The Use of Models for Water Administration In Colorado

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Division of Water Resources
Department of Natural Resources

Presentation Scope

- Areas of model use
- Colorado Decision Support Systems
- Implications and Lessons Learned

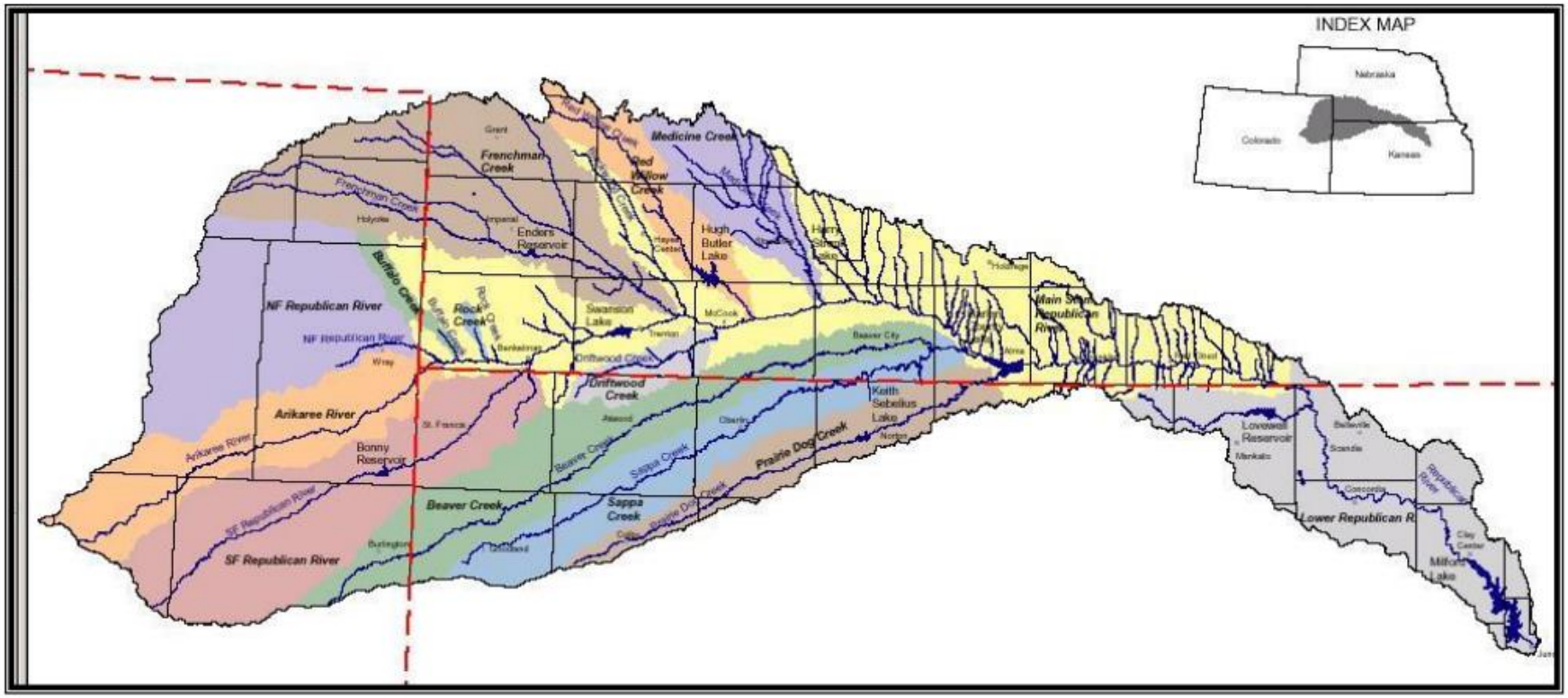
Areas of Model Use

- Interstate compact compliance
- State models for internal water rights administration
- Water user models
- Planning models

Interstate Compact Compliance Models

- Primarily used to estimate groundwater use impacts to the stream for compact administration.
- Currently used models
  - Republican River Basin (Colorado, Nebraska, Kansas)
  - Arkansas River Basin (Colorado, Kansas)

Republican River Basin

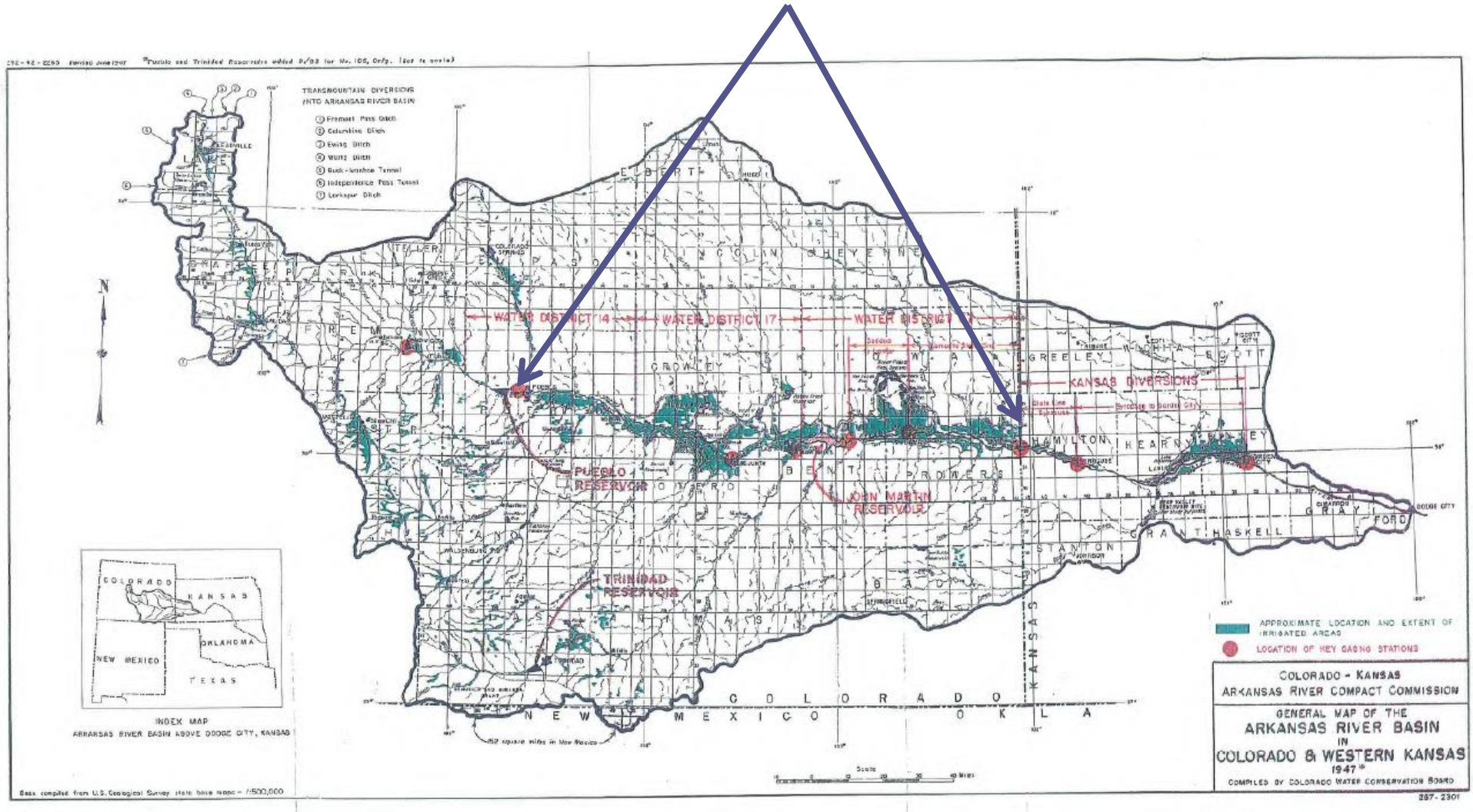


Republican River Basin Groundwater Model

- Developed in accordance with the 2002 Final Settlement Stipulation in Kansas v. Nebraska and Colorado
- Purpose: determine amount, location and timing of streamflow depletions to the Republican River caused by well pumping and to determine streamflow accretion from recharge of water imported from the Platte River Basin into the Republican River Basin
- Model finalized in 2003 and is update annually

Arkansas River Basin

Model Area: Pueblo Reservoir – State Line



Arkansas River Basin: Hydrologic-Institutional Model

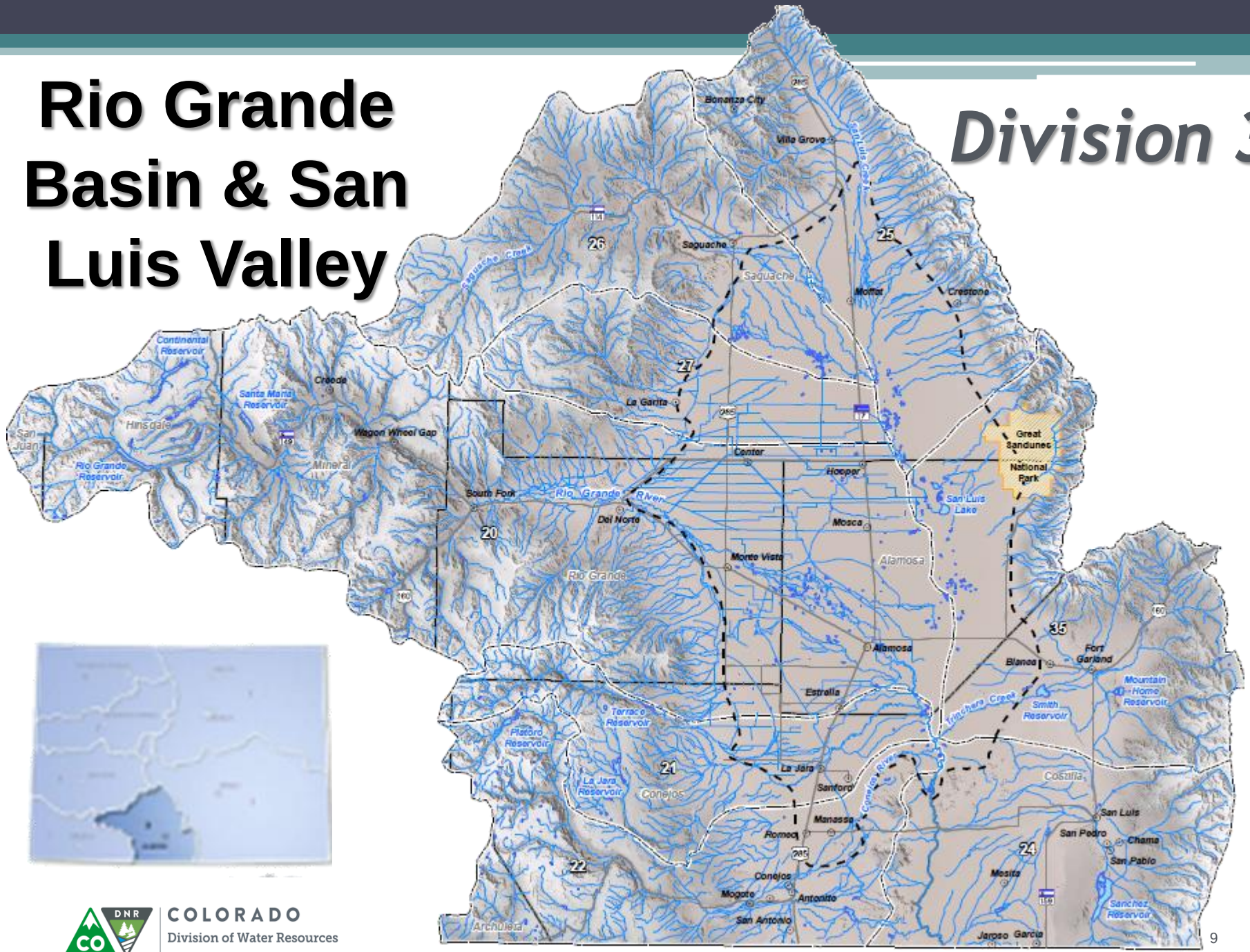
- Surface water and consumptive use model which includes groundwater response functions.
- Model specified in Final Opinion Kansas v. Colorado (Supreme Court #105) Proposed Judgment and Decree (Jan 2008)
- The H-I model is used to determine depletions and accretions to usable Stateline flow caused by groundwater pumping and replacement. Provides 10-year accounting of compact compliance.

State Models for Internal Water Rights Administration

- Typically needed to address regional issues where individual water user models are not workable.
- Requires legislative approval for spending and for authority.
- Examples:
  - Denver Basin Aquifer Models (Senate Bill 85-5)
  - Rio Grande Decision Support System (RGDSS) Groundwater Model (HB 98-1011 and SB 04 – 222)

Rio Grande Basin & San Luis Valley

Division 3



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Need for RGDSS Groundwater Model

- Model is part of the Rules Governing the Withdrawal of groundwater in the Rio Grande Basin (Phase 6 Released in September 2015)
- Require groundwater users to replace their injurious depletions to the surface water streams and restore and maintain aquifer sustainability.
- Because of complex layered hydrogeology (i.e. confined aquifer) simple, inexpensive methods such as SDF, Glover, AWAS can't be used to calculate well impacts to streams in the SLV.
- Need basin-wide groundwater flow model to determine well impacts to streams.

RGDSS Groundwater Model Highlights

- Significant Water User Inputs: Technical Peer Review Team (PRT) open to all interested parties and were attended by staff, water users, engineers, geologists, modelers and other occasional observers. PRT met 47 times from 2011 to 2015.

- Phase 6 Major Enhancements 6P98:
  - Monthly transient model:1970 to 2010
  - Lots of enhanced geology
  - Added irrigated datasets for 2002, 2005, 2009 and 2010
  - Enhanced understanding of irrigated acreage, CIR and water supplies
  - Incorporated meter data for 2009 and 2010.

- Calibrated to heads and fluxes (1,565 well hydrographs, stream gains/losses on major streams and McIntyre Spring)

Denver Basin Aquifers

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Denver Basin Aquifer Models

- In 1985 Senate Bill 5 provided a new framework to guide the appropriation of groundwater from the Denver Basin aquifers.
- CDWR Staff developed individual models for each of the Denver Basin Aquifers: Dawson, Denver, Arapahoe and Laramie-Fox Hills.
- These models were used to identify locations where the use of ground water from the Denver Basin would have a minimal effect on the surface water system. An aquifer with this characteristic is legally identified as nontributary.
- These 1985 groundwater models are still used today to determine stream depletions for wells in the “not nontributary” areas.

Water User Models

- Water rights determinations in Water Court cases. Primarily used for groundwater use either for estimating stream depletions or determination of nontributary status.

- Extensive use includes:
  - Augmentation plans to replace stream depletions from over 6,000 coal bed methane wells
  - Water rights for recharge ponds to provide water to meet ESA stream flows.
  - Multitude of augmentation plans for groundwater user groups.

Planning Models

- Funded by the Colorado Water Conservation Board (CWCB).
- Managed jointly by CWCB and CDWR under the Colorado Decision Support Systems (CDSS) – this was the topic of my 2014 AWSE talk.
- Models include:
  - Surface water/water rights models for the Colorado River Basins (San Juan, Dolores, Yampa, White, Colorado River main stem)
  - Groundwater model for the South Platte River alluvial aquifer.
  - Coming soon are surface water/water rights and groundwater planning models for the Arkansas River and a surface water/water rights planning model for the South Platte River.

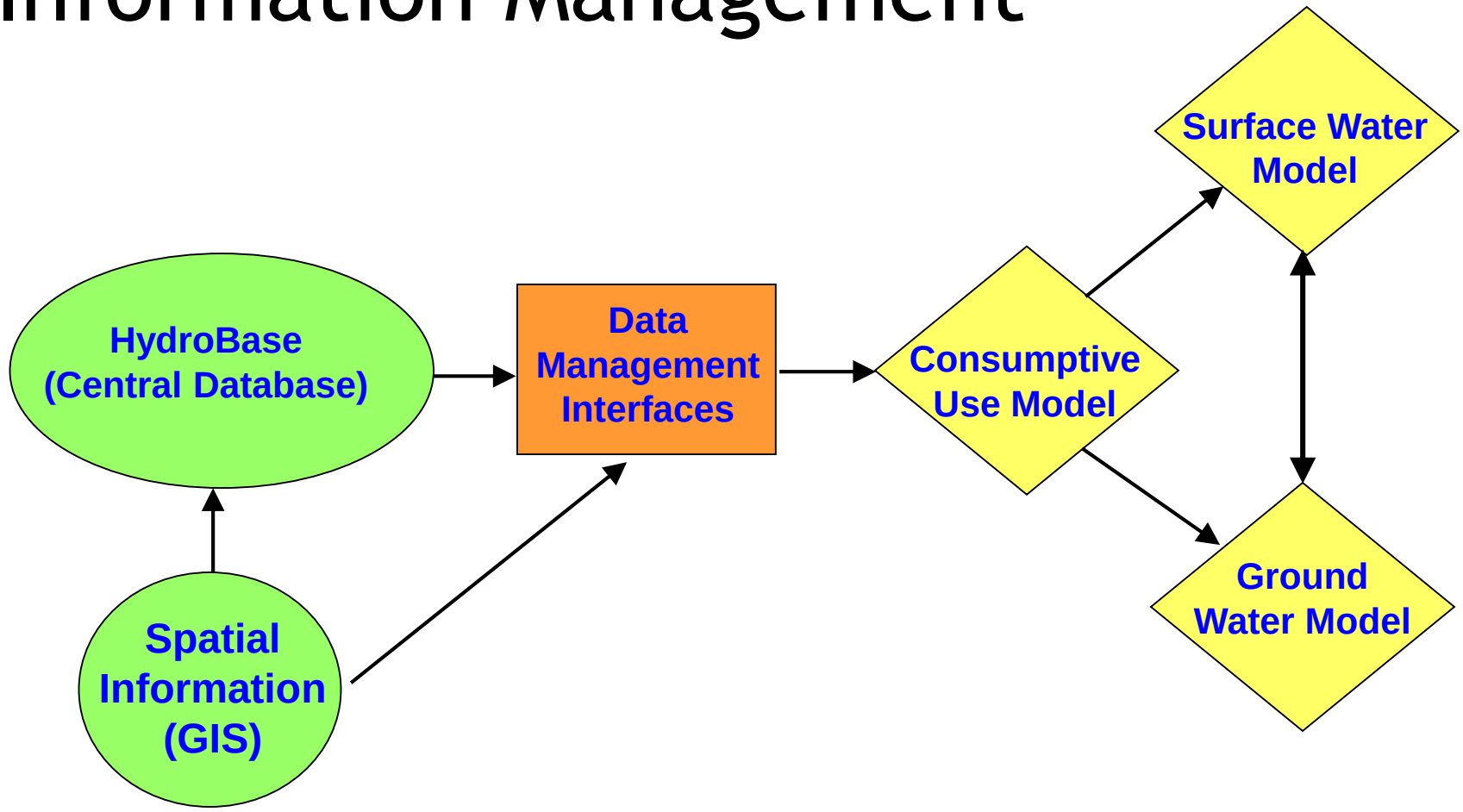
CDSS: Data Centered Approach for all Models

- Central repository for all hydrogeologic and modeling data and tools
- Provides consistency and improves data integrity
- A system of data and tools developed to assist in making informed decisions regarding historical and future use of water

Basins	Online Tools	Software Products	Modeling Data	GIS Data	Documents
Arkansas	Call Chronology	StateCU	Consumptive Use (StateCU)	Division 1 South Platte	Basin Reports
Colorado	Streamflow Stations	StateDMI	Surface Water (StateMod)	Division 2 Arkansas	Meeting Materials
Gunnison	Structures (Diversions)	StateMod	Groundwater (MODFLOW)	Division 3 Rio Grande	Modeling Briefs
Rio Grande	Water Rights	StateView	Water Budget (StateWB)	Division 4 Gunnison	Modeling Dataset Documentation
San Juan / Dolores	Map Viewer	StateWB		Division 5 Colorado	Peer Review
South Platte	Ground Water (Water Levels)	TSTool		Division 6 Yampa / White	Publications
Yampa / White		Third Party Software		Division 7 San Juan / Dolores	Reports
	More ...			**More ...**	**More ...**

Welcome to Colorado's Decision Support Systems!

Information Management

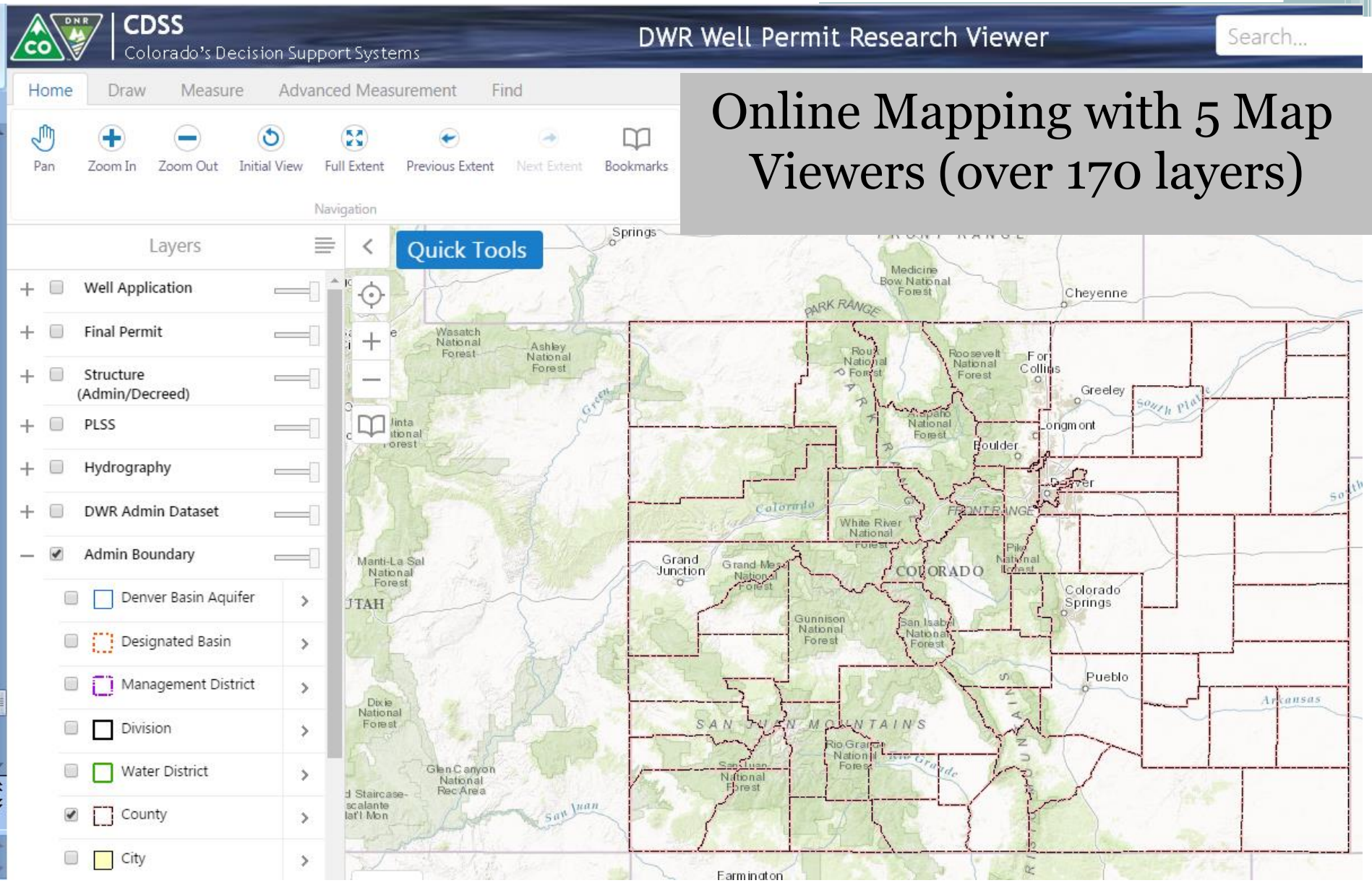


Data Collection and Review

Data Viewing and Format

Modeling Tools

Online Mapping with 5 Map Viewers (over 170 layers)



Implications and Lessons Learned

- Models are being used more and more and these models are becoming more complex.
- Models are expensive and typically are related to litigation.
- Need model savvy staff that understands modeling but who are also able to communicate this knowledge to the public.
- Public involvement difficult but critical:
  - RGDSS Rules/model – 47 technical PRT meetings just for Phase 6 and 24 public meetings in the San Luis Valley from 2009 to 2015.