

Arkansas Basin Roundtable: Basin Implementation Plan

Section 3: Basin Operations & Hydrologic Modeling



March 12, 2014



Outline

- **Project Tasks**
- **Basin Implementation Plan (Section 3)**
- **Basin Operations Report (Section 3.1)**
- **Water Rights Administration Policies and Procedures (Section 3.2)**
- **Hydrologic Modeling (Section 3.3)**
- **Current and Future Shortages Analysis (Section 3.4)**



Project Tasks

- **Task A Water Data Review:** review and identify water use data for the selected study period 1982 to 2012
- **Task B Basin Water Operations Report:** describe historical water operations in the basin by major water users for 3 years that reflect dry, average and wet hydrology
- **Task C Water Administration:** provide common understanding of water administration and the Arkansas River Compact administration policies
- **Task D Model Development:** develop a model of the basin and a visualization tool to support the Basin Implementation Plan
- **Task E Shortage Analysis:** analyze water supply availability and uses for current and future planning horizon (2050) to identify shortages



Basin Implementation Plan

- Section 3 of the Basin Implementation Plan is to evaluate consumptive and nonconsumptive constraints and opportunities
 - Analysis of existing water use data
 - Water rights administration and policies
 - Hydrologic modeling
 - Current and future shortage analysis



Water Data Review

- Task is to review, identify and obtain water use data to support this study for the study period 1982 to 2012
- Review Arkansas Decision Support System (DSS) Feasibility Study where water resources data has been inventoried
- Use data from Division of Water Resources (DWR's) HydroBase where applicable
- Solicit additional data from Water providers, Division Engineer and Bureau of Reclamation

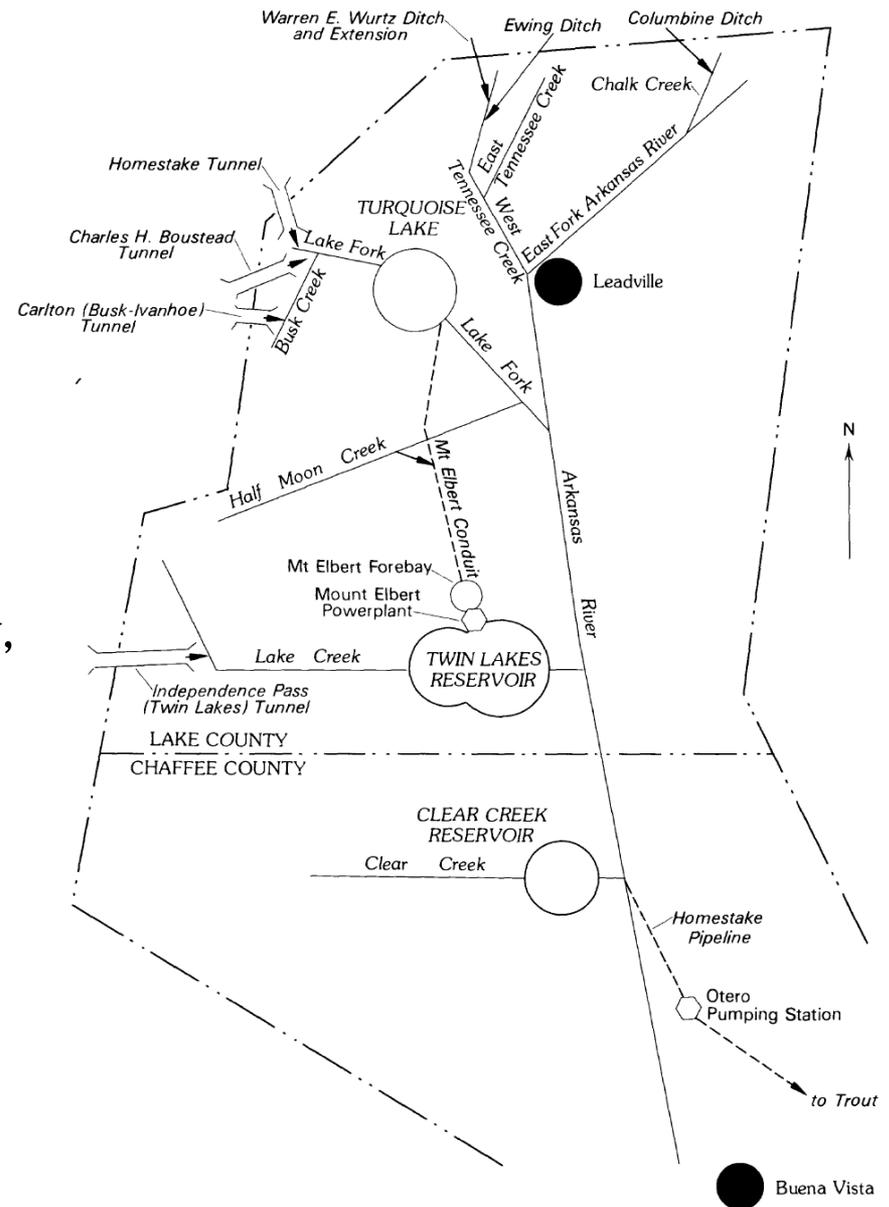


Water Use and Operation Data

- Use data collected under this task to support subsequent tasks
 - Operations Report to summarize water resources operations in the basin for dry, average and wet hydrology (Task B)
 - Support the development of a hydrologic model of the major streams, diversions and reservoirs (Task D)
- Prepare a Technical Memorandum containing the list of data available and obtained to perform this study and support the Basin Implementation Plan

Basin Operations

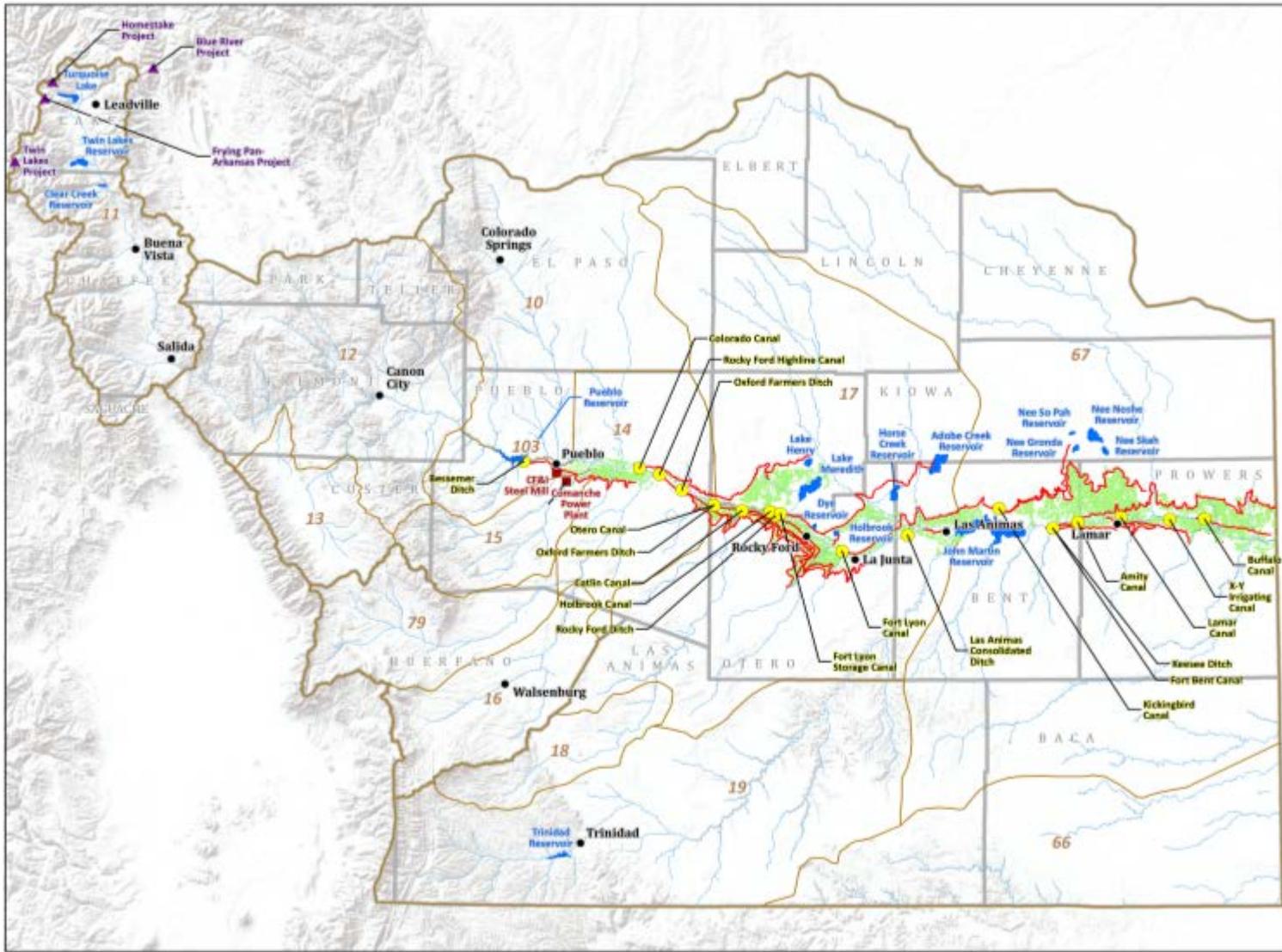
- Task is to develop a report summarizing the water resources operations in the Arkansas River Basin.
- Describes historical monthly operations for 3 years that reflect dry, average and wet hydrology
 - Diversions
 - Storage
 - Exchanges
 - Groundwater withdrawals
 - Return flows





Basin Operations (cont.)

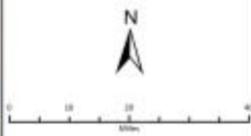
- Reviewing historical hydrology within the study period (1982 to 2012) to identify dry, average and wet years
- Soliciting water use data from major water providers
- Summarizing historical data in figures and tables
- Preparing basin maps that show the locations of diversions and storage by major water users including the irrigated acres under major irrigation diversions



Major Water Users Arkansas Basin

*Arkansas River Basin
Implementation Plan*

- Legend**
- Major Cities & Municipalities
 - Major Irrigation System Headgate
 - Major Industrial Water User
 - ▲ Major Transmountain System
 - Major Irrigation Canal
 - Major Reservoir
 - Irrigated Acreage [2003]
 - Water District Boundary
 - County Boundary



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**CDM
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Water Administration

- The purpose of this task is to provide a common understanding of water administration and Arkansas River Compact administration policies. This will aid the Basin Roundtable with a better understanding how these policies impact water use in the basin.
- Described in term of:
 - Surface Water Administration
 - Groundwater Administration
 - Compact Administration



Surface Water Administration

- Water is administered using the Doctrine of Prior Appropriation
- The Prior Appropriation System is mandated by Colorado's Constitution
- The 1969 Water Rights Determination and Administration Act contains the primary legal provisions governing the administration of surface and ground water rights
- Water users with earlier court-decreed rights (senior rights) can divert in times of short natural supply before junior rights



Winter Water Storage Program

- The Winter Water Storage Program (WWSP) became a reality as a result of the building of Pueblo Reservoir in 1975
- Prior to the WWSP, agricultural water users diverted water as available to irrigate perennial crops and increase soil moisture content
- The concept of WWSP is that there now is a vessel to store water to be released later, allowing for better water usage by the farming and ranching communities in the Lower Arkansas Valley.
- The WWSP is administered by the Division 2 office and operates from November 15 to March 14

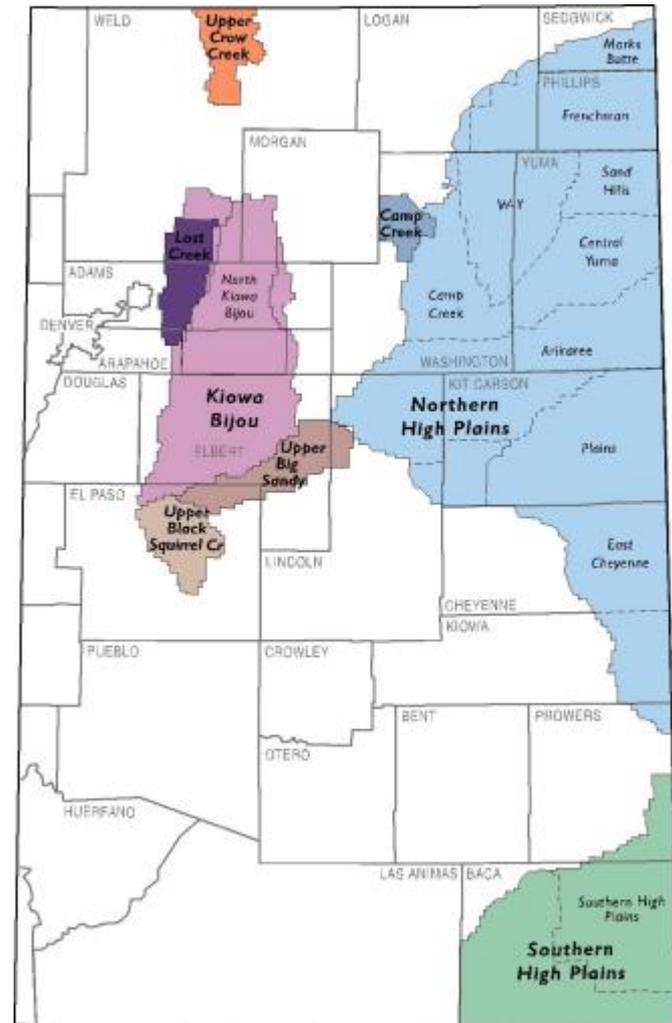


Groundwater Administration

- Tributary groundwater is administered in accordance with the Doctrine of Prior Appropriation and Rules and Regulations adopted by the State Engineer in response to the litigation with Kansas over compliance with the Arkansas River Compact of 1948.
- Nontributary groundwater (Denver Basin) is administered by the Division of Water Resources per the Denver Basin Rules in 1985
- Designated groundwater in Division 2 is under the jurisdiction of the Colorado Ground Water Commission and is not administered by the State Engineer

Designated Basins in Arkansas River Basin

- Upper Big Sandy
- Upper Black Squirrel Creek
- Southern High Plains
- Small part of Northern High Plains



Designated Ground-Water Basins and Management Districts

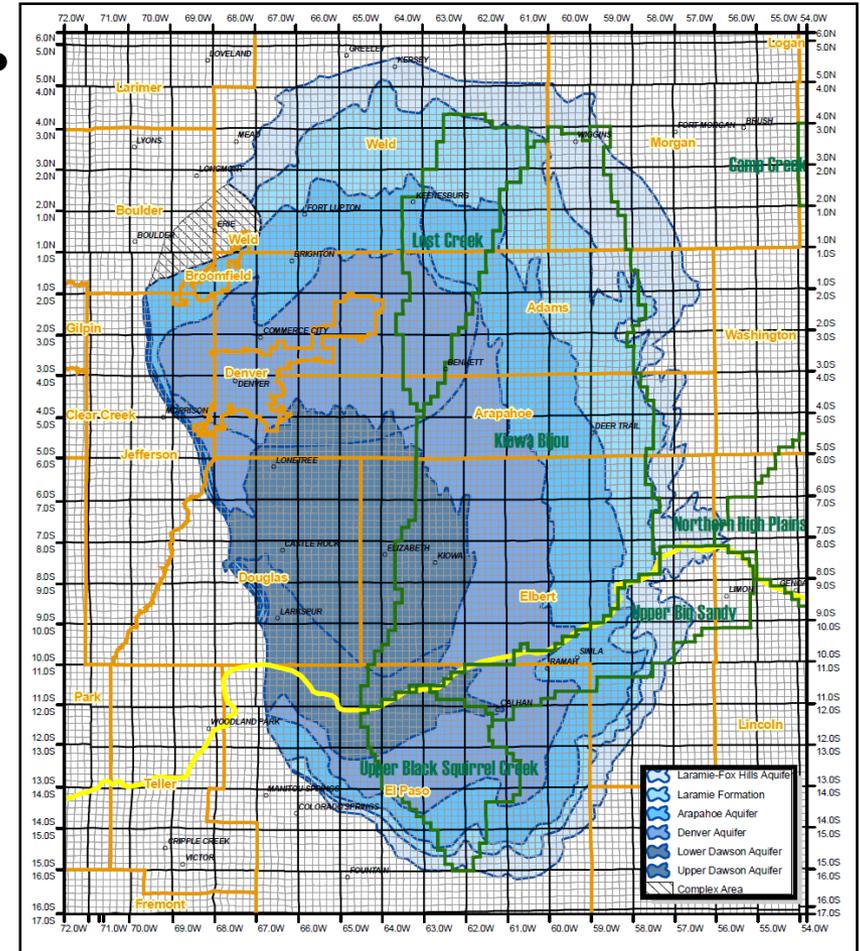


Groundwater Administration – Tributary

- Tributary groundwater is water in an aquifer that is hydrologically connected to the river
- Colorado's prior appropriation system and State Engineer Rules regulate tributary groundwater

Groundwater Administration – Non-tributary

- Senate Bill 5 required the State Engineer to promulgate rules for groundwater withdrawal from Denver Basin Aquifers aka the “Denver Basin Rules”
- Non-tributary groundwater is the withdrawal of which will not within 100 years deplete the flow in a natural stream at an annual rate $> 1/10$ of 1%





Arkansas River Compact (1948)

- Divides water in Arkansas River between Colorado and Kansas and allows for storage in John Martin Reservoir
- Compact signed on December 14, 1948
- Does not contain measurable Stateline flow requirements
- Does require each state to not deplete usable flows by post-compact uses
- Kansas initiated litigation in 1985 about post-compact well pumping depleting usable Stateline flows
- Agreement between states on the final technical issues reached in mid-2009
- Kansas and Colorado are working together to monitor well pumping and replacement of well depletions
- The Hydrologic Institutional (HI) model is used to evaluate compact compliance by Colorado



Model Development

- **Develop a hydrologic model of Arkansas Basin and Visualization Tool**
- **Model to include key operational water resources elements**
 - Major rivers and streams
 - Major reservoirs
 - Major diversions
- **Arkansas DSS – Not available for many years**
- **Simplified Water Allocation Model (SWAM)**



Key Water Resources Elements

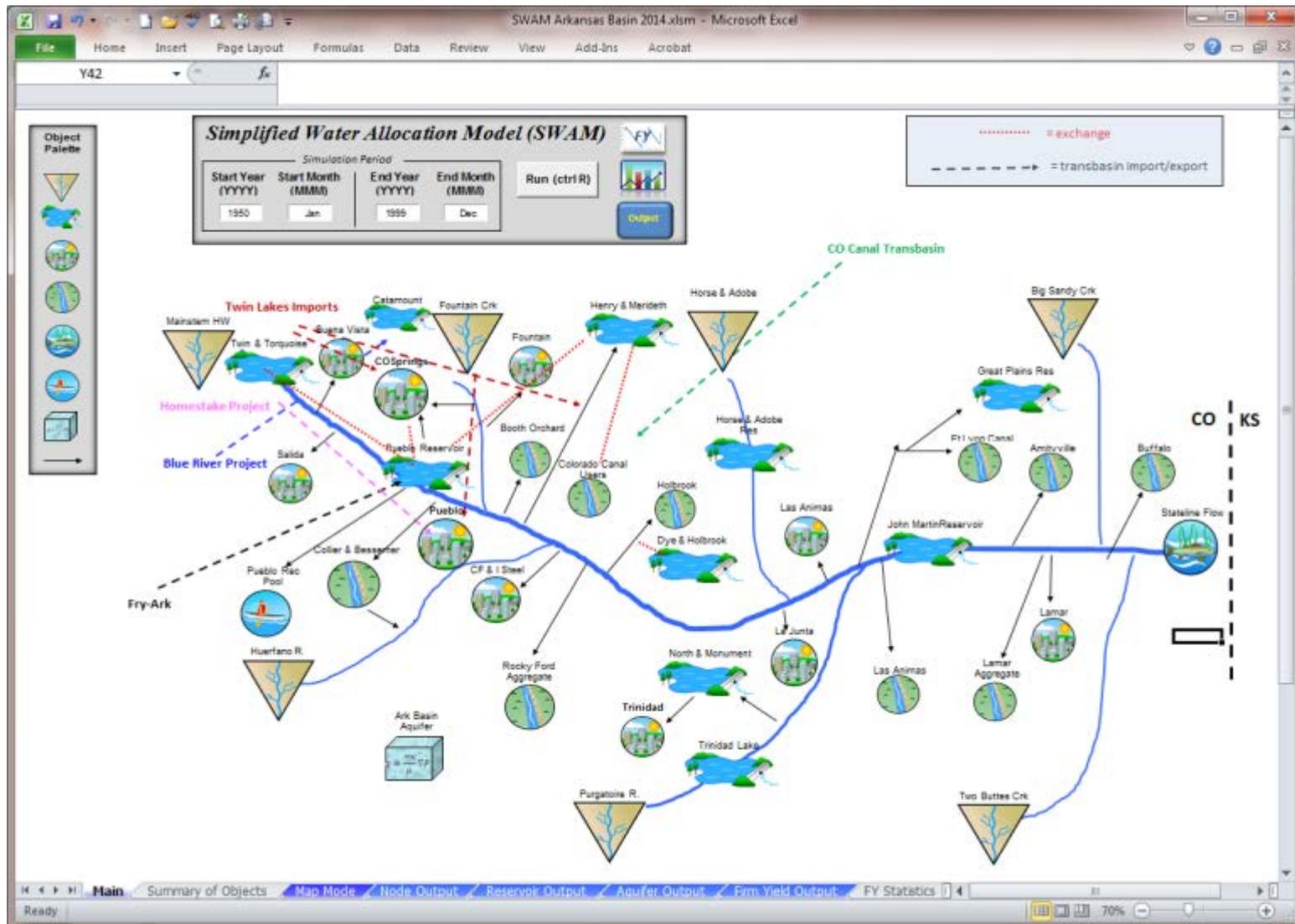
- Rivers and Streams
- Major Reservoirs
- Major Diversions
- Important Imports and Exports
- Key exchanges of water
- Ground water diversions as an aggregate



Simplified Water Allocation Model (SWAM)

- Generalized water allocation modeling software designed for planning applications
- Easy to use
 - well suited for use by a broad range of practitioners
 - portable and transparent
 - well suited for smaller budget studies
- Includes: demand nodes (agricultural and M&I), water rights (prior appropriation), reservoirs, instream flow constraints, transbasin imports, networked tributaries, simplified operations
- Monthly timestep for an extended hydrologic record
- Limitations on the number of nodes (requires aggregation)

SWAM Model – Arkansas River Basin





Shortage Analysis

- Task is to analyze water supply availability and uses for current and future (2050) to gain better understanding of both
- Use the hydrologic model developed under Task D to simulate a range of hydrologic conditions
- Shortages under varying hydrology will be identified



Next Steps

- Solicit water use data from major water users
- Document basin operations
 - Dry, average and wet hydrology
- Develop hydrologic model of Arkansas River Basin
 - Including major streams, reservoirs and diversions
- Use the hydrologic model to simulate potential shortages
- Integrate analysis in to the Arkansas Basin Implementation Plan