

# The Climate of Uncertainty for Colorado's Agricultural Water: Management Responses and Coordination of Objectives

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USDA CSREES Water Meeting

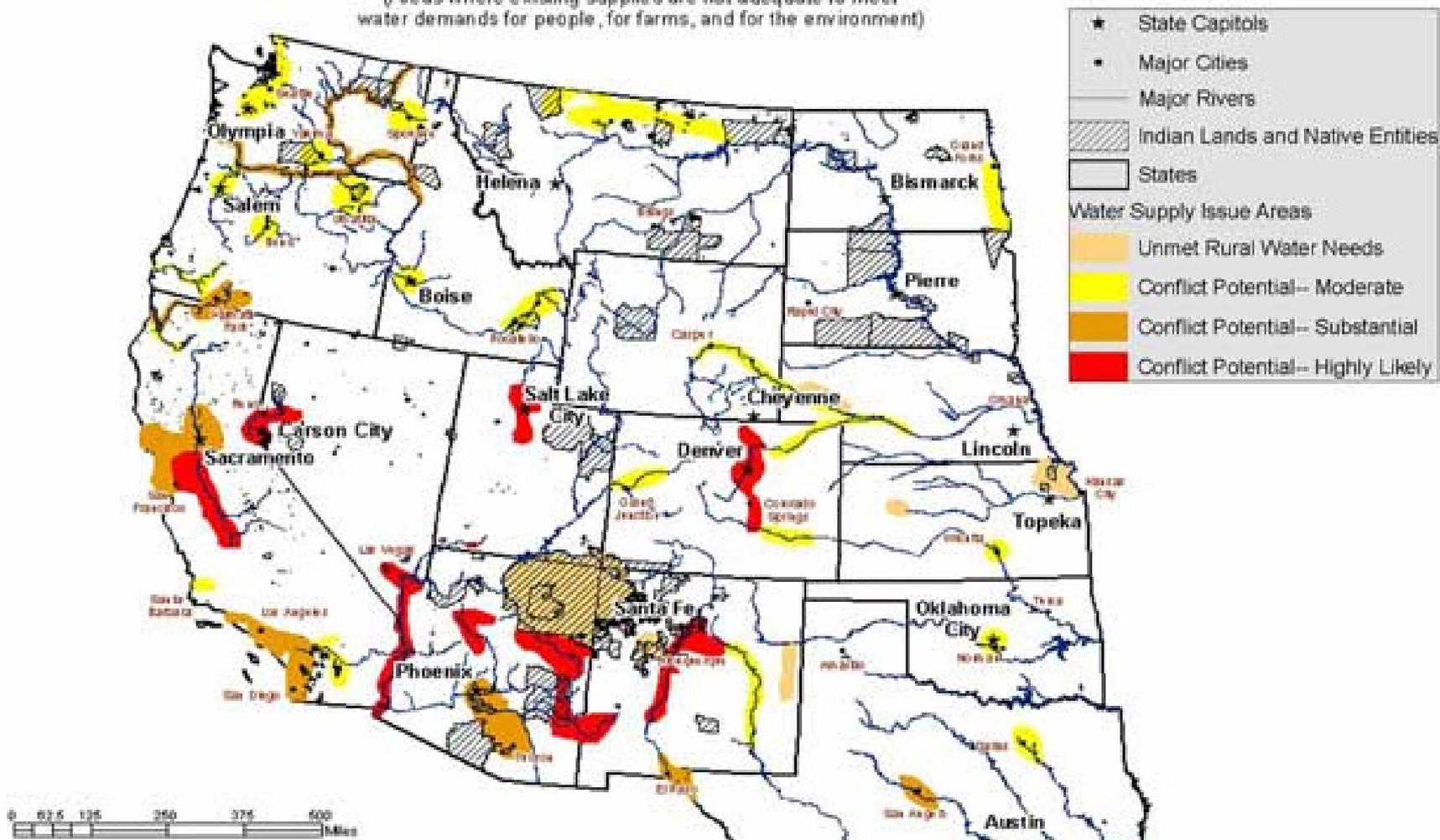
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This is edited for length from the set provided for posting  
in which many slides use "speaker's notes" for  
references and comments.

# Potential Water Supply Crises by 2025

(Areas where existing supplies are not adequate to meet water demands for people, for farms, and for the environment)



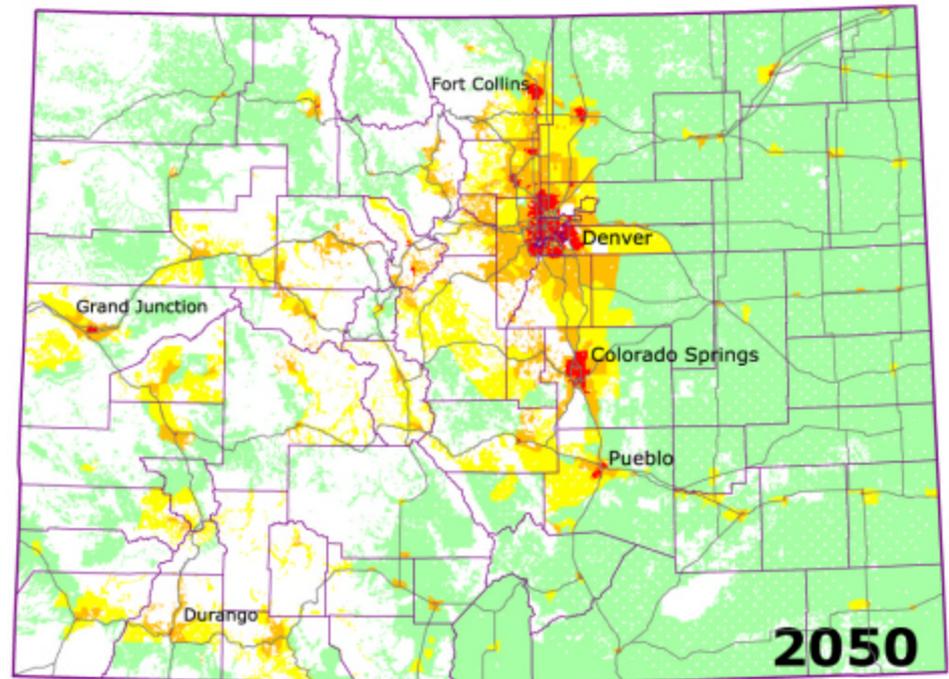
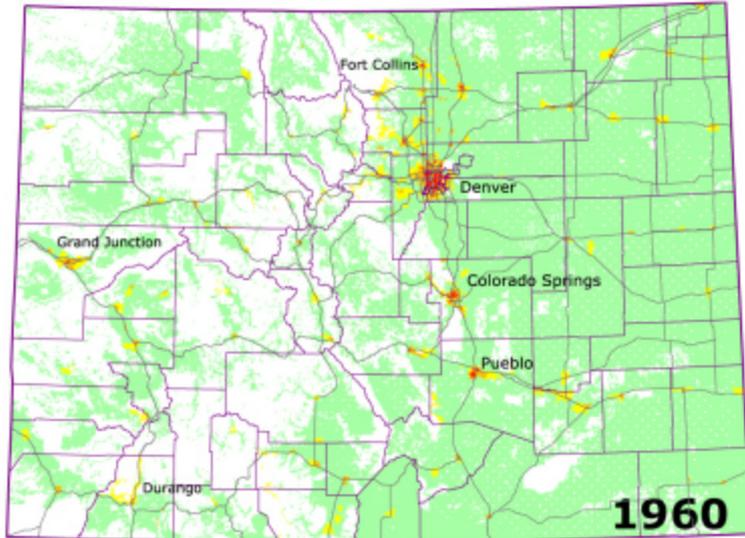
**“...water supplies are or will be inadequate to meet water demands, even under normal water supply conditions.”**

– U.S. Dept. of Interior  
Water 2025

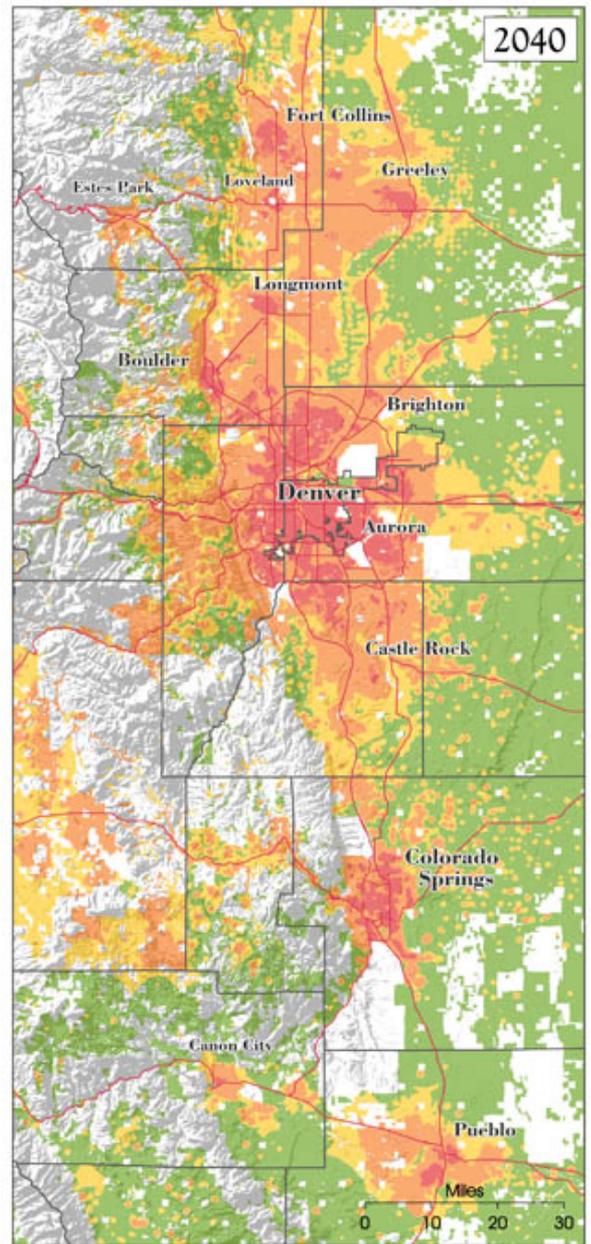
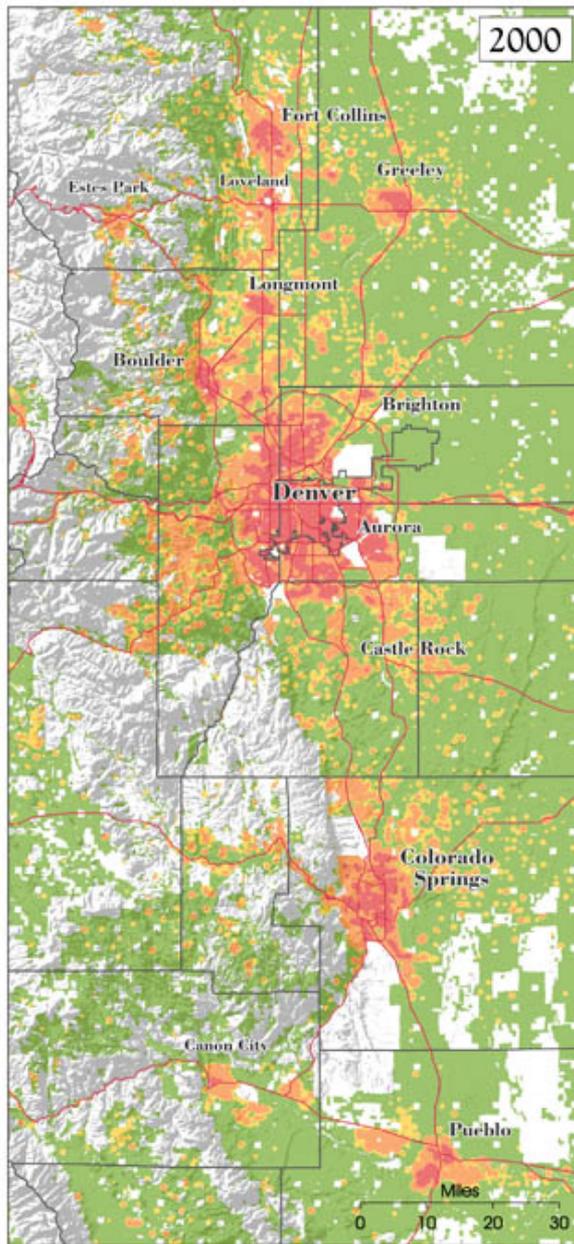
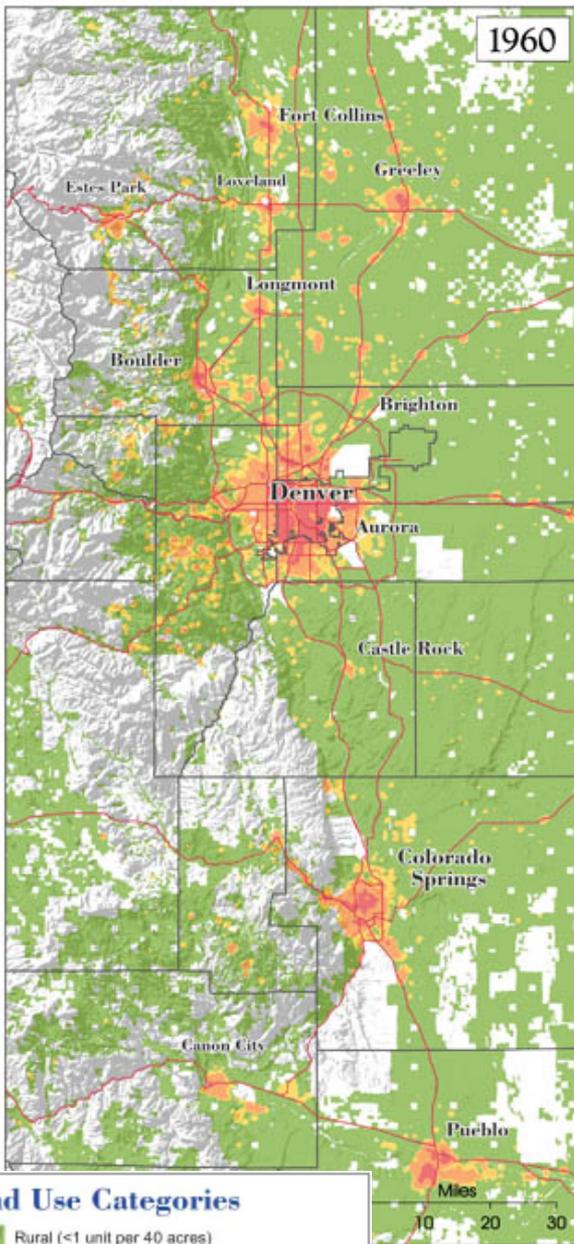


# Housing Density Change 1960 - 2050

(Tom Dickinson, C.U. Center for American West,  
and IBS Social Sciences Data Analysis Center)



Municipal demand for water is  
growing -- where will the  
water come from?



# Colorado Front Range

(Center of the American West, on the internet with two other cases)

# Arkansas River Basin in Colorado

Map by Tom Dickinson, SSDAC, IBS, University of Colorado

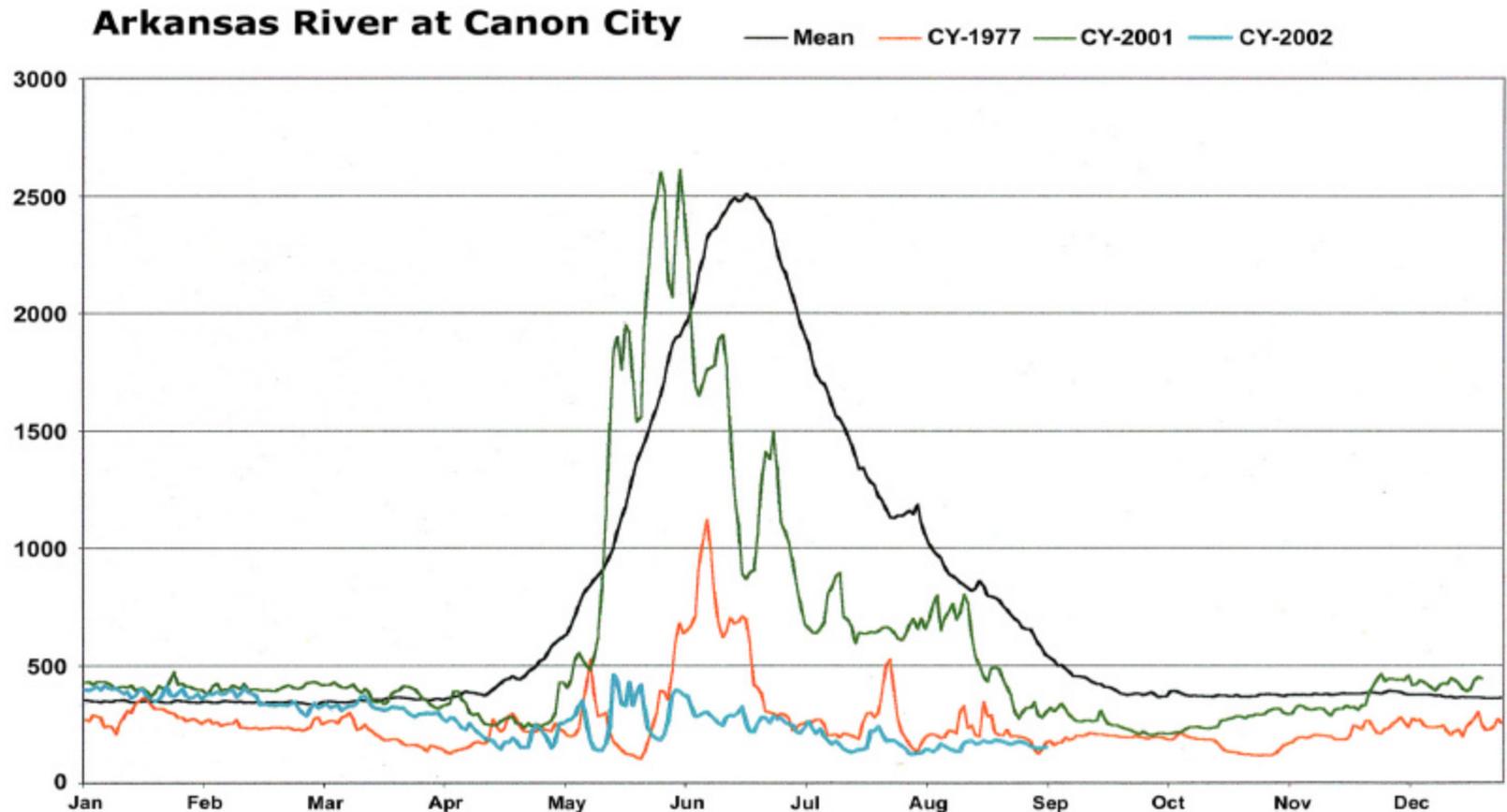


# Arkansas River Hydrographs (Canon City)

Mean, 1977, 2001, 2002

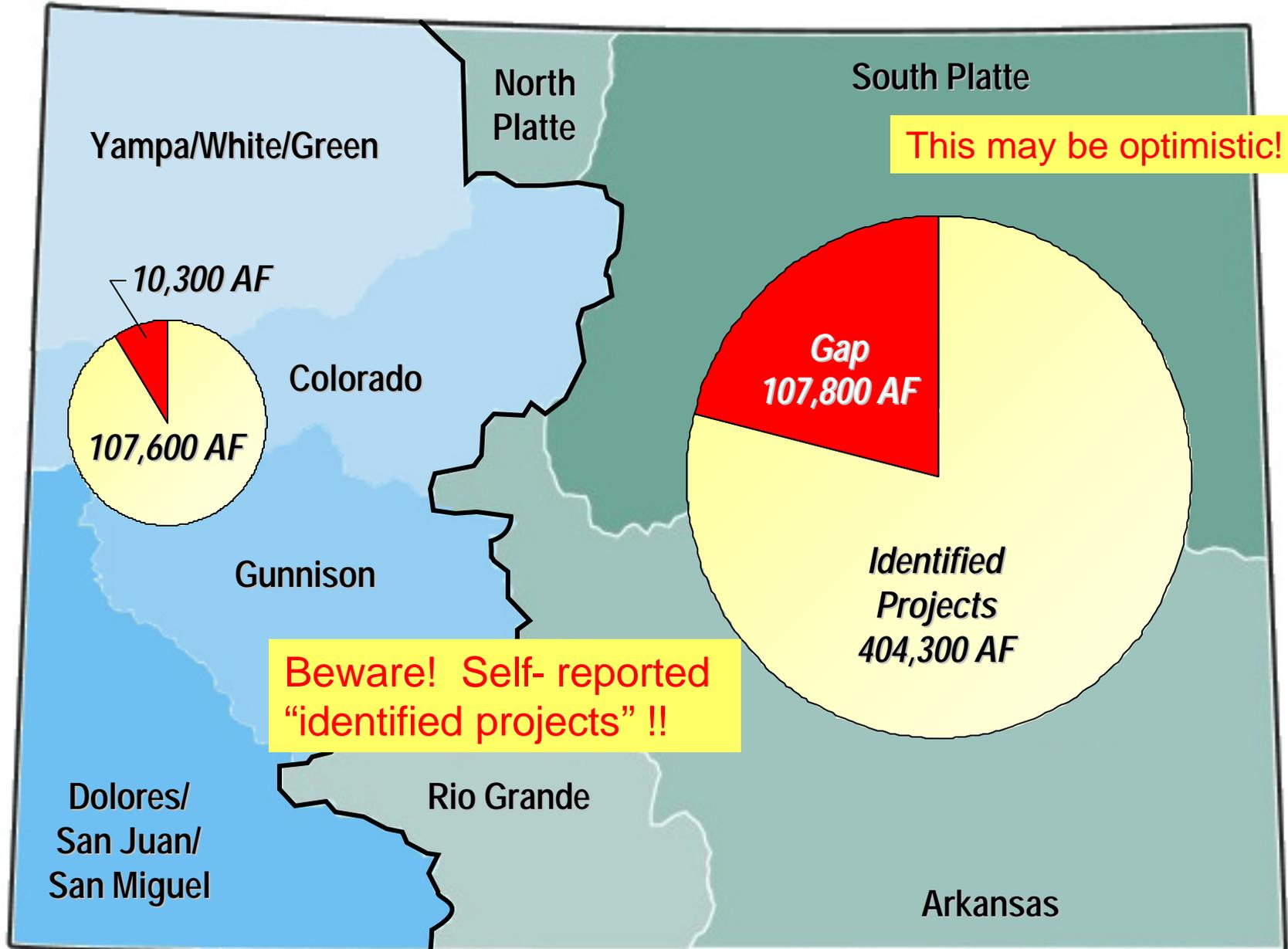
(Office of the State Engineer)

Flow in cfs; note early peak in 2001 - low soil moisture as well going in to 2002

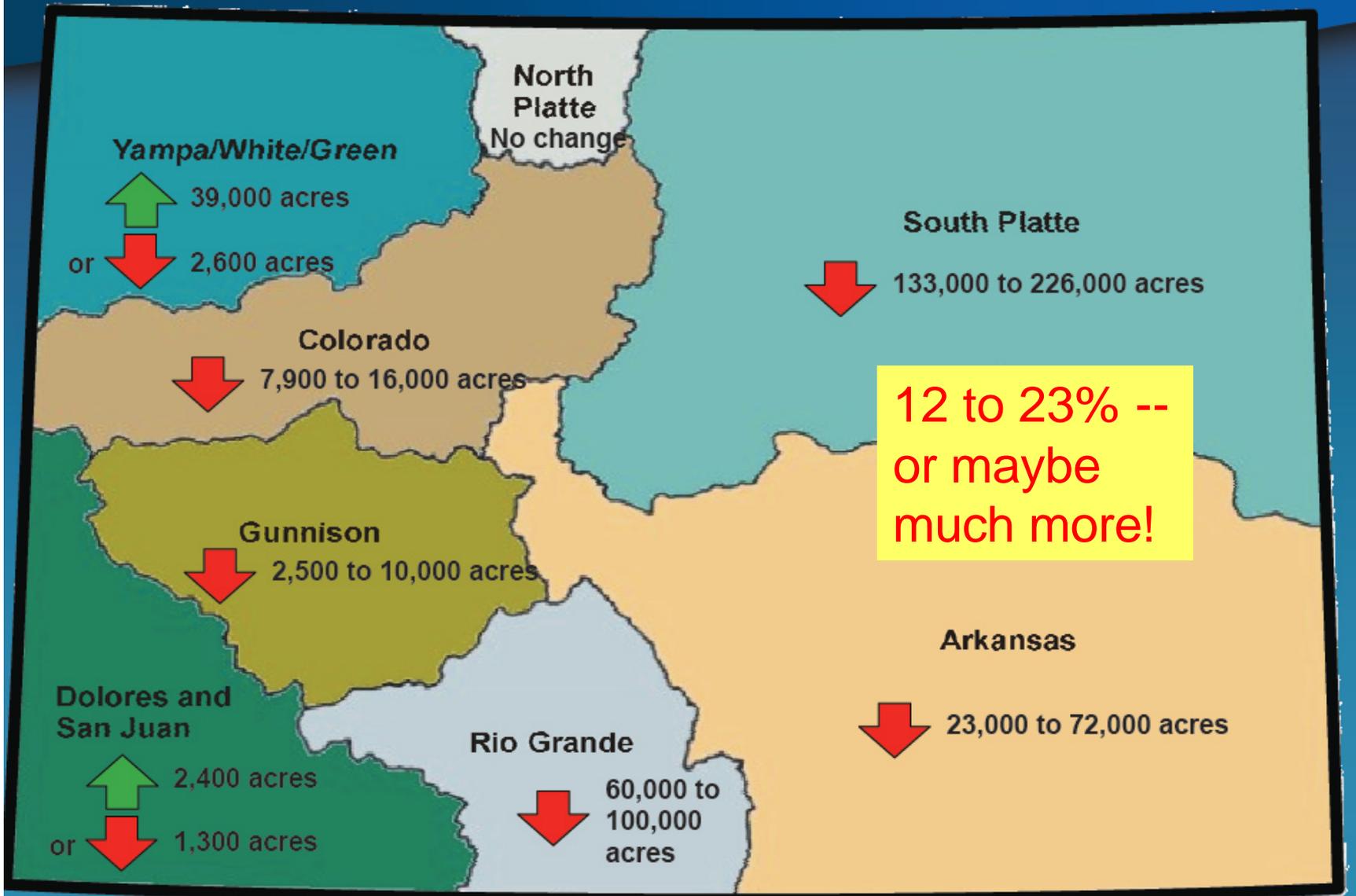


# 2030 M&I “NEW” Water Demands and “Gaps”

(Statewide Water Supply Initiative (SWSI) slide except for comments)



# Potential Changes in Irrigated Acres (2000-2030)



SWSI slide

**BIG** questions about this: **water to acres varies**, and the basis of the demand estimate is uncertain... And, **no climate effects!**

## Oh yeah...**Climate!** Climate Change Vs Western Irrigation

- USGCRP Sectoral Assessments (Water, Ag.):
  - Small changes with big water consequences? (2000)
  - Nationally, moderate effects on ag., no “crisis” (2001)
- USGCRP: Central Great Plains (Ojima et al 2002)
  - With less water, irrigation hurt
  - With more water, irrigation loses to dryland
- USGCRP: Great Basin/Rocky Mtns. (Wagner et al. 2003)
  - Ag declines in all scenarios
- Integrated Assessments (2004, 2005):
  - **Current** management in trouble
  - Ag. Loses water, all scenarios, even “best case” (references, interpretive memo available) -- changes in comparative advantage of irrigation versus dryland



**B-2**    **EXCAVATING FOR THE SOUTH HOLLOW SIPHON ON THE HIGH LINE CANAL,**  
**— MARCH 1899**    (slide from Douglas Kemper)

# Holbrook Canal Headgate Works -- May 2002

Note that these are substantial investments with significant effects on the environment and positive as well as negative effects on the ecology



# What to DO?? Two Constants and the Quickie Social Welfare Function

- Constant 1: **Urban ability and will to pay** -- for water AND ALSO for amenity, environment, open space, ag. preservation.... \$24 billion locally voted in 5 years (US); \$3.8B in Colorado so far, passing 110 of 148 measures (TPL)
- Constant 2: **Soil** formation is slow at best; **climate** is faster!
- **What Would YOU do if you owned all the pieces?** What could you do to maximize the outcomes?
  - Answer tells **what** you want to maximize (pie flavors)
  - Answer tell **how much** you might get (pie size)
  - Problem: you don't own it all. So, **how to organize** so as to get the biggest and best possible pie, for owners and others affected?
- We use **markets, mostly...** Can they work better?

# Markets in Colorado Are Not Working Well

- **Little information** who owns what, or prices paid. Compare **houses** or cars or almost anything else...
- Lack and/or **cost of information** probably favors the few buyers over the many sellers and **Asymmetry** probably favors brokers even more!
- **Historic limitations** on “beneficial” uses of water...
  - Biggest change: In-stream Flow Rights – recent innovation, **unfinished project**, many quite junior
- Exclusion of those affected by “third party impacts” or **externalities** – no standing to object to a sale -- **Public** interests not well identified or represented yet
- Un-represented seek “entry” by **political** or regulatory means
- Limits on **kinds of contracts and arrangements** –
  - short-term moves very limited
  - no long-term lease deals yet
  - “interruptible supply” very limited in Colorado

# Under-Invested Interests - Environmental

- Cumulative Impacts Under-Represented in Water Markets
  - **Minimum stream flows** - **Begun... but** underfunded? Low reliability water rights? Missing reaches? Wetlands? Habitat?
  - **Water Quality** - **how** to integrate?... high stakes in **NPDES permits** etc. Threats of **TMDLS** with unpredictable effects?
  - Threatened or Endangered **Species**. Little foresight or information, **fear/anger** at abrupt, uneven **inequitable** imposition of limits
- **Not Represented, not often financially supported**
  - “Isolated” Wetlands, created **wetlands with value to others** -- who might pay to support them
  - Ecological sufficiency for **resilience** to stresses, restoration, adaptation to change
  - **The long term** and the maintenance of options for the future
    - farm productivity, including **farmer** viability and capacity
    - farm **land management!** These are “hybrid ecologies” -- like forests now, no “walk away” looks good...

# Under-Invested Interests – Recreational - Tourism and Travel

- Financially large recreational interests **very little involved** in securing needed water conditions
- **Access** limits on private land – unconsidered resources
  - Traditional disinterest in diversification and & \$#@! fools...
- Riparian recreation and amenity values underused and under-subscribed – should be worth money!
- Just beginning to consider **pay for timing** of flows
  - Fisheries and fishing
  - Rafting, kayaking, canoeing
- **Increasing role** of recreational economy
  - Second residences
  - “Agritourism” booming – see Nebraska!
- Conservation easements are not all of the answers

# Under-Invested Interests – Local Communities and Local Governments

- Local **amenity and quality of life** issues
  - What do people want? Look at ads!
- **Future** amenity and attractiveness -- needed for attraction of new activity and new economic base
- **Rural tax values** -- irrigated, dry-farmed, and unfarmed land; counties, small towns, school districts
- **Urban and suburban** amenity and tax values from ditches and reservoirs – In foothills study area, <1% standing water was natural in origin...
- Land Use Planning for Value and Cost control! Someday, even in the Wild West?
  - Local **costs** (e.g. to counties) much bigger than local benefits (E.g, Colorado: \$1.62 costs/\$1 revenue ave.)

# Under-Invested Interests - Agricultural?

- **Livestock feed** -- crop sales are much smaller than livestock sales; threats to irrigation affect feedlots, rural economies...
- Agricultural land is being developed in ways that **fail to maximize value of the real estate to the agricultural and rural communities – maybe even the seller !?!**
  - difference between “raw land” versus platted, permitted, or marketed -
    - how much new value should be kept by whom?
- **Agricultural water is very likely undervalued** -- Information problems from **uniqueness** of water rights, expense of **valuation** in secretive and competitive market
  - Information problems from denial of possible **limits** on transfer that might reduce supply
  - Problems of **cooperation** among large number of sellers facing small number of buyers
- Agricultural **capitalization** problems, especially small and medium-sized farms, limits ability to reorganize and adapt...

# NEW FORMS OF WATER TRANSFER WANTED

- **Short term** spot market -- “water bank”
  - Long-term “**rotating crop management**” -- timing specified intermittent transfer to meet “base load” demand for municipalities (M&I sector), other high-value uses
  - Long-term **interruptible supply** arrangement -- transfer when condition is met, to meet foreseeable but timing-unspecified demand
  - [Along with temporary “bridge” deals (substitute water supply) and micro deals]
  - AND, ALL INTERESTS CAN **PARTICIPATE**
- Just give ‘em the handouts from Water Congress!**

# Long-Term Rotational Crop Management

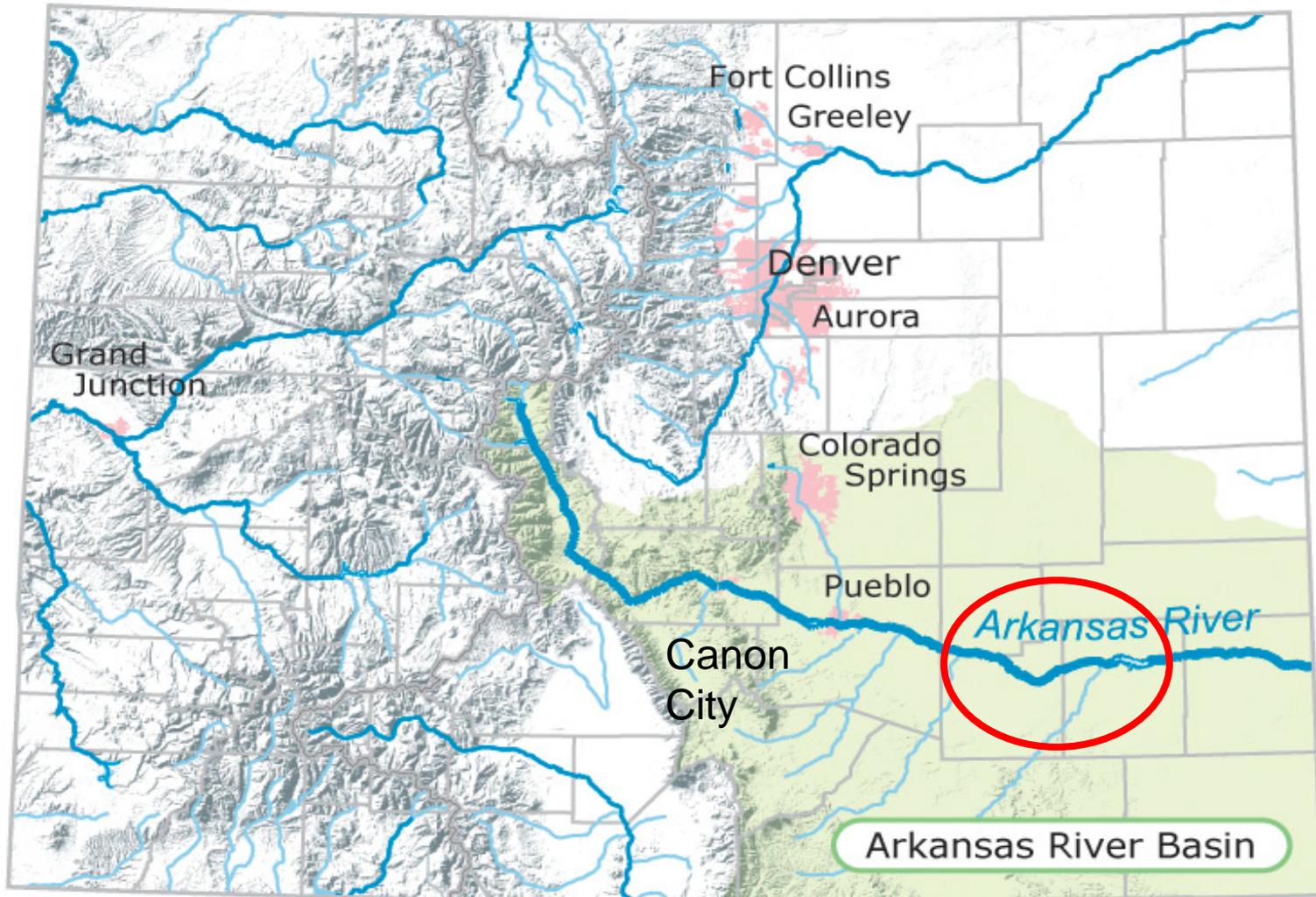
- Very **long-term** is ideal -- stability for all
  - Planned locations of fallow/etc
  - Farm incomes and financing improved – Oughtta be!
- **“Base-load”** predictable water supplies
- Only **Up-front** infrastructural costs (e.g., diversions, conveyance) -- financed
- **“Pay-as-you-go”** acquisition, **not** bonding, (save 50% at 3.25% interest for 30 years), better match of costs and benefits and what **constituents/rate-payers** want:
  - 110 **votes** for conservation/preservation/open space in Colorado, \$3.8 Billion
  - Birding, hunting, fishing, environmental groups -- **\$\$\$**
  - What attracted people? What will in the future?
- **ALL terms** of deals negotiable - including end of term, indexing, risk management (Still some limits in **new** CRS 37-92-103 and -305(4)(a)(IV))
- IT IS **BEING PURSUED!!** (25 January 2007 announcement)

# Long-Term Interruptible Supply

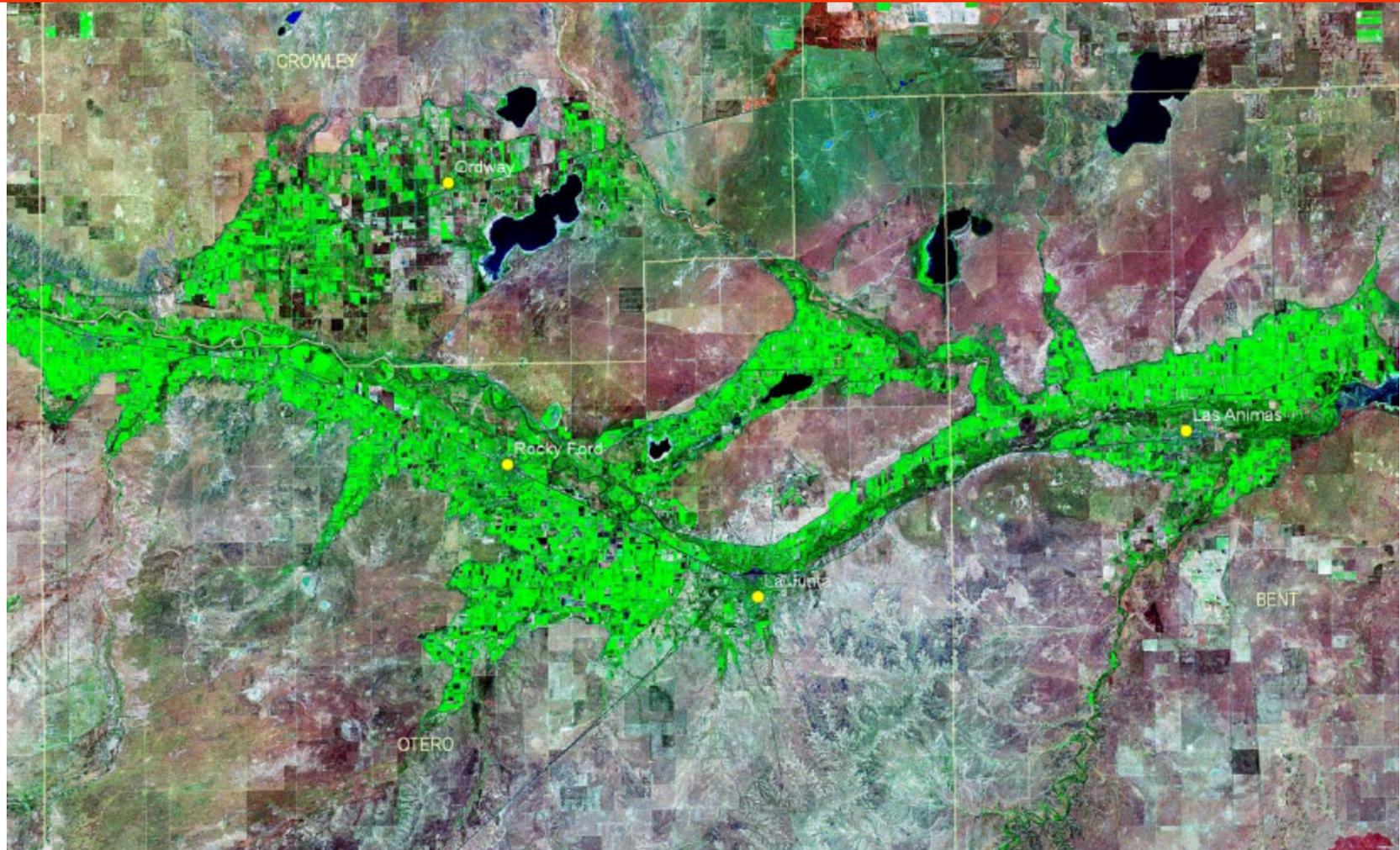
- Also very **long-term** idea -- stability goals
- NOT available in “3/10” years, 10 year limit deals in CRS 37-92-309 -- want much longer
- Water moved **on call**, as specified, e.g. for...
  - **Dry-year** and drought recovery
  - **Facility** management
  - **Wet-year** opportunities (ASR, etc)
- Financing negotiable, “pay-as-you-go”, prices indexed to **opportunity costs, costs of flexibility**, and **timing** of “call” and situation
- ALL terms should be negotiated!

# Arkansas River Basin in Colorado

Map by Tom Dickinson, SSDAC, IBS, University of Colorado



Biological and Environmental Issues: The Green is  
“under a ditch”... but we have little science on “out there”...  
Water Law: maintain pattern of flows IN THE RIVER ONLY!



**Data source:** Landsat Enhanced Thematic Mapper, 2005.

**Map by** Thomas W. Dickinson, Institute of Behavioral Science, University of Colorado at Boulder

# Looking for Trouble... the Big 3 of What Can Go Wrong with this splendid plan...

- Municipalities have to **buy in, represent all constituency interests – avoid MISSION MYOPIA** – Represent all constituency interests, now and future... at least ask!!!
- Irrigators need to know they won't lose **other incentives and opportunities** –
  - Base acreage? CRP? EQIP? Crop Insurance? Etc
- Everyone needs to know that the new deals have **certainty**
  - Avoiding surprises means adequate info – on **cumulative impacts and “show-stoppers”**
  - State support means adequate **investment** in administration – not just cheapest, easiest... It's a complex world! Love it or leave it...

# Uncertainties that beg for research

- Acreage and agricultural economy impacts of withdrawal of irrigation water –
  - “Firm yield” of water: **seniority** (reliability of water right) times **application** amount (acre-inches) times **acres**
  - Available “Seniority” is a **moving target** as water is **sold** (secretly or not) and – uh oh... as **climate change** “reels in” the junior water rights
  - Less senior water associated with lower applications
  - Correlation with **soil quality** not known
- **Cumulative Impact and Thresholds** (TMDL, ESA)
  - Water **quality** impacts – less dilution, different runoff, less of some ag. inputs, more of others? Soil changes from ending irrigation, climate change, erosion?
  - **Biological** impacts – more change in Hybrid Ecology
  - Habitat **connectivity**, restoration/adaptation...

An ironic diversion...

**“Ten years from now, Americans could be as concerned over the loss of the nation’s prime and important farm lands as they are today over shortages of oil and gasoline!”**

“Where Have the Farmlands Gone?” Brochure reporting results of the National Agricultural Lands Study (wgos for knowing date)

# Thank you!

- Contact author for support of claims and other materials
- Contact author to correct his errors and outrages
- <John.Wiener@Colorado.edu>

# Major Trans-basin Diversions to the Arkansas and other Colorado basins

How about just moving more water over the mountains?

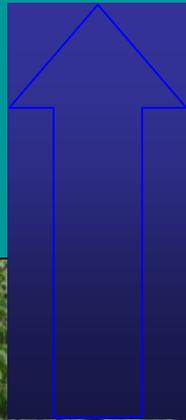


West Slope has hit its limits, it says... strong political pressure against more transfers...

Why is moving water so complicated?

# Consumptive Use

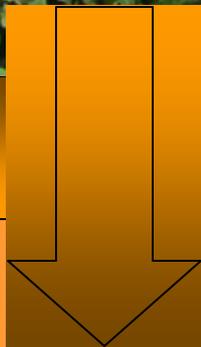
THIS is what can legally be transferred



Surface Return



THESE parts are owned by others, in other water rights



Subsurface Return

# After the shouting... Visible Design Problems with the Pilot Program As Tried...

- **Subject** - Stored water only - not direct flow
- **Duration** of deals - not long enough for municipal firming
- **Timing** -- not fast enough for spot
- **Geography** -- in-basin preference, then out-of-basin exclusion
- **Medium** -- Internet; phone “excluded”
- **Disclosure** of bids

- Ditch company **physical** problems
- Ditch **accounting** management problems
- Farm **management** fears
- Failed to use traditional **pathway** for agricultural innovation
- Lack of **price discovery**
- The “**SHEEEP**” factors
- E.g. **Fear** loss of future