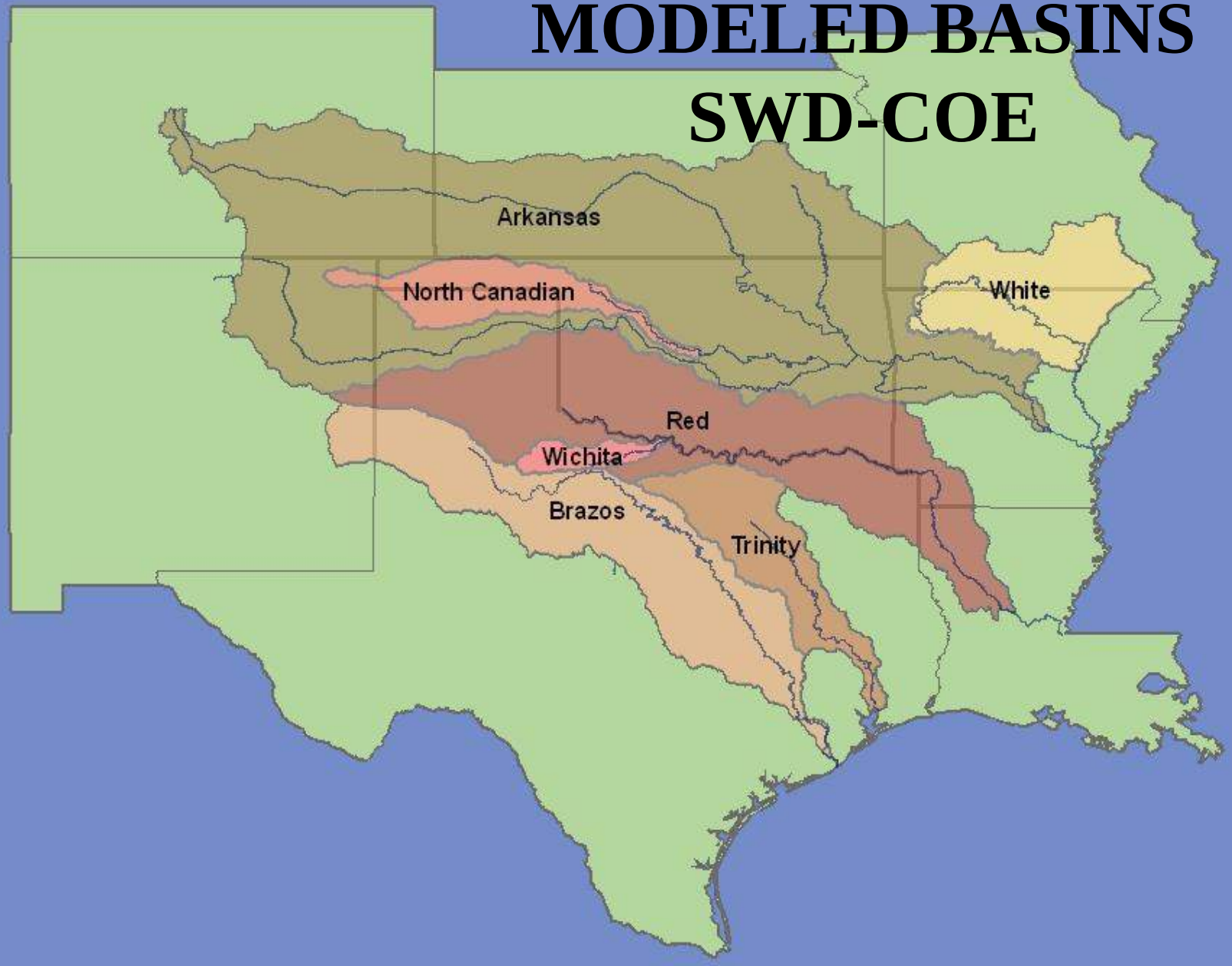
Recent Capacity Survey

Future Capacity Projection: YR 2072



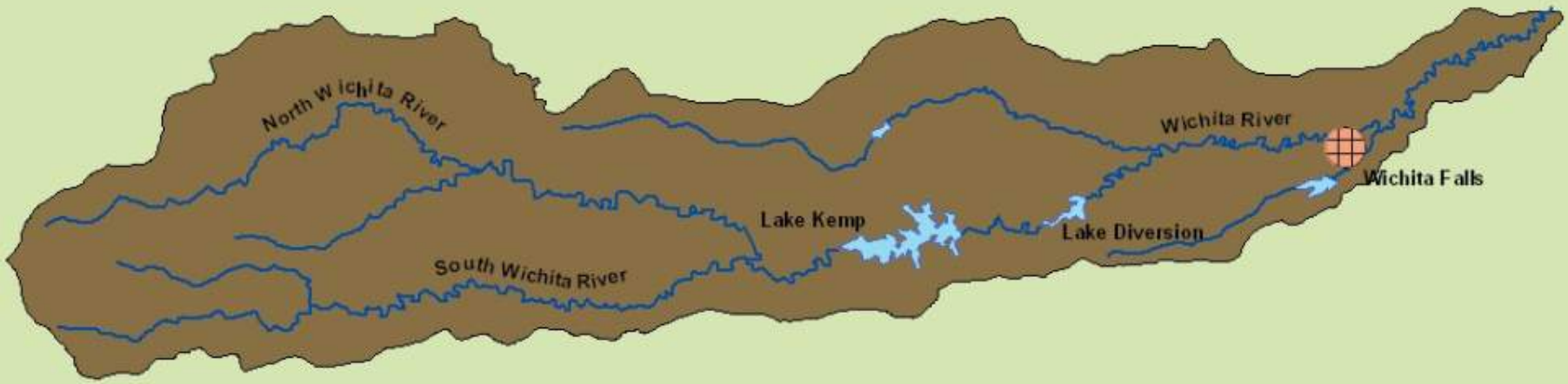
USACE storage divisions and balance levels

MODELED BASINS SWD-COE



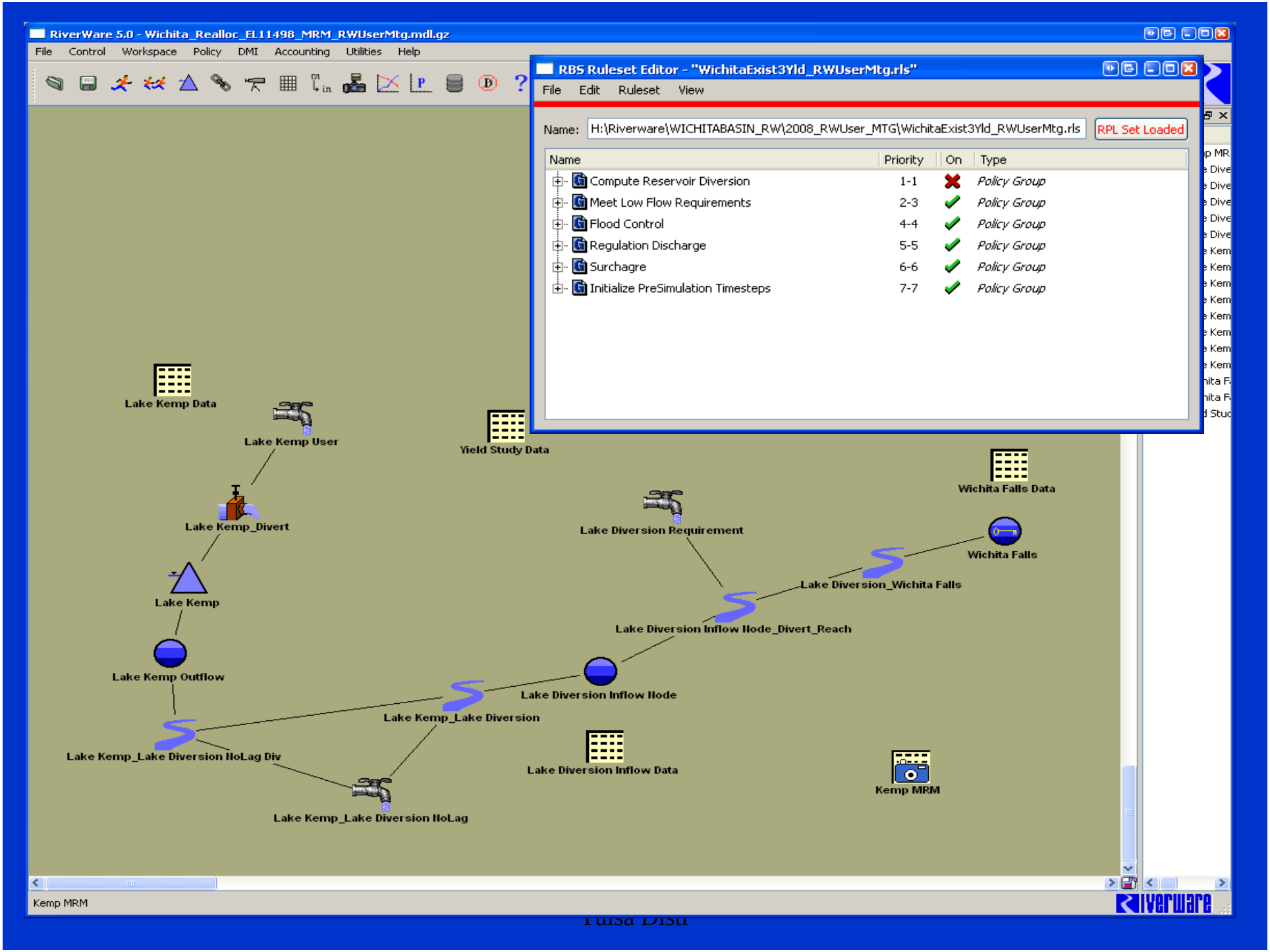
Wichita River Basin: approx 3,480 sq mi

Lake Kemp: approx 2,090 sq mi

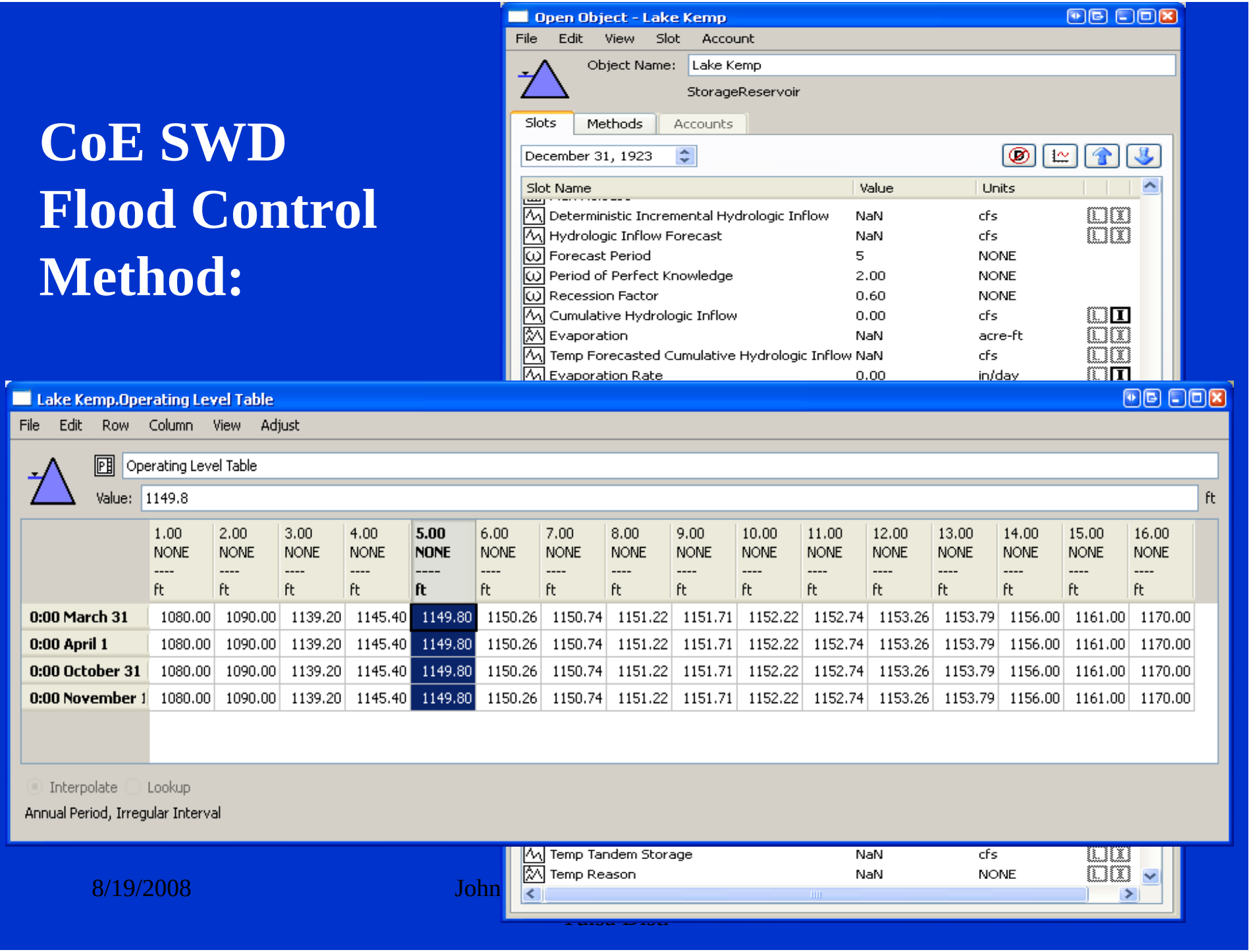


RIVERWARE APPROACH:

- **SWD CoE Flood Control Balancing Method**
- **Rules Based**
- **79-Year Period of Record Daily Simulation**
- **Multi-Run-Mgr for Yield**
- **Base Condition & Alternative Runs**
- **Statistics**


RiverWare 5.0 - Wichita_Realloc_EL11498_MRM_RWUserMtg.mdl.gz
File Control Workspace Policy DMI Accounting Utilities Help
RBS Ruleset Editor - "WichitaExist3Yld_RWUserMtg.rls"
File Edit Ruleset View
Name: H:\Riverware\WICHITABASIN_RW\2008_RWUser_MTG\WichitaExist3Yld_RWUserMtg.rls
RPL Set Loaded
Name Priority On Type
Compute Reservoir Diversion 1-1 Policy Group
Meet Low Flow Requirements 2-3 Policy Group
Flood Control 4-4 Policy Group
Regulation Discharge 5-5 Policy Group
Surchagre 6-6 Policy Group
Initialize PreSimulation Timesteps 7-7 Policy Group
Lake Kemp Data
Lake Kemp User
Yield Study Data
Wichita Falls Data
Lake Kemp_Divert
Lake Diversion Requirement
Wichita Falls
Lake Kemp
Lake Diversion_Wichita Falls
Lake Diversion Inflow Node_Divert_Reach
Lake Kemp Outflow
Lake Diversion Inflow Node
Lake Kemp_Lake Diversion
Lake Kemp_Lake Diversion NoLag Div
Lake Diversion Inflow Data
Kemp MRM
Lake Kemp_Lake Diversion NoLag
Kemp MRM
RiverWare

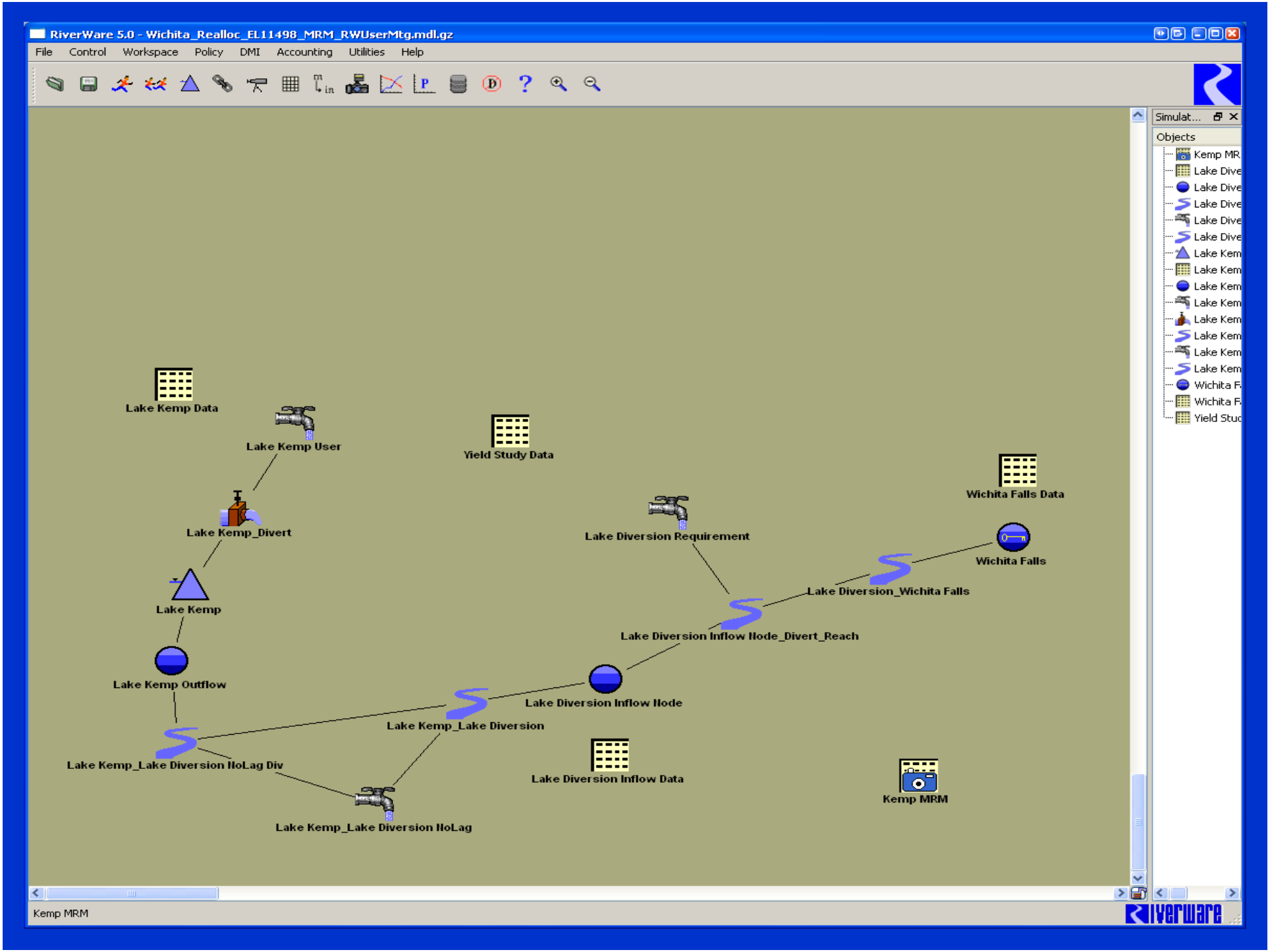
CoE SWD Flood Control Method:



	1.00 NONE ---- ft	2.00 NONE ---- ft	3.00 NONE ---- ft	4.00 NONE ---- ft	**5.00 NONE ---- ft**	6.00 NONE ---- ft	7.00 NONE ---- ft	8.00 NONE ---- ft	9.00 NONE ---- ft	10.00 NONE ---- ft	11.00 NONE ---- ft	12.00 NONE ---- ft	13.00 NONE ---- ft	14.00 NONE ---- ft	15.00 NONE ---- ft	16.00 NONE ---- ft
0:00 March 31	1080.00	1090.00	1139.20	1145.40	1149.80	1150.26	1150.74	1151.22	1151.71	1152.22	1152.74	1153.26	1153.79	1156.00	1161.00	1170.00
0:00 April 1	1080.00	1090.00	1139.20	1145.40	1149.80	1150.26	1150.74	1151.22	1151.71	1152.22	1152.74	1153.26	1153.79	1156.00	1161.00	1170.00
0:00 October 31	1080.00	1090.00	1139.20	1145.40	1149.80	1150.26	1150.74	1151.22	1151.71	1152.22	1152.74	1153.26	1153.79	1156.00	1161.00	1170.00
0:00 November 1	1080.00	1090.00	1139.20	1145.40	1149.80	1150.26	1150.74	1151.22	1151.71	1152.22	1152.74	1153.26	1153.79	1156.00	1161.00	1170.00

“Critical Dependable Yield”

Dependable Yield that Results in the Depletion of the Conservation Storage During Period of Record Drought


RiverWare 5.0 - Wichita_Realloc_EL11498_MRM_RWUserMtg.mdl.gz
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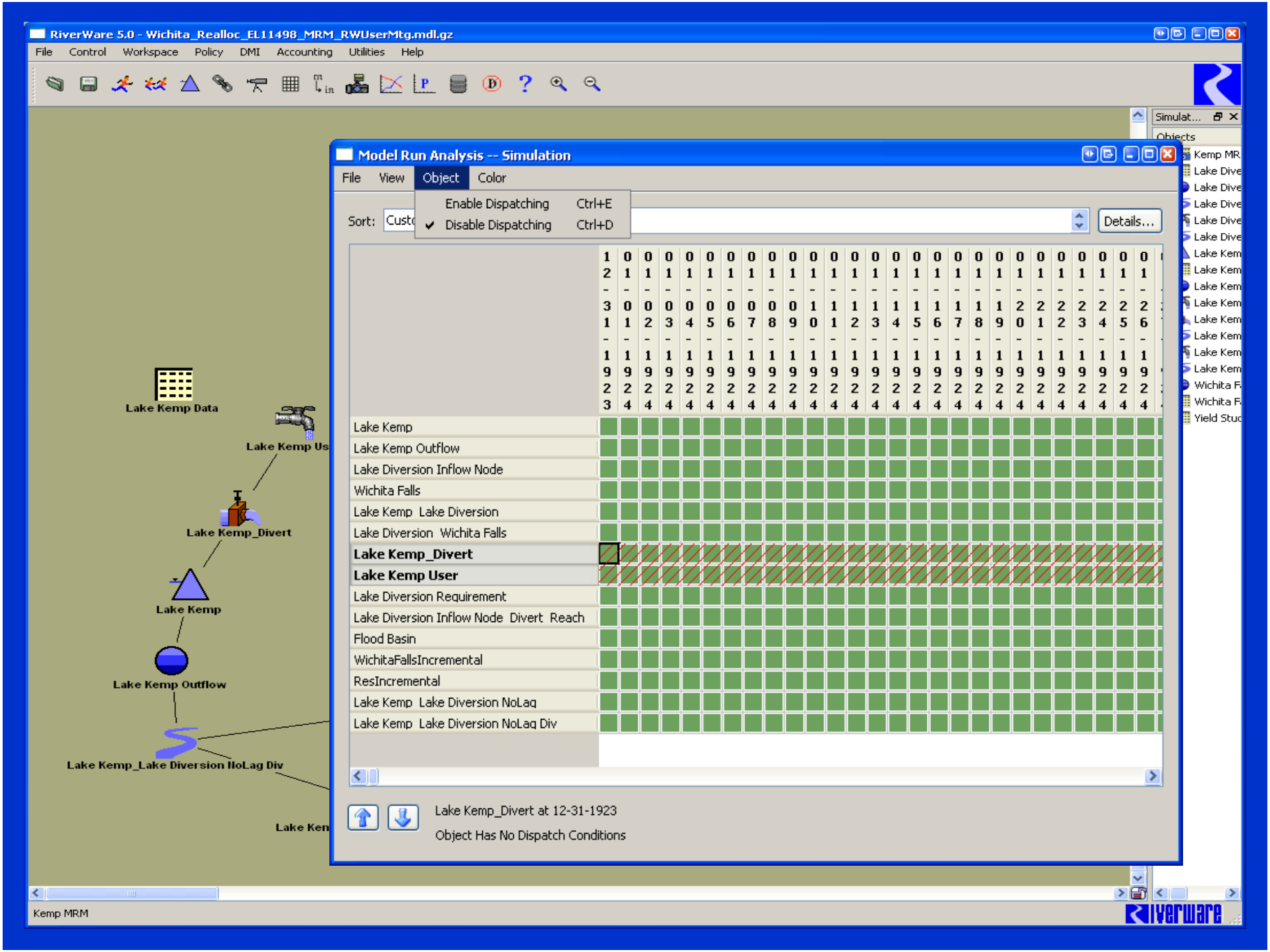
Kemp MRM
RiverWare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File Control Workspace Policy DMI Accounting Utilities Help
Model Run Analysis -- Simulation
File View Object Color
Enable Dispatching Ctrl+E
Disable Dispatching Ctrl+D
Sort:
Details...
Lake Kemp
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Lake Diversion Inflow Node
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Lake Kemp User
Lake Diversion Requirement
Lake Diversion Inflow Node Divert Reach
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ResIncremental
Lake Kemp Lake Diversion NoLag
Lake Kemp Lake Diversion NoLag Div
Lake Kemp_Divert at 12-31-1923
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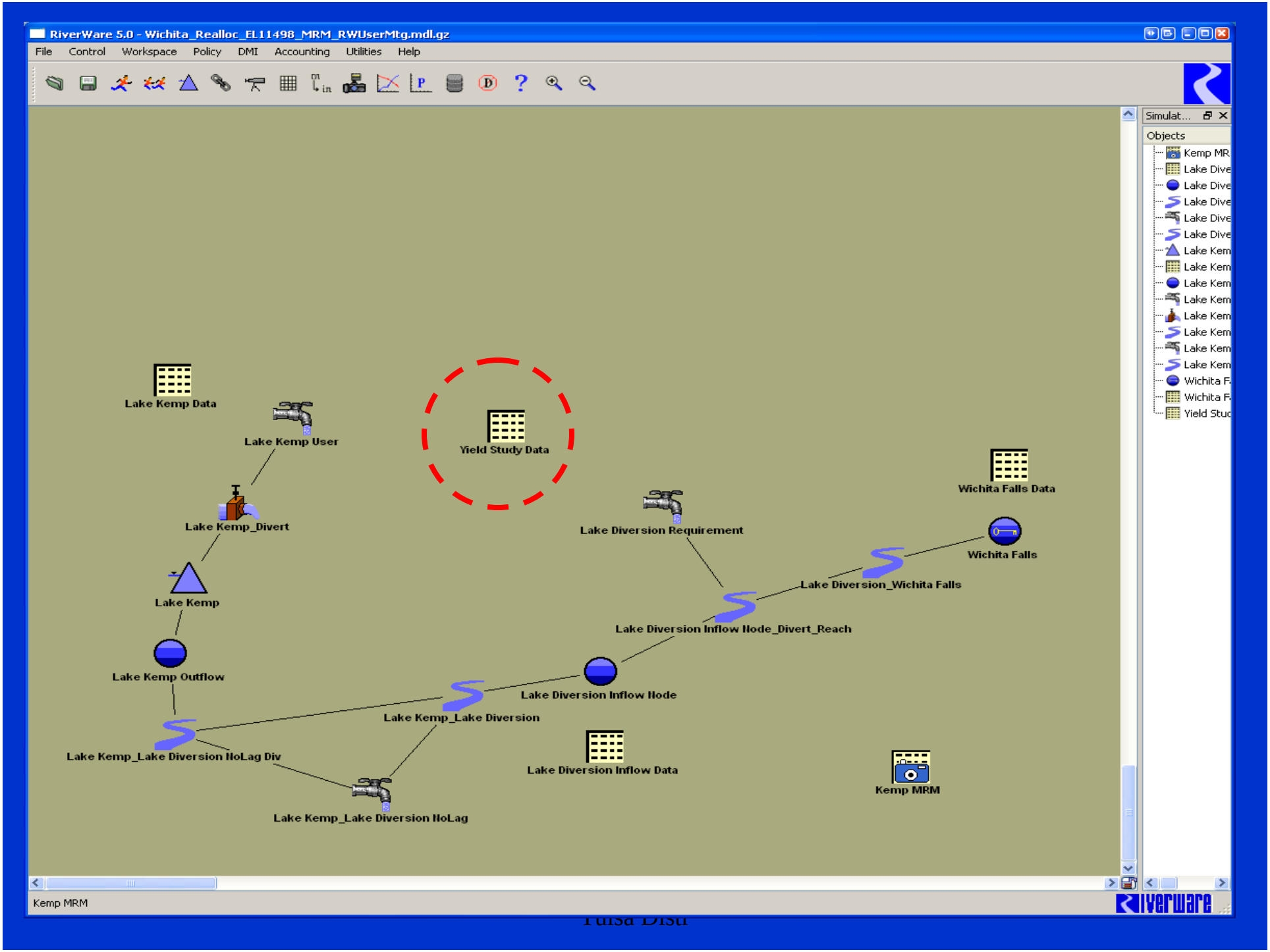
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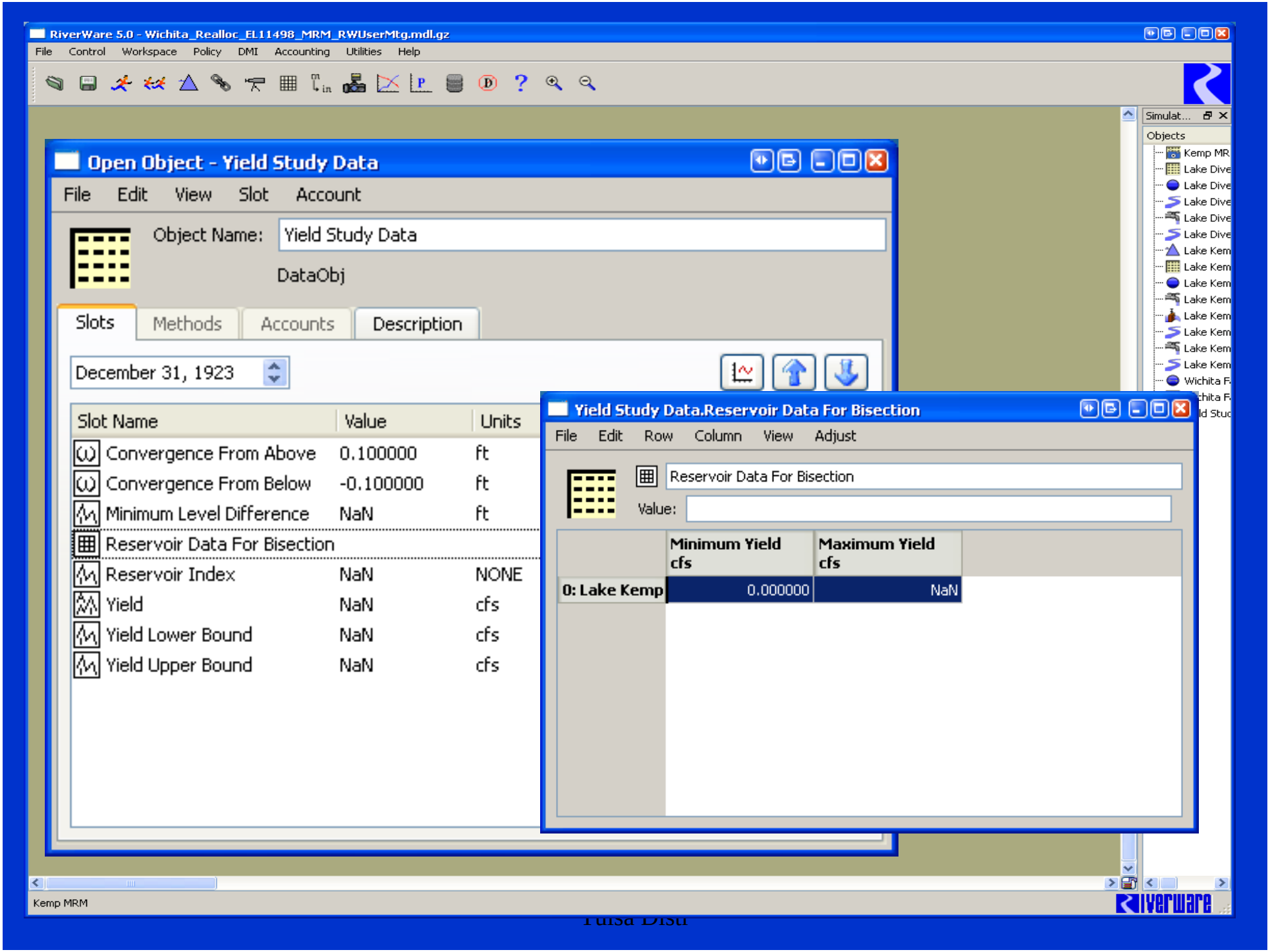
Kemp MRM
Riverware

Tulsa Dist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Open Object - Yield Study Data
File Edit View Slot Account
Object Name: Yield Study Data
DataObj
Slots Methods Accounts Description
December 31, 1923
Slot Name Value Units
Convergence From Above 0.100000 ft
Convergence From Below -0.100000 ft
Minimum Level Difference NaN ft
Reservoir Data For Bisection
Reservoir Index NaN NONE
Yield NaN cfs
Yield Lower Bound NaN cfs
Yield Upper Bound NaN cfs
Yield Study Data.Reservoir Data For Bisection
File Edit Row Column View Adjust
Reservoir Data For Bisection
Value:
Minimum Yield cfs
Maximum Yield cfs
0: Lake Kemp 0.000000 NaN
Simulat...
Objects
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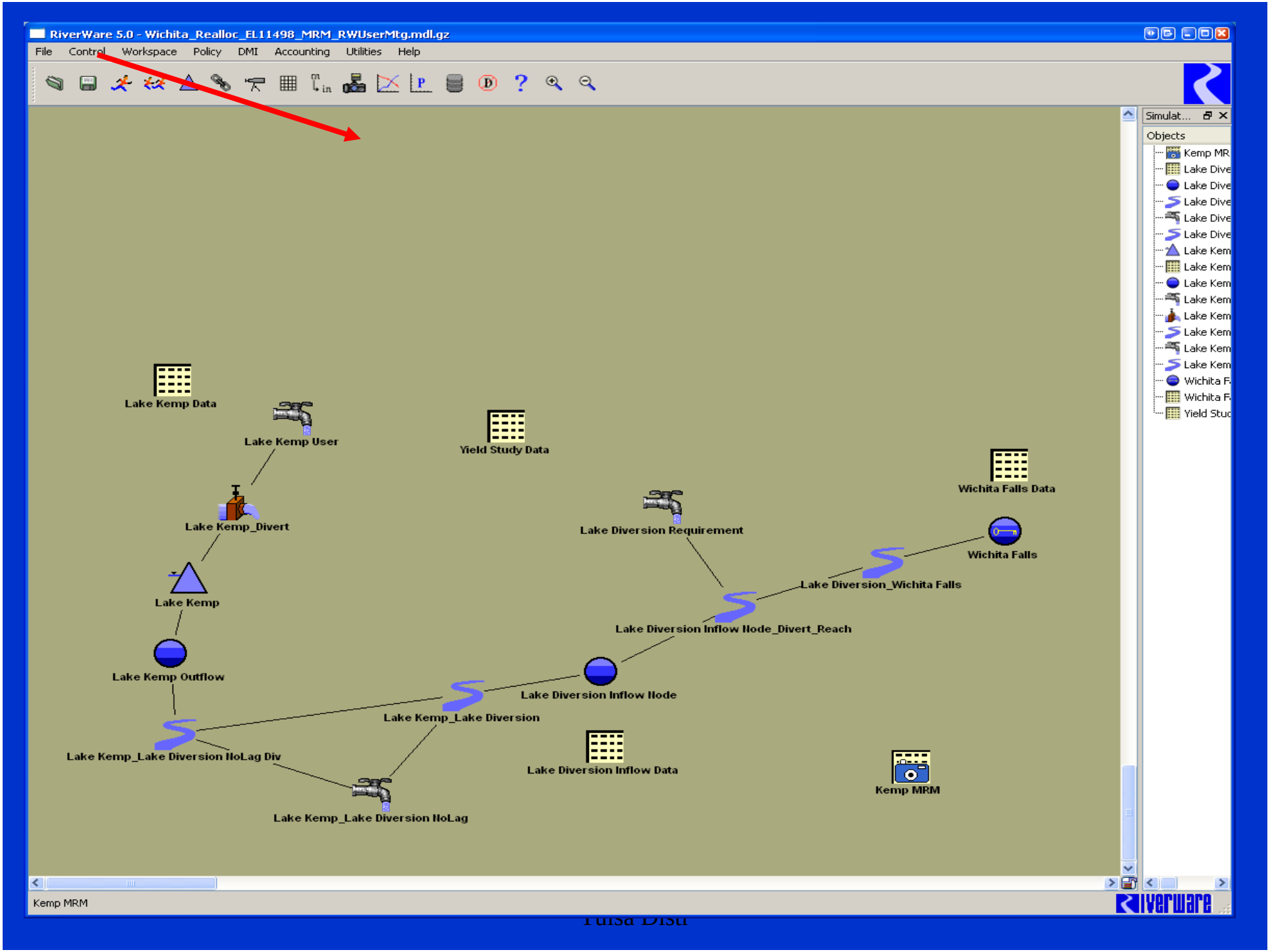
Lake Dive
Lake Kem
Wichita F
Kemp MRM
RiverWare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Lake Kemp_Lake Diversion
Lake Kemp_Lake Diversion NoLag Div
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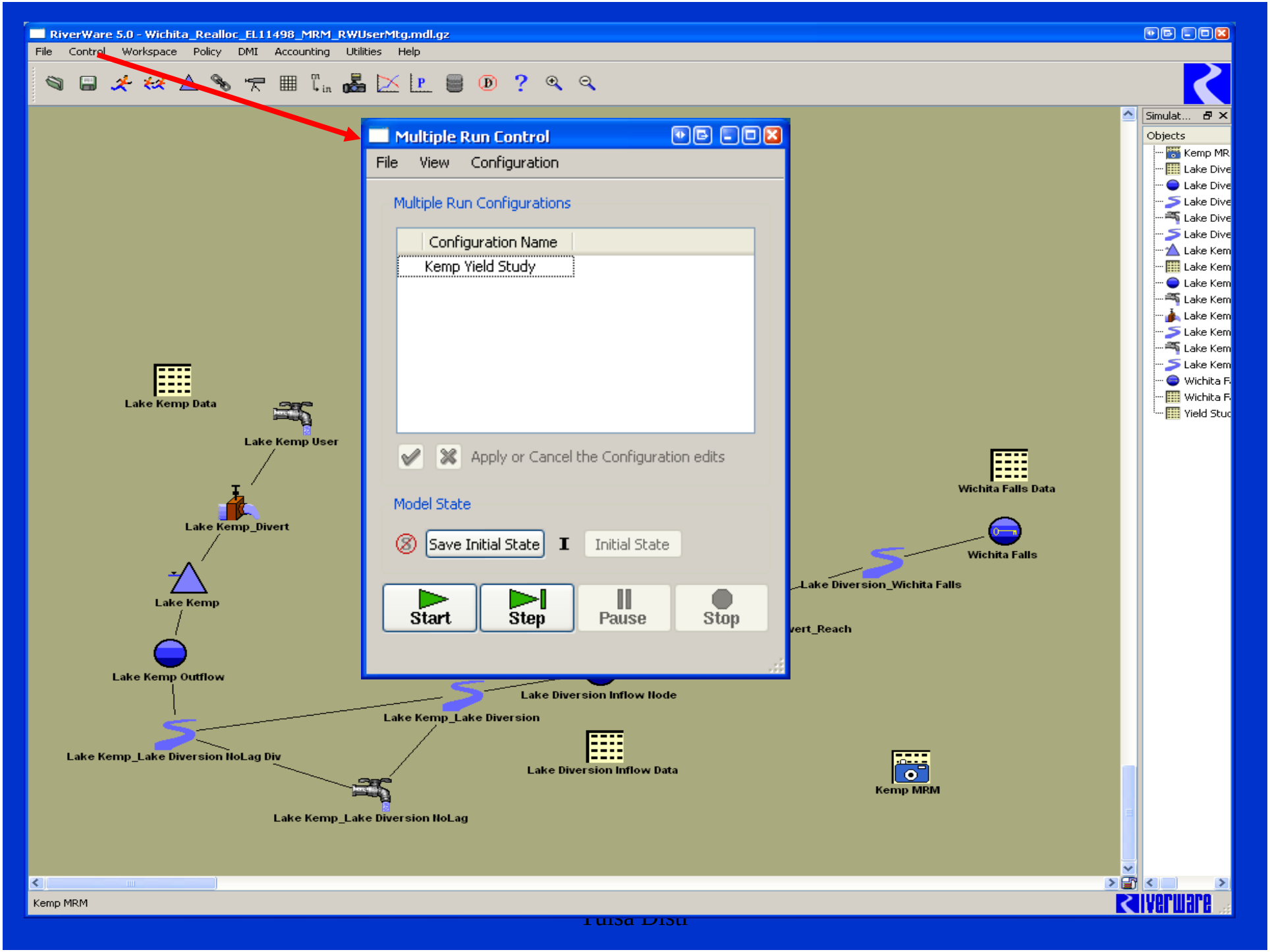
Kemp MRM
RiverWare

Tulsa Dist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Multiple Run Control
File View Configuration
Multiple Run Configurations
Configuration Name
Kemp Yield Study
Apply or Cancel the Configuration edits
Model State
Save Initial State
Initial State
Start
Step
Pause
Stop
Lake Kemp Data
Lake Kemp User
Lake Kemp_Divert
Lake Kemp
Lake Kemp Outflow
Lake Kemp_Lake Diversion NoLag Div
Lake Kemp_Lake Diversion NoLag
Lake Kemp_Lake Diversion
Lake Diversion Inflow Node
Lake Diversion Inflow Data
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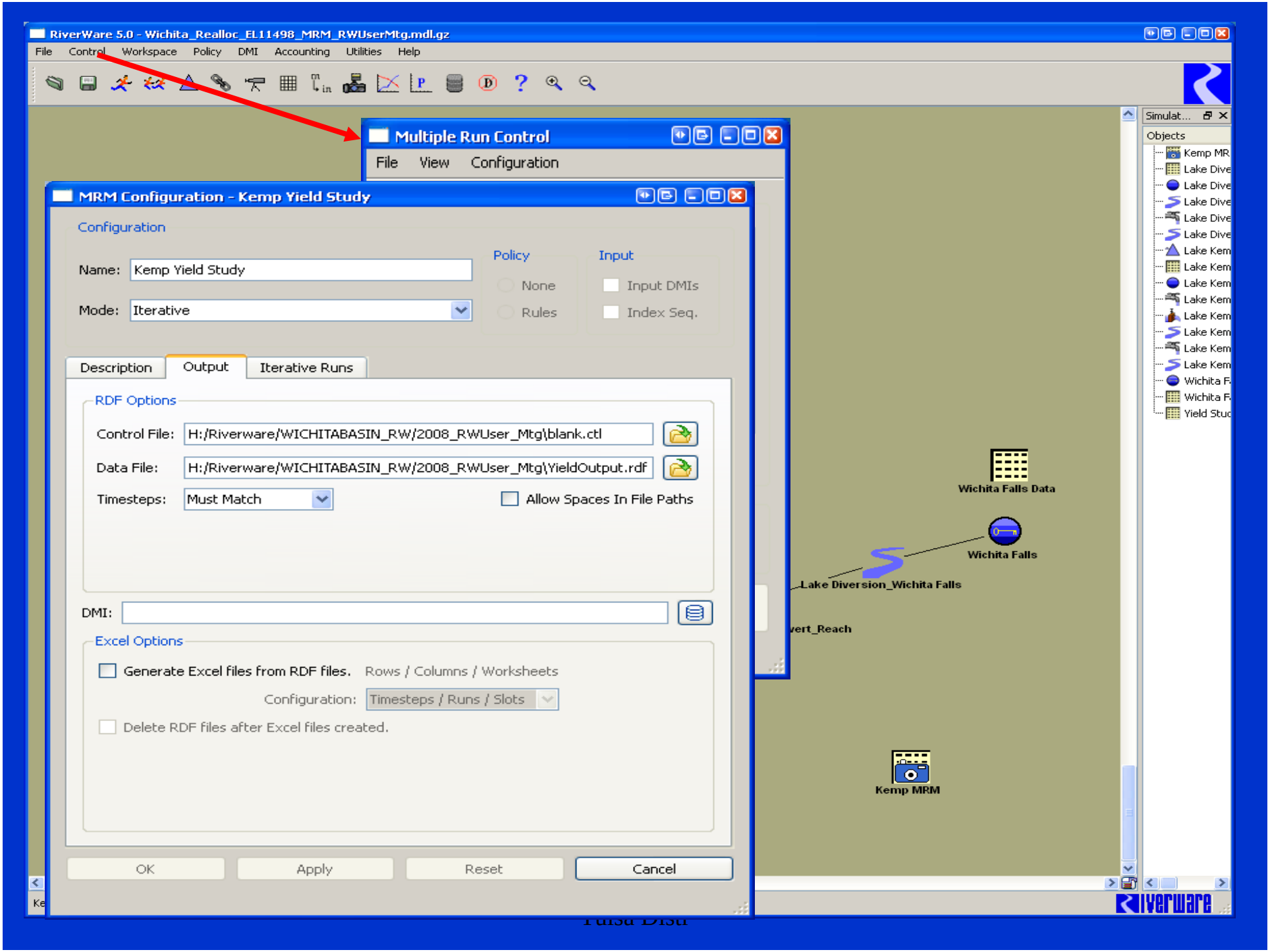
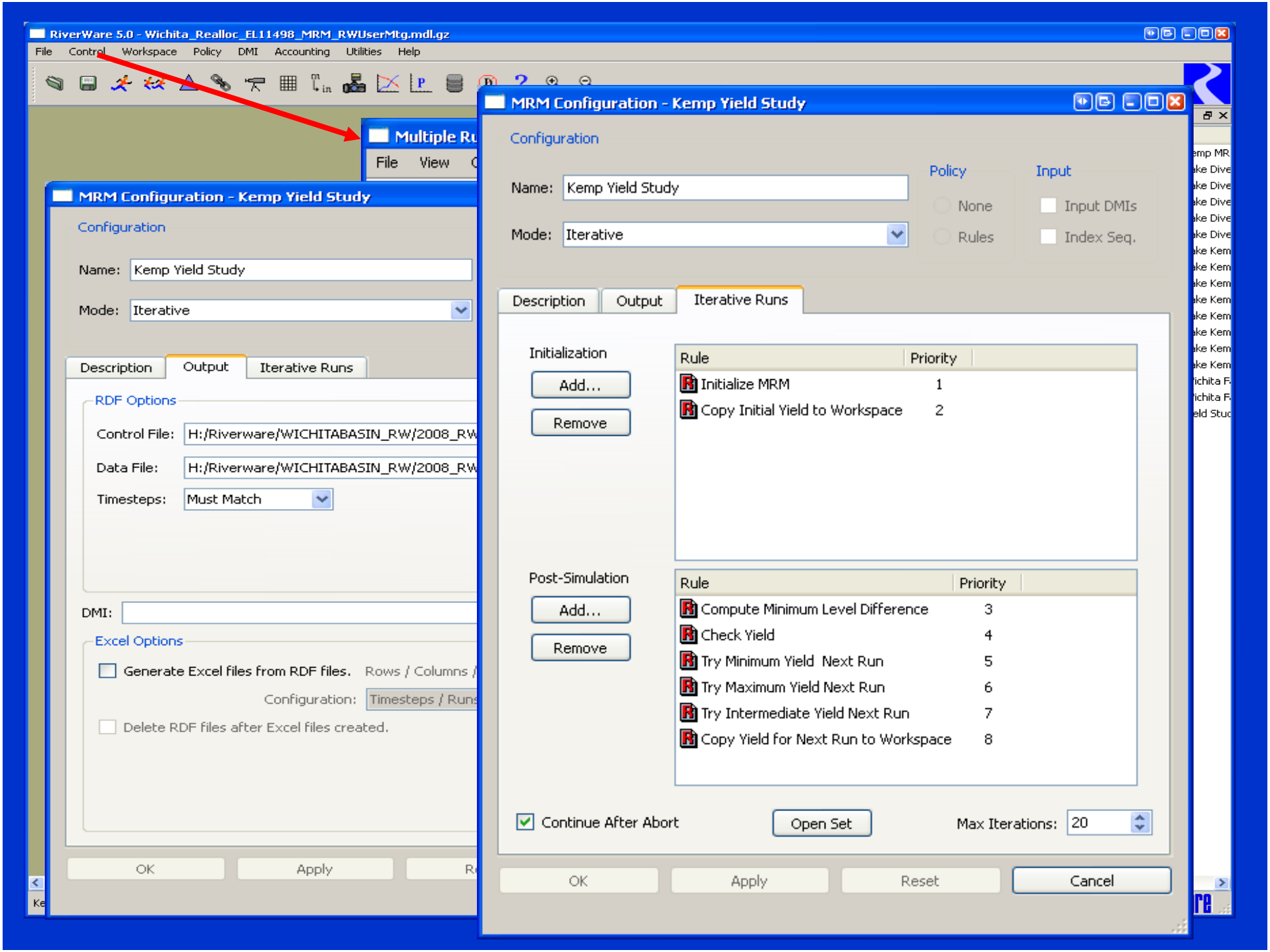
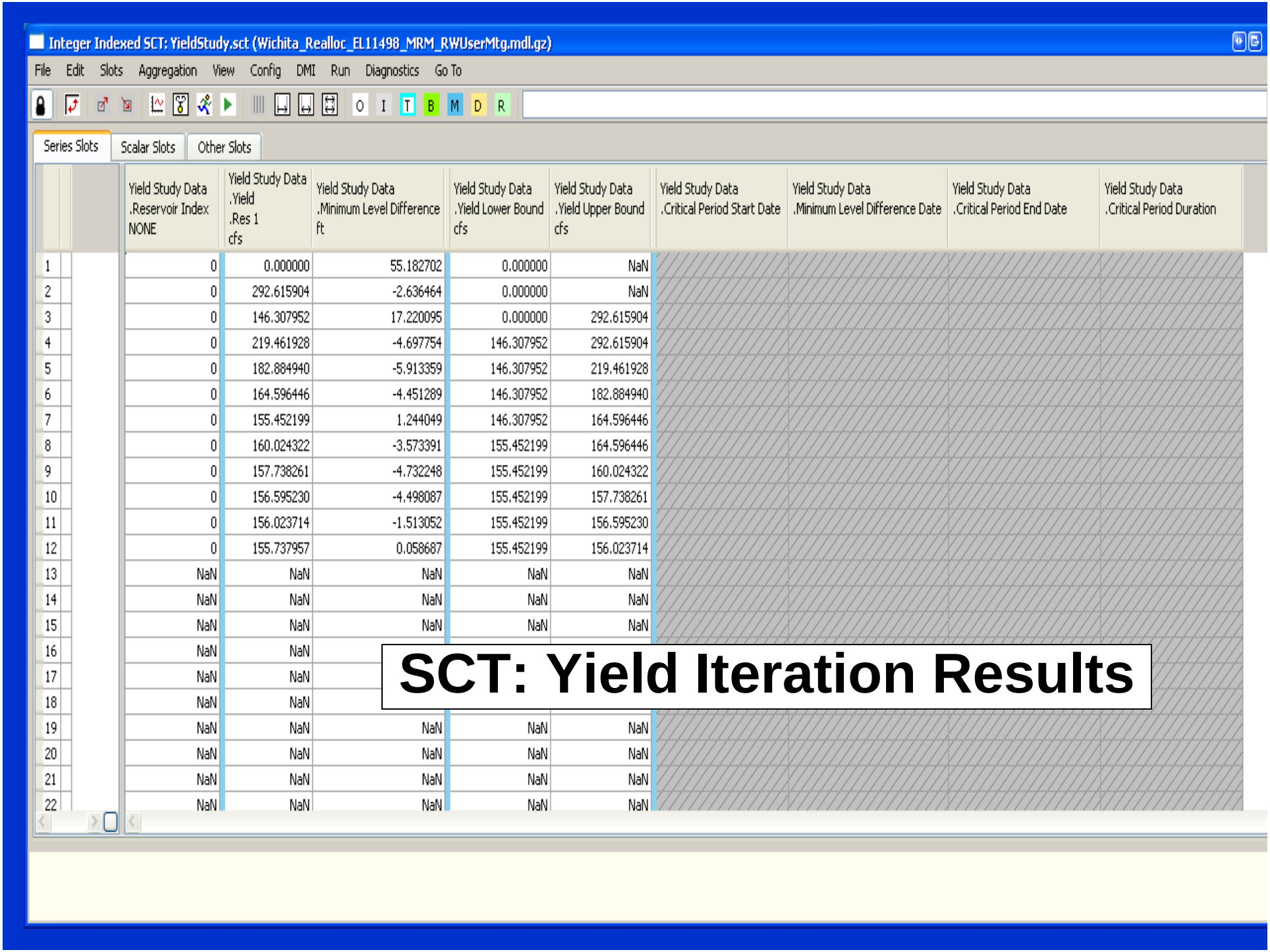
Kemp MRM
RiverWare


RiverWare 5.0 - Wichita_Realloc_EL11498_MRM_RWUserMtg.mdl.gz
File Control Workspace Policy DMI Accounting Utilities Help
Multiple Run Control
File View Configuration
MRM Configuration - Kemp Yield Study
Configuration
Name: Kemp Yield Study
Mode: Iterative
Policy
None
Rules
Input
Input DMIs
Index Seq.
Description Output Iterative Runs
RDF Options
Control File: H:/Riverware/WICHITABASIN_RW/2008_RWUser_Mtg\blank.ctl
Data File: H:/Riverware/WICHITABASIN_RW/2008_RWUser_Mtg\YieldOutput.rdf
Timesteps: Must Match
Allow Spaces In File Paths
DMI:
Excel Options
Generate Excel files from RDF files. Rows / Columns / Worksheets
Configuration: Timesteps / Runs / Slots
Delete RDF files after Excel files created.
OK Apply Reset Cancel
Wichita Falls Data
Wichita Falls
Lake Diversion_Wichita Falls
Kemp MRM
Objects
Kemp MR
Lake Dive
Lake Kem
Wichita F
Yield Stud
RiverWare


RiverWare 5.0 - Wichita_Realloc_EL11498_MRM_RWUserMtg.mdl.gz
File Control Workspace Policy DMI Accounting Utilities Help
Multiple Ru
File View
MRM Configuration - Kemp Yield Study
Configuration
Name: Kemp Yield Study
Mode: Iterative
Description Output Iterative Runs
RDF Options
Control File: H:/Riverware/WICHITABASIN_RW/2008_RW
Data File: H:/Riverware/WICHITABASIN_RW/2008_RW
Timesteps: Must Match
DMI:
Excel Options
Generate Excel files from RDF files. Rows / Columns /
Configuration: Timesteps / Runs
Delete RDF files after Excel files created.
OK Apply
MRM Configuration - Kemp Yield Study
Configuration
Name: Kemp Yield Study
Mode: Iterative
Policy
None
Rules
Input
Input DMIs
Index Seq.
Description Output Iterative Runs
Initialization
Add...
Remove
Rule Priority
Initialize MRM 1
Copy Initial Yield to Workspace 2
Post-Simulation
Add...
Remove
Rule Priority
Compute Minimum Level Difference 3
Check Yield 4
Try Minimum Yield Next Run 5
Try Maximum Yield Next Run 6
Try Intermediate Yield Next Run 7
Copy Yield for Next Run to Workspace 8
Continue After Abort
Open Set
Max Iterations: 20
OK Apply Reset Cancel


Integer Indexed SCT: YieldStudy.sct (Wichita_Realloc_EL11498_MRM_RWUserMtg.mdl.gz)
File Edit Slots Aggregation View Config DMI Run Diagnostics Go To
Series Slots
Scalar Slots
Other Slots
Yield Study Data .Reservoir Index NONE
Yield Study Data .Yield .Res 1 cfs
Yield Study Data .Minimum Level Difference ft
Yield Study Data .Yield Lower Bound cfs
Yield Study Data .Yield Upper Bound cfs
Yield Study Data .Critical Period Start Date
Yield Study Data .Minimum Level Difference Date
Yield Study Data .Critical Period End Date
Yield Study Data .Critical Period Duration
1 0 0.000000 55.182702 0.000000 NaN
2 0 292.615904 -2.636464 0.000000 NaN
3 0 146.307952 17.220095 0.000000 292.615904
4 0 219.461928 -4.697754 146.307952 292.615904
5 0 182.884940 -5.913359 146.307952 219.461928
6 0 164.596446 -4.451289 146.307952 182.884940
7 0 155.452199 1.244049 146.307952 164.596446
8 0 160.024322 -3.573391 155.452199 164.596446
9 0 157.738261 -4.732248 155.452199 160.024322
10 0 156.595230 -4.498087 155.452199 157.738261
11 0 156.023714 -1.513052 155.452199 156.595230
12 0 155.737957 0.058687 155.452199 156.023714
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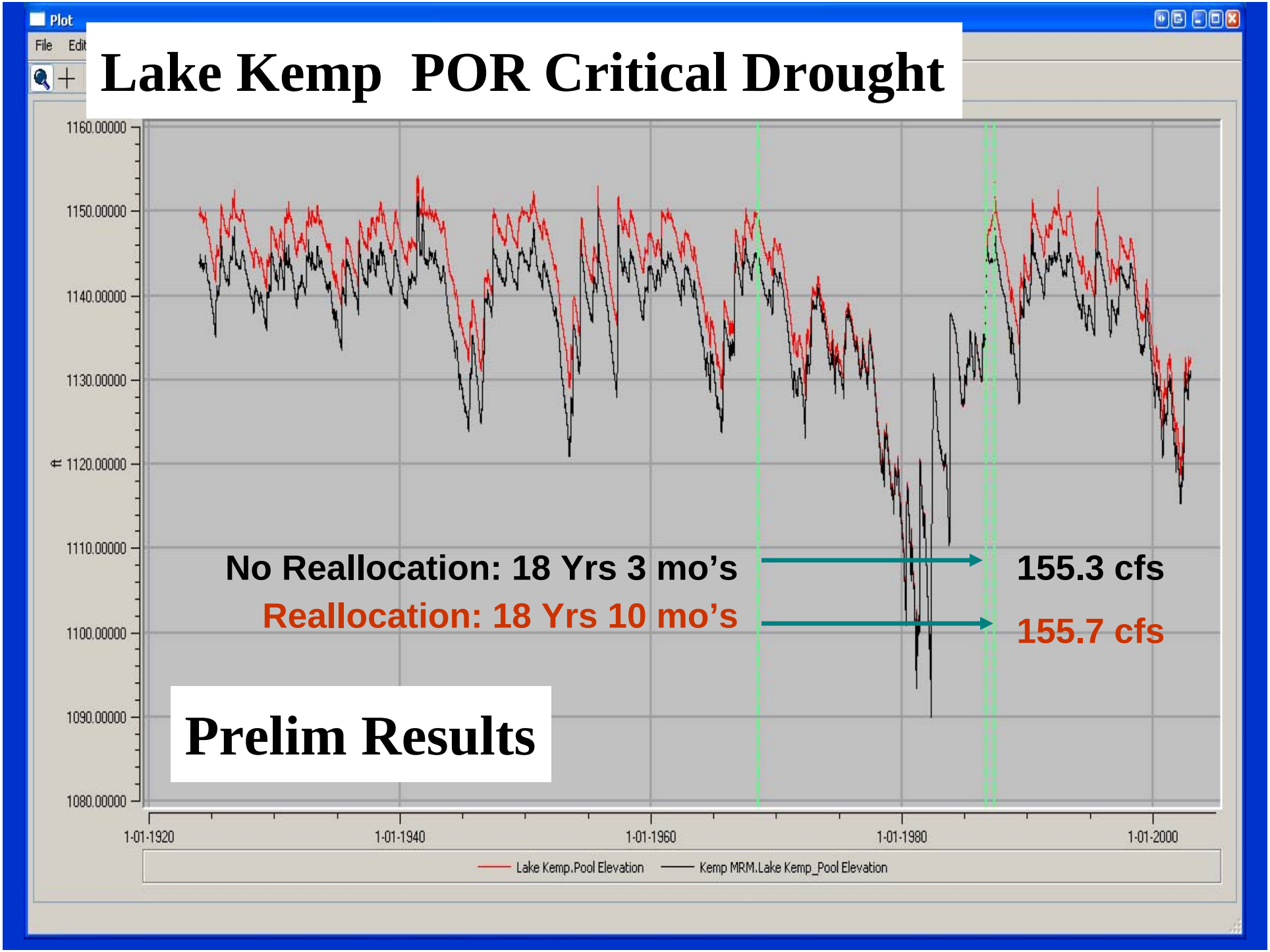
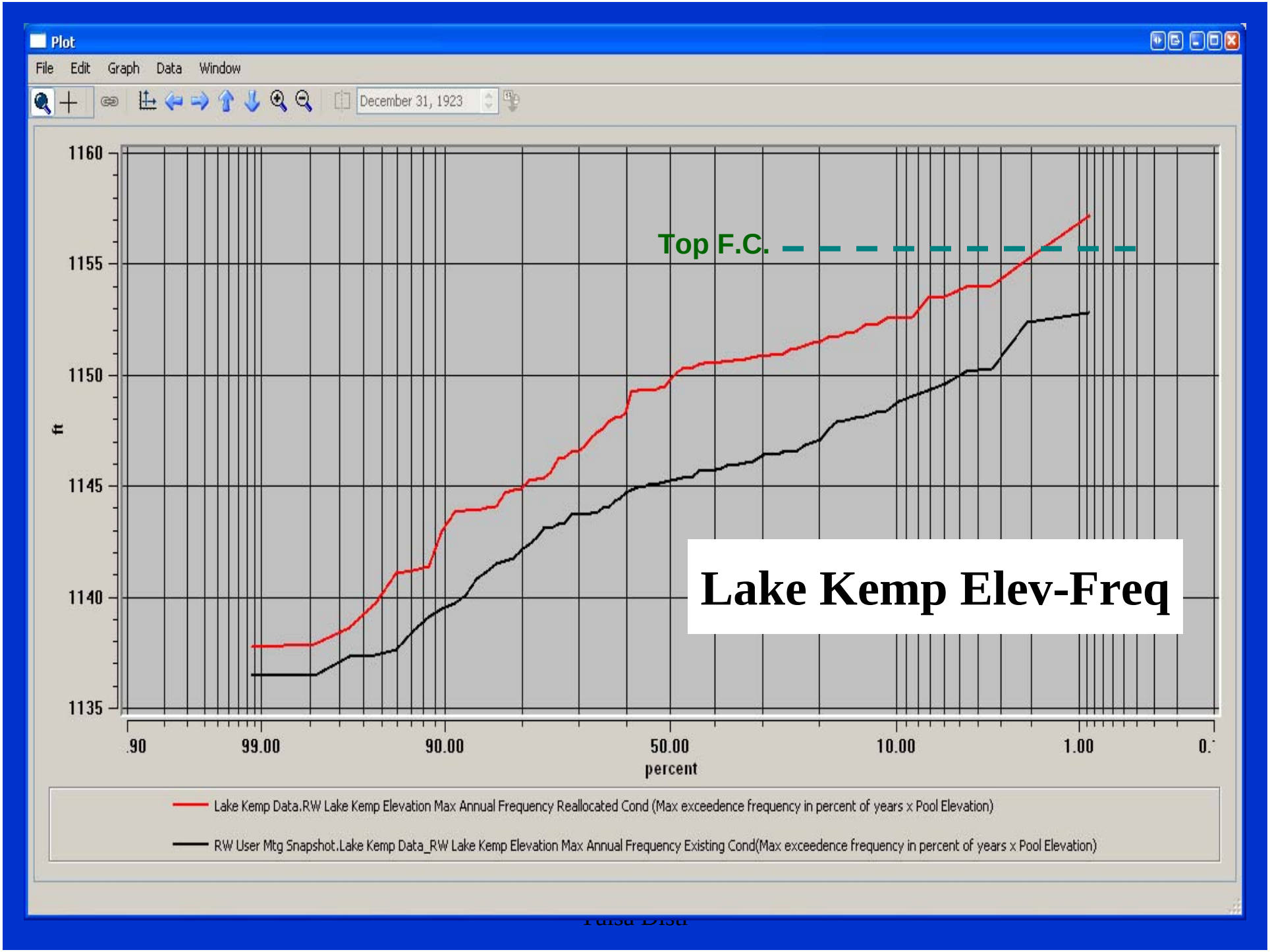
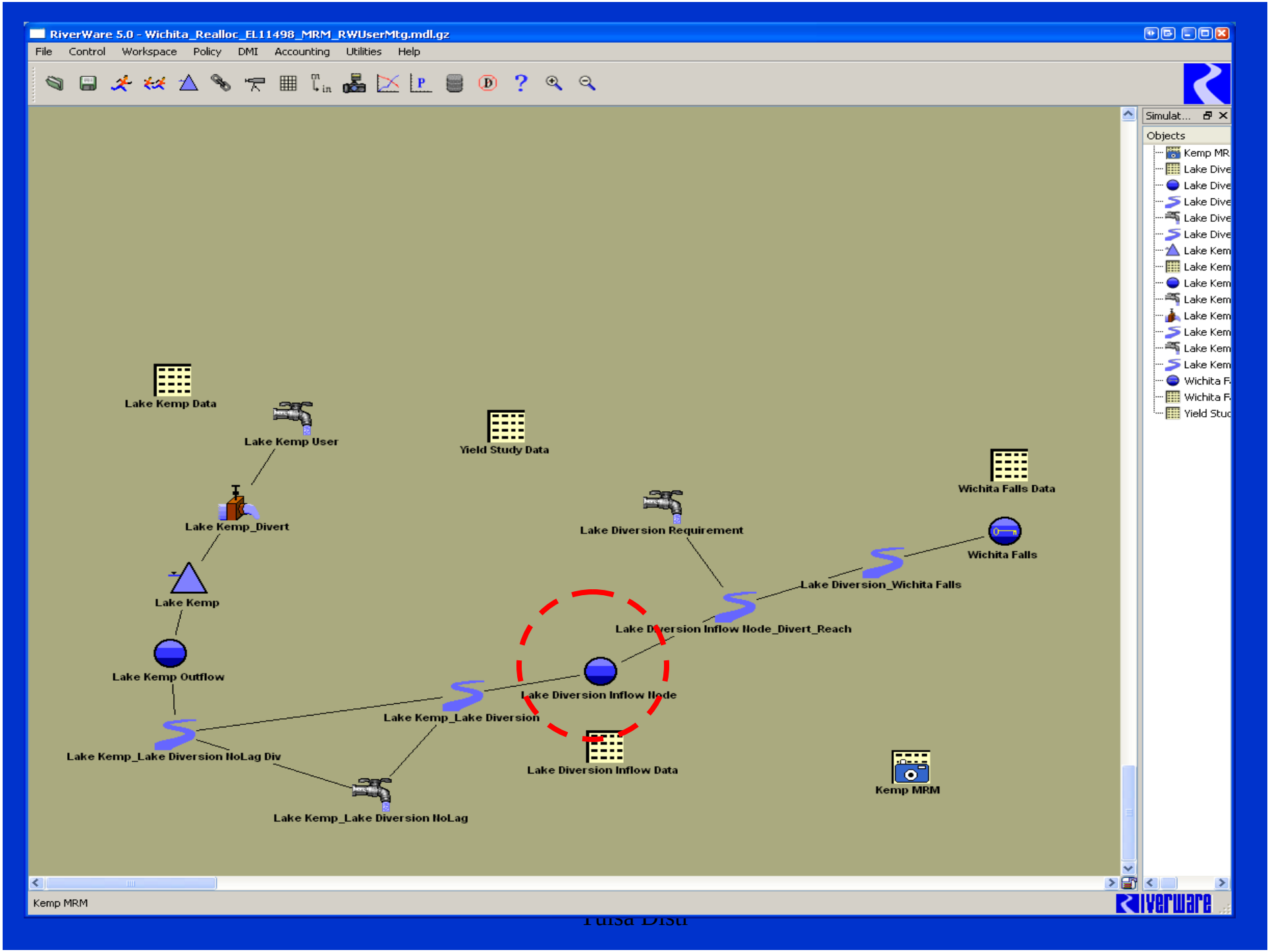
SCT: Yield Iteration Results

Lake Kemp POR Critical Drought




Plot
File Edit Graph Data Window
December 31, 1923
1160
1155
1150
1145
1140
1135
ft
Top F.C.
Lake Kemp Elev-Freq
.90
99.00
90.00
50.00
10.00
1.00
percent
Lake Kemp Data.RW Lake Kemp Elevation Max Annual Frequency Reallocated Cond (Max exceedence frequency in percent of years x Pool Elevation)
RW User Mtg Snapshot.Lake Kemp Data_RW Lake Kemp Elevation Max Annual Frequency Existing Cond(Max exceedence frequency in percent of years x Pool Elevation)


RiverWare 5.0 - Wichita_Realloc_EL11498_MRM_RWUserMtg.mdl.gz
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Wichita Falls Data
Lake Kemp_Divert
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Lake Diversion Inflow Node_Divert_Reach
Lake Kemp Outflow
Lake Diversion Inflow Node
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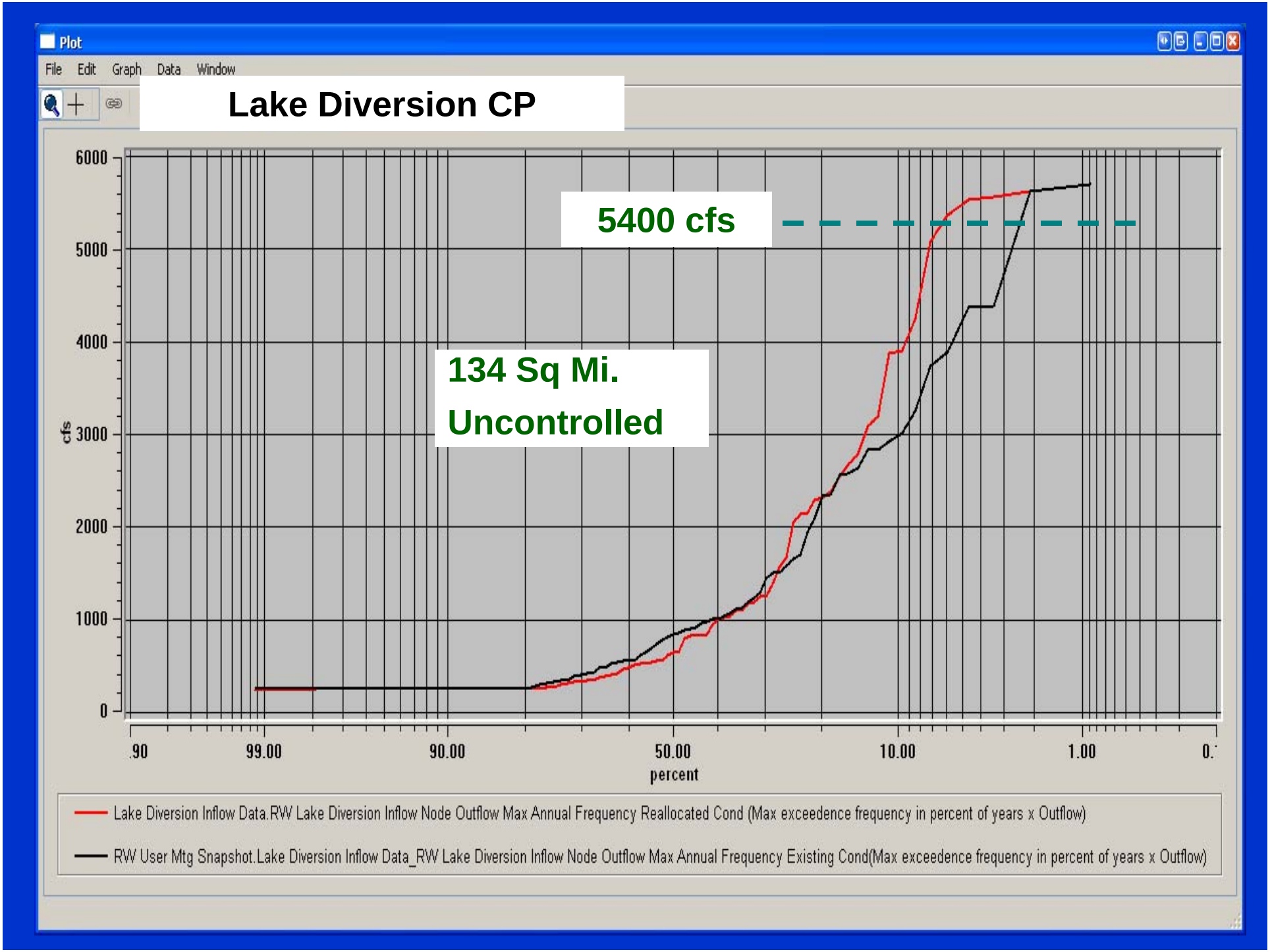
Tulsa Dist


Plot
File Edit Graph Data Window
Lake Diversion CP
5400 cfs
134 Sq Mi.
Uncontrolled
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5000
4000
3000
2000
1000
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cfs
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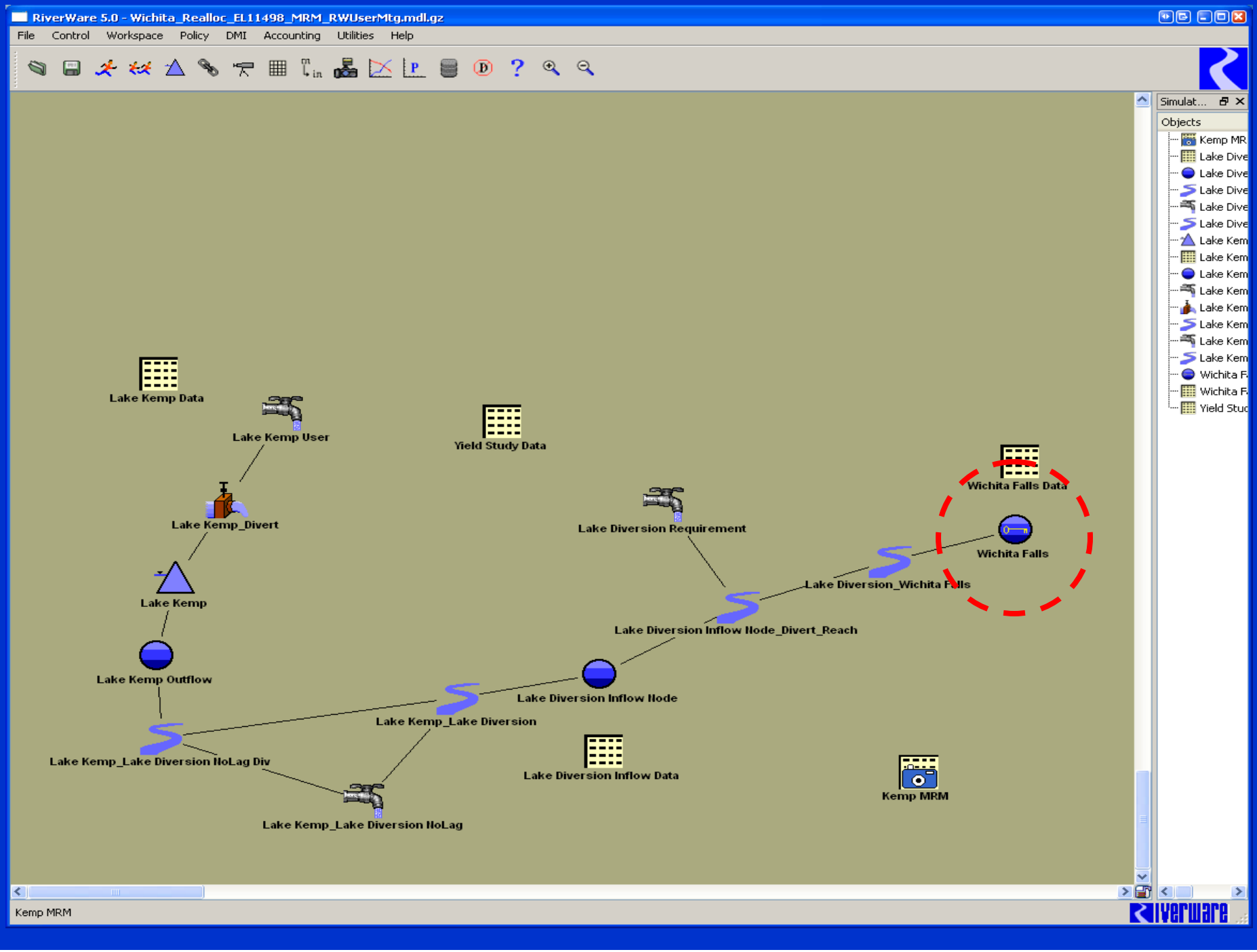
90.00
50.00
10.00
1.00
0.
percent
Lake Diversion Inflow Data.RW Lake Diversion Inflow Node Outflow Max Annual Frequency Reallocated Cond (Max exceedence frequency in percent of years x Outflow)
RW User Mtg Snapshot.Lake Diversion Inflow Data_RW Lake Diversion Inflow Node Outflow Max Annual Frequency Existing Cond(Max exceedence frequency in percent of years x Outflow)


RiverWare 5.0 - Wichita_Realloc_EL11498_MRM_RWUserMtg.mdl.gz
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Lake Kemp Data
Lake Kemp User
Yield Study Data
Wichita Falls Data
Lake Kemp_Divert
Lake Diversion Requirement
Wichita Falls
Lake Diversion_Wichita Falls
Lake Kemp
Lake Diversion Inflow Node_Divert_Reach
Lake Kemp Outflow
Lake Diversion Inflow Node
Lake Kemp_Lake Diversion
Lake Kemp_Lake Diversion NoLag Div
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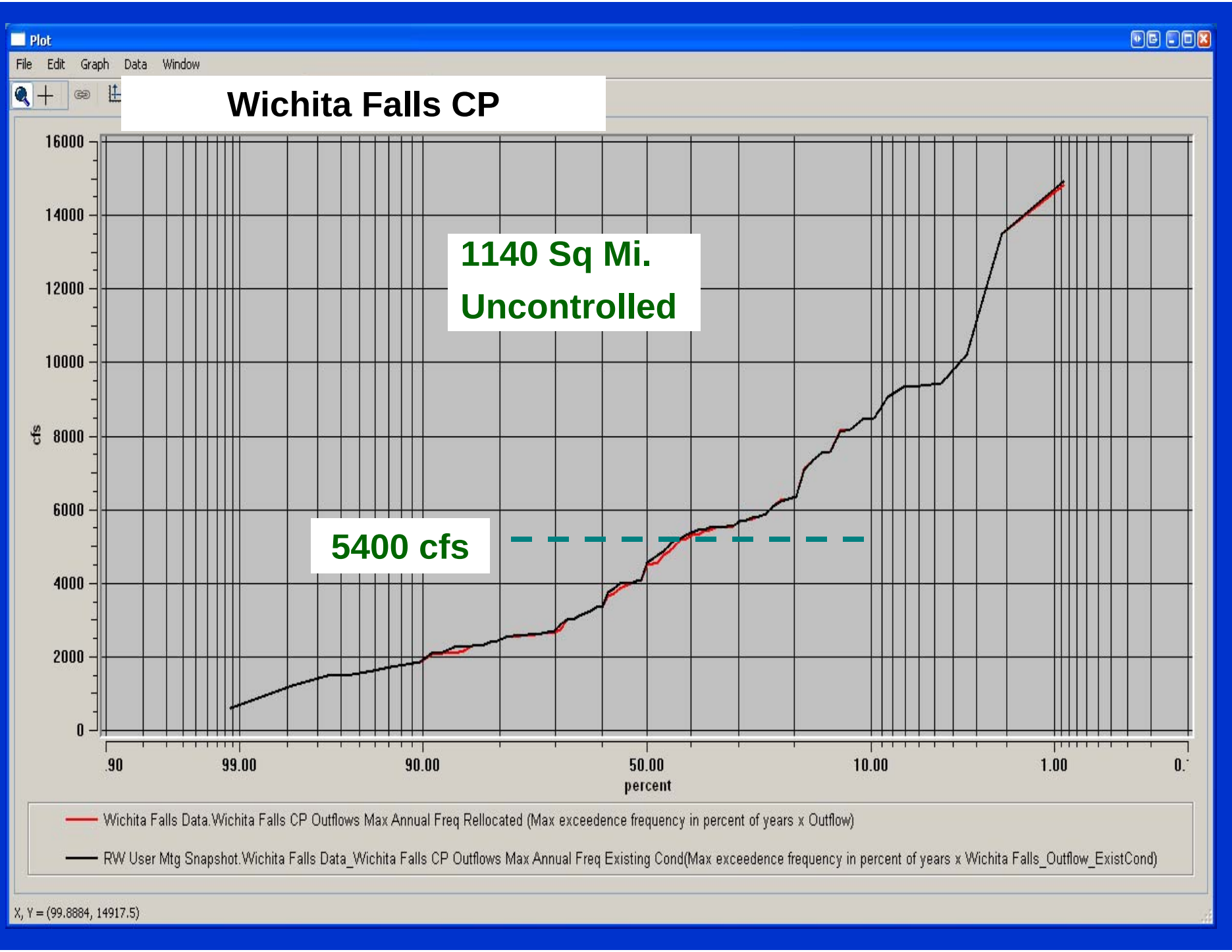
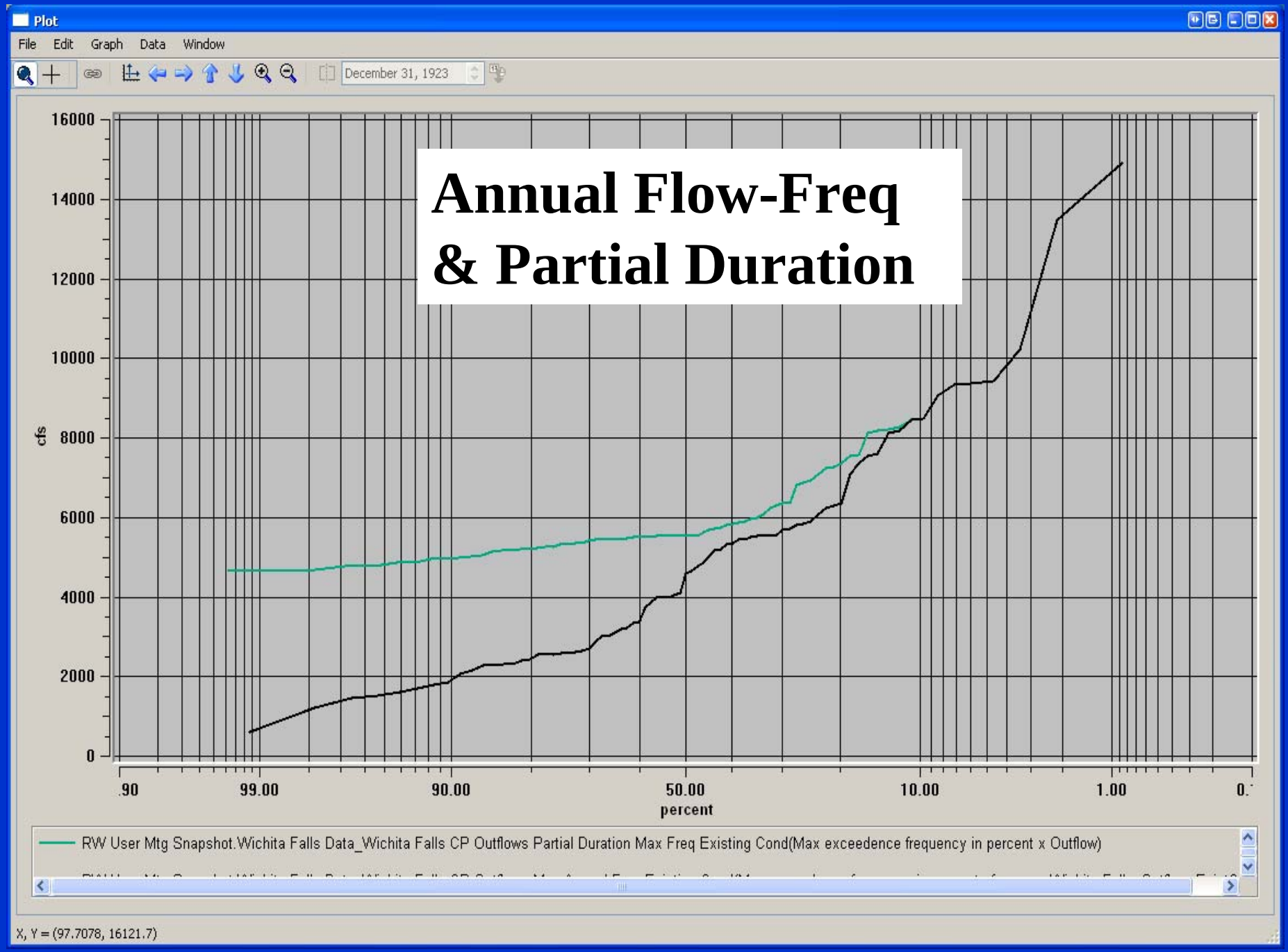
Kemp MRM
Lake Kemp_Lake Diversion NoLag
Kemp MRM
RiverWare


Plot
File Edit Graph Data Window
Wichita Falls CP
1140 Sq Mi.
Uncontrolled
5400 cfs
16000
14000
12000
10000
8000
6000
4000
2000
0
cfs
.90
99.00
90.00
50.00
10.00
1.00
0.
percent
Wichita Falls Data.Wichita Falls CP Outflows Max Annual Freq Rellocated (Max exceedence frequency in percent of years x Outflow)
RW User Mtg Snapshot.Wichita Falls Data_Wichita Falls CP Outflows Max Annual Freq Existing Cond(Max exceedence frequency in percent of years x Wichita Falls_Outflow_ExistCond)
X, Y = (99.8884, 14917.5)


Plot
File Edit Graph Data Window
December 31, 1923
Annual Flow-Freq
& Partial Duration
16000
14000
12000
10000
8000
6000
4000
2000
0
cfs
.90
99.00
90.00
50.00
10.00
1.00
percent
RW User Mtg Snapshot.Wichita Falls Data_Wichita Falls CP Outflows Partial Duration Max Freq Existing Cond(Max exceedence frequency in percent x Outflow)
X, Y = (97.7078, 16121.7)

UPCOMING APP'S WITH RIVERWARE, COE TULSA:

- **GRDA FERC Lic: D.O. Analysis**
- **Red River Watershed Master Manual Update**
- **Extend POR All RiverWare Models**
- **Okla Water Board: State-Wide Plan**
- **Bartlesville, OK: Water Supply**
- **Lower Grand System Yield: 3-Reservoirs**
- **Below John Redmond M&I and WQ**
- **S.E. Okla Water Availability**

Lake Kemp

John Daylor, Corps of Engineers
Tulsa Distr