

Changing Colorado Agricultural Water Management: Reflections on a Failure of Adaptation

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This is the “director’s cut” version – (the one with the
kitchen sink) – for posting

Notes

- Hand-out has summaries of several parts of project on moving towards climate-responsive water management - available by e-mail also
- Further information on the Water Bank experiment and associated topics is available on request
- See “notes” below slides for citations, commentary for some slides; see also Wiener, J.D., 2007 USDA CSREES Water Meeting:
http://www.usawaterquality.org/conferences/2007/abstract_index.html#W
- Disclaimers: Nothing here represents any position of the National Oceanic and Atmospheric Administration, the National Center for Atmospheric Research, or the University of Colorado, and the secretary will disavow all knowledge.

Rough Outline

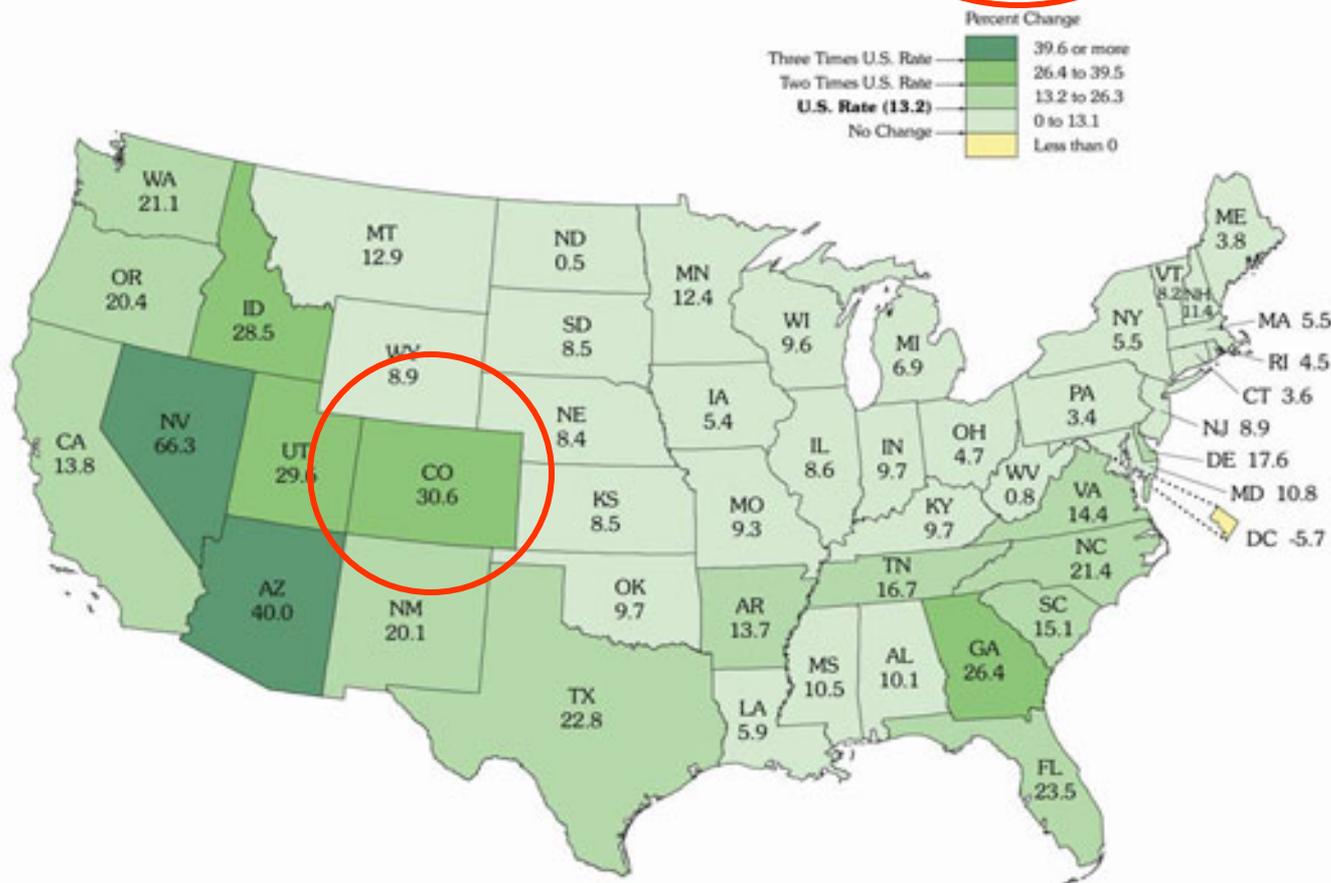
- Colorado Agricultural Water
- What's a water bank? Who cares?
- What happened?
- Adaptation? To what?
- What would that adaptation look like?
- Opportunity for Extension

Why I am Here: Because I Know What You Do

- Wiener, J.D., 2005, Learning From and About Co-Operative Extension Services, Session Report and annotated references, from Panel Discussion at Climate Prediction Applications Science Workshop II, Tallahassee, FL, March 2004. Posted as Appendix to Wiener, 2005 presentation at Climate Prediction Applications Science Workshop III, Palisade, NY, International Research Institute for Climate Prediction, at <http://iri.columbia.edu/outreach/meeting/CPASW2005/Presentation/JWiener.pdf>

Demographic Changes: Population Has Grown Fastest in the West, Particularly in the “Public Land States”

Percent Change in Resident Population for the 48 States and the District of Columbia: 1990 to 2000



- Darker areas denote faster growth rates.

- Nevada (66%) and Arizona (40%) lead the nation.

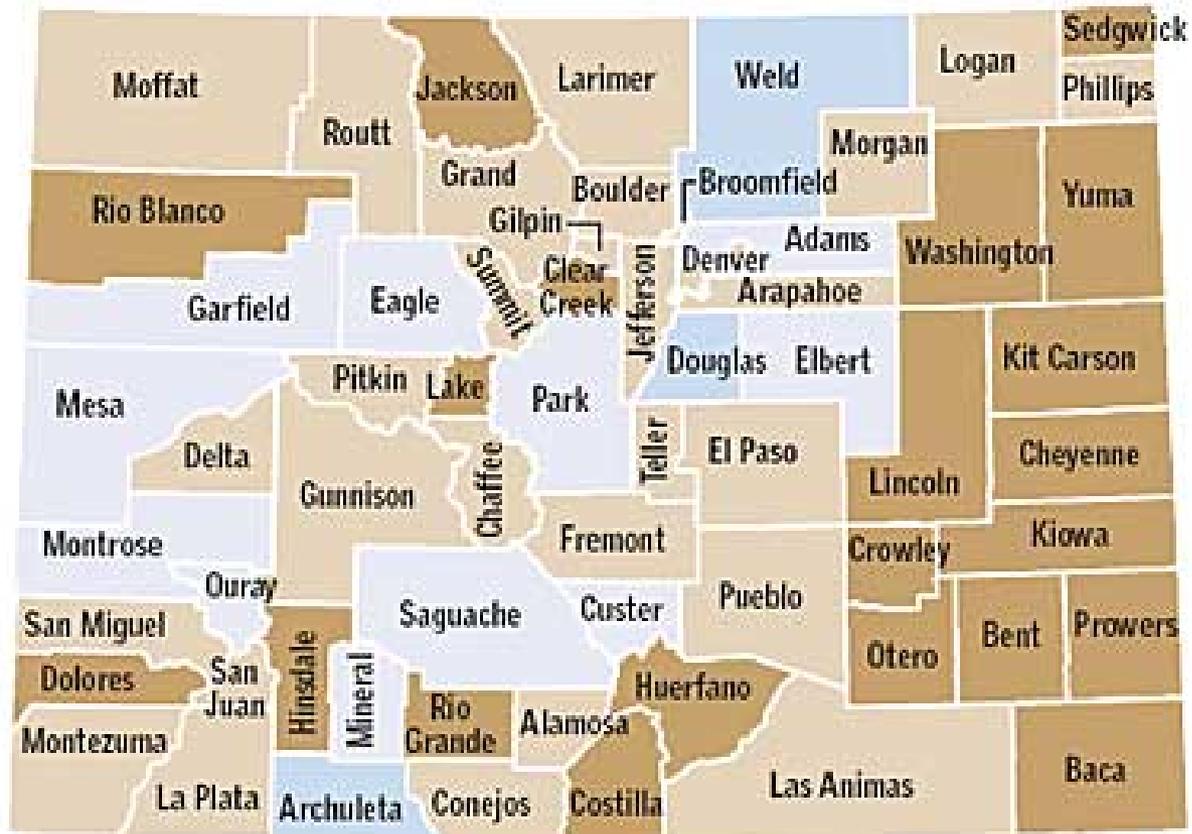
- Intermountain states average about 30%.

What is now happening to the farm-dependent areas of Colorado?

What about those blue areas gaining population?

Percentage growth from 2000 to 2005

-12.5% to 0% 0.1% to 10% 10.1% to 20% 20.1% to 41.9%



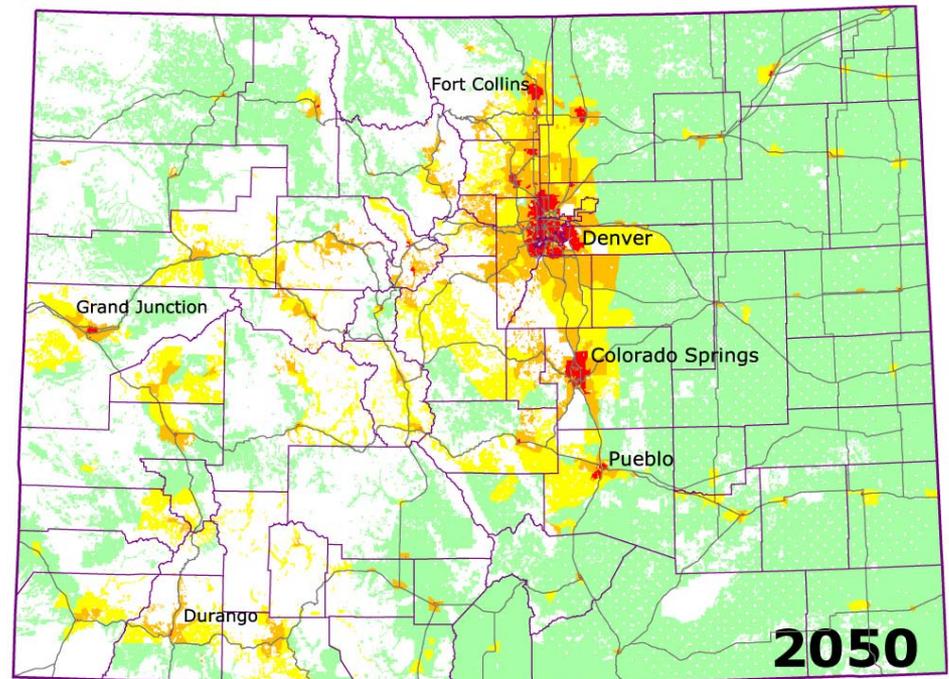
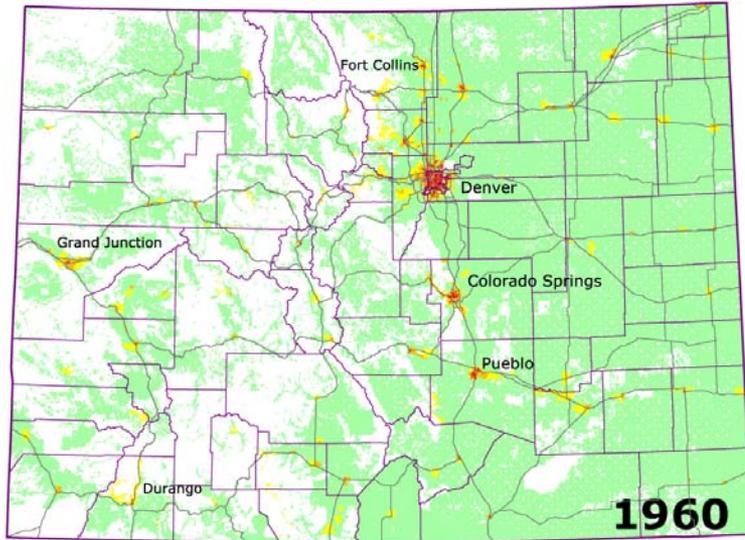
Source: U.S. Census Bureau

The Denver Post

Growth is NOT evenly distributed

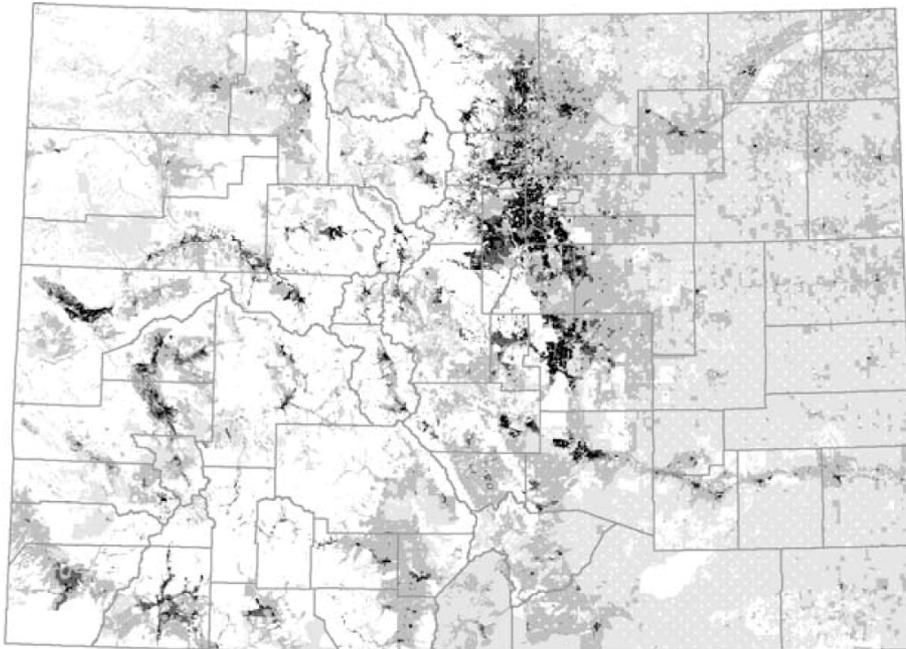
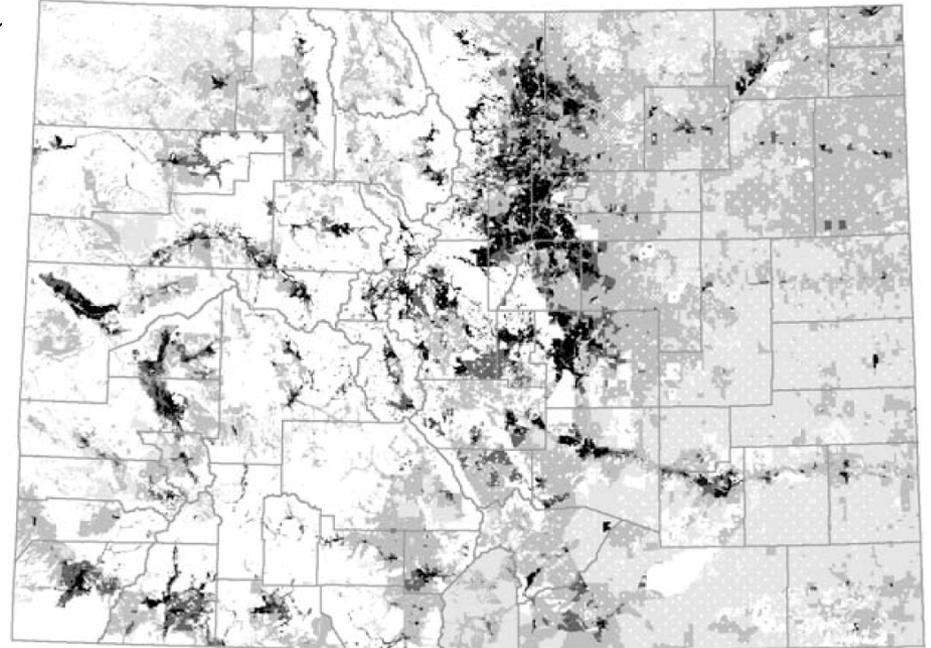
Housing Density Change 1960 - 2050

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



Housing Density Change In Colorado 2000 - 2020

2020



Riparian corridors!

2000

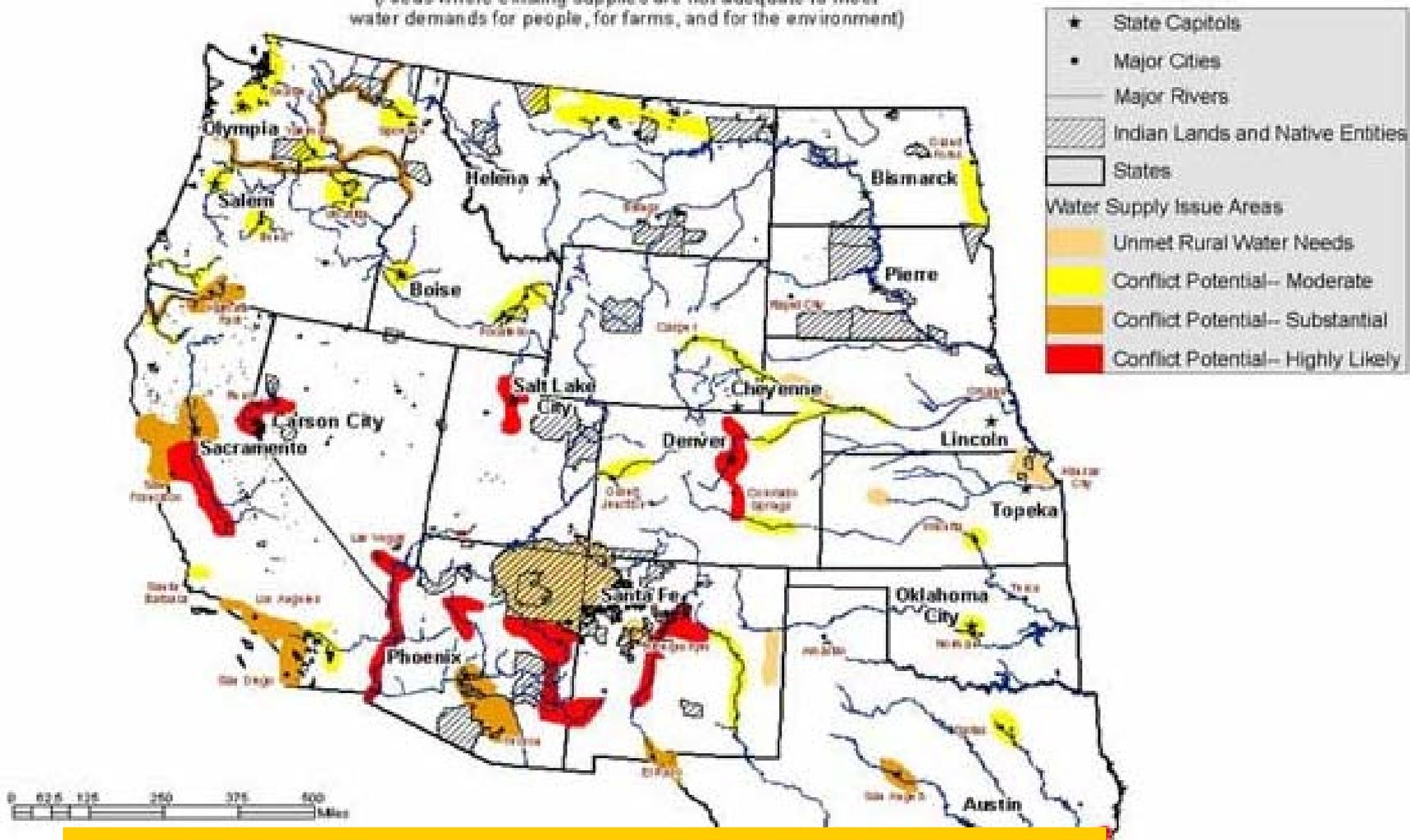
Housing Density



David M. Theobald. "Targeting Conservation Action through Assessment of Protection and Exurban Threat." *Conservation Biology*, 17(6):1624-1637. Dec. 2003

Potential Water Supply Crises by 2025

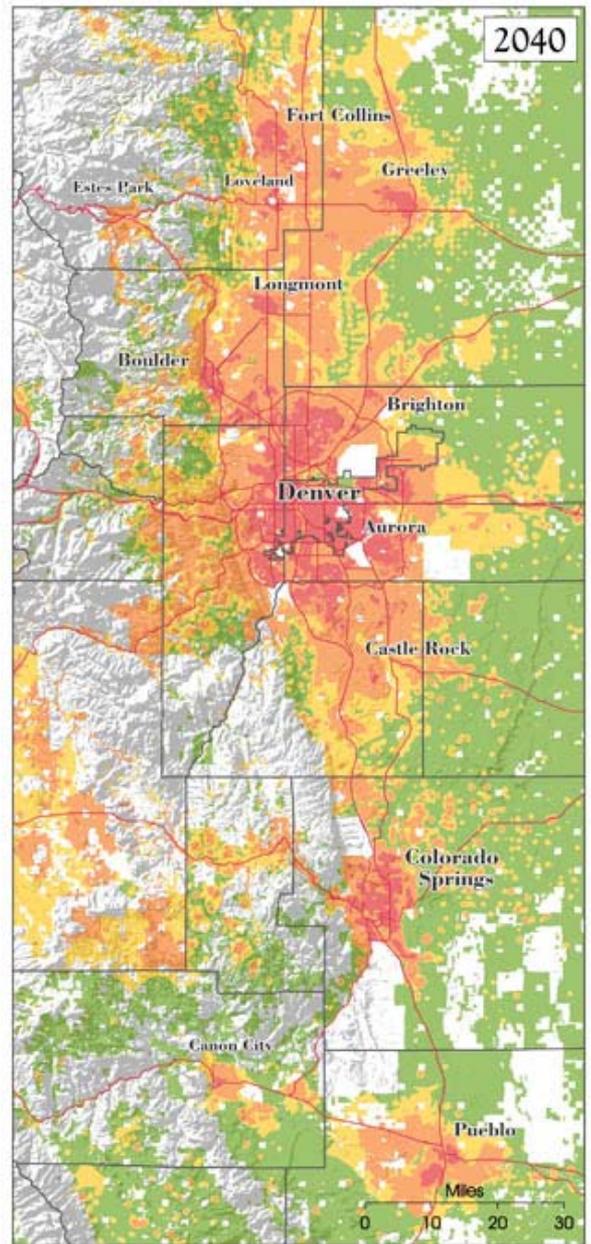
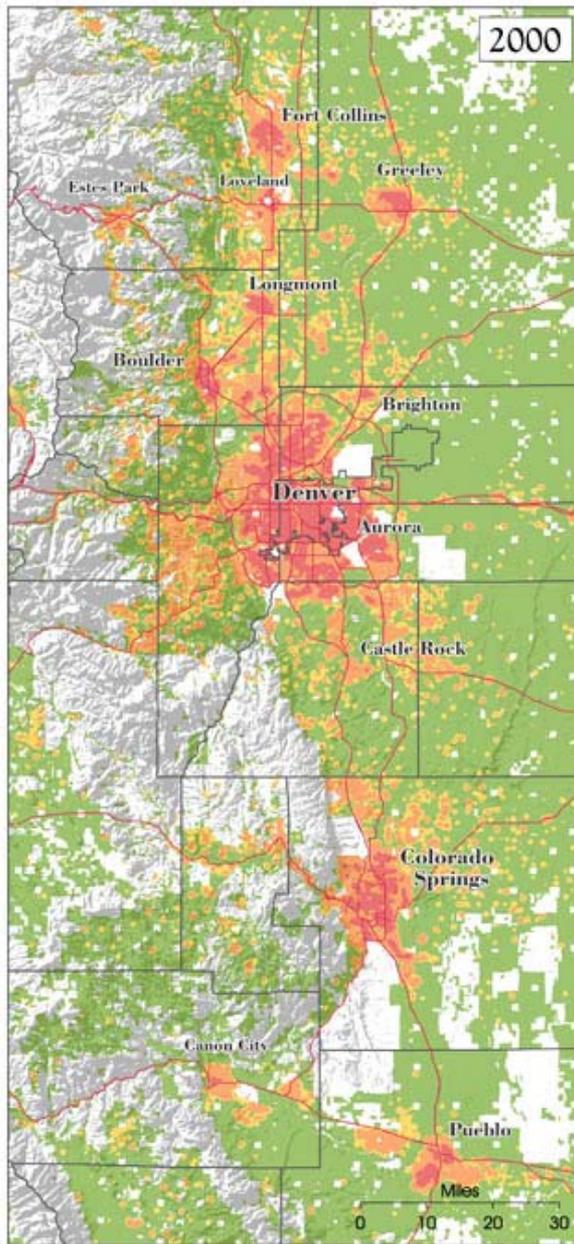
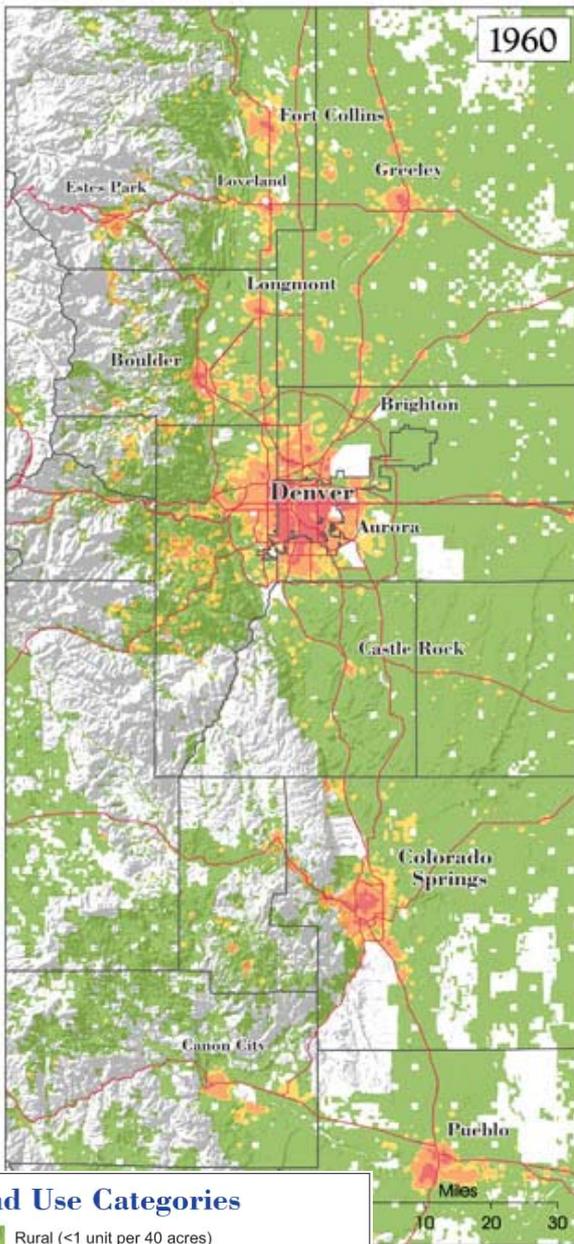
(Areas where existing supplies are not adequate to meet water demands for people, for farms, and for the environment)



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

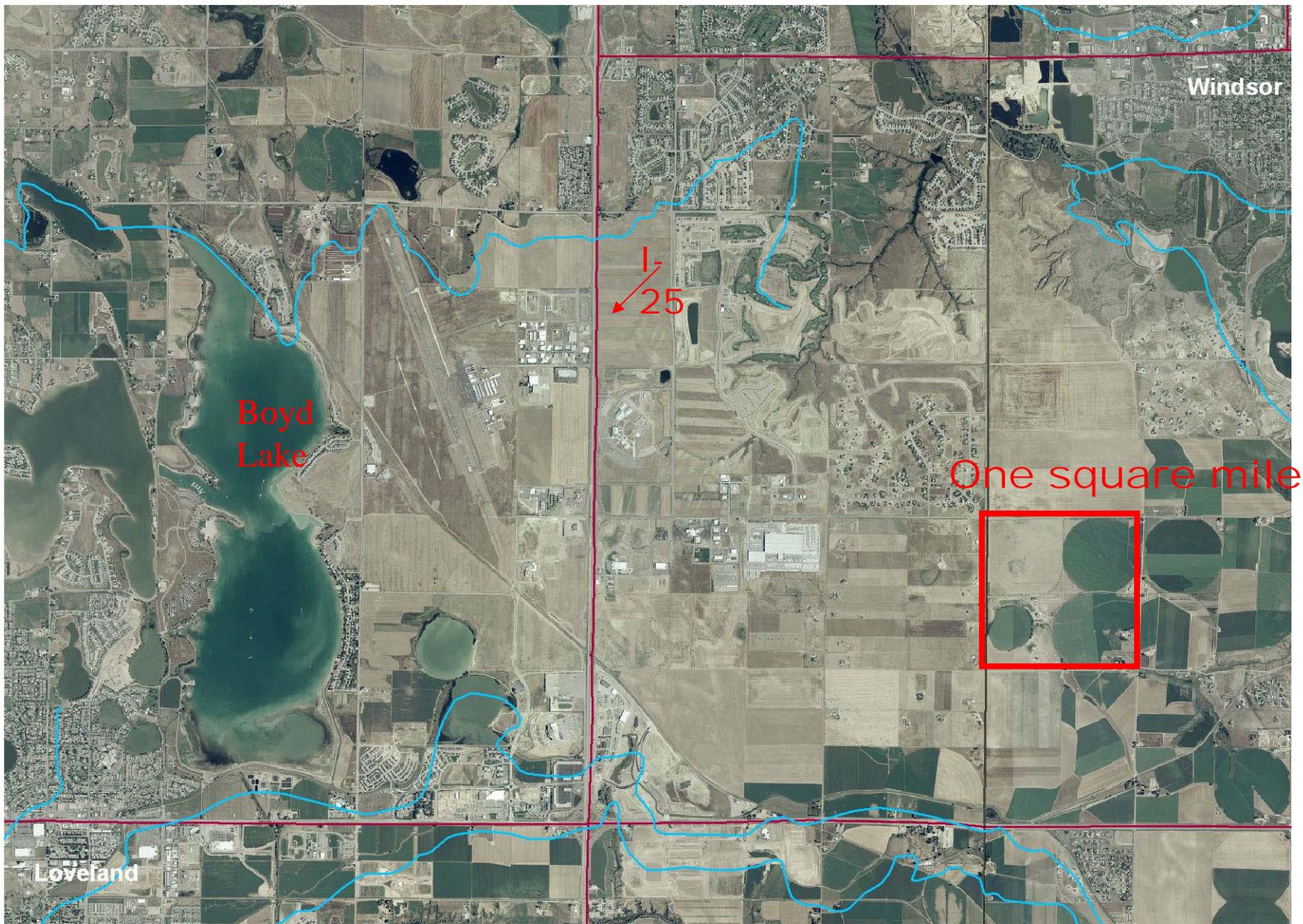
– U.S. Dept. of Interior
Water 2025





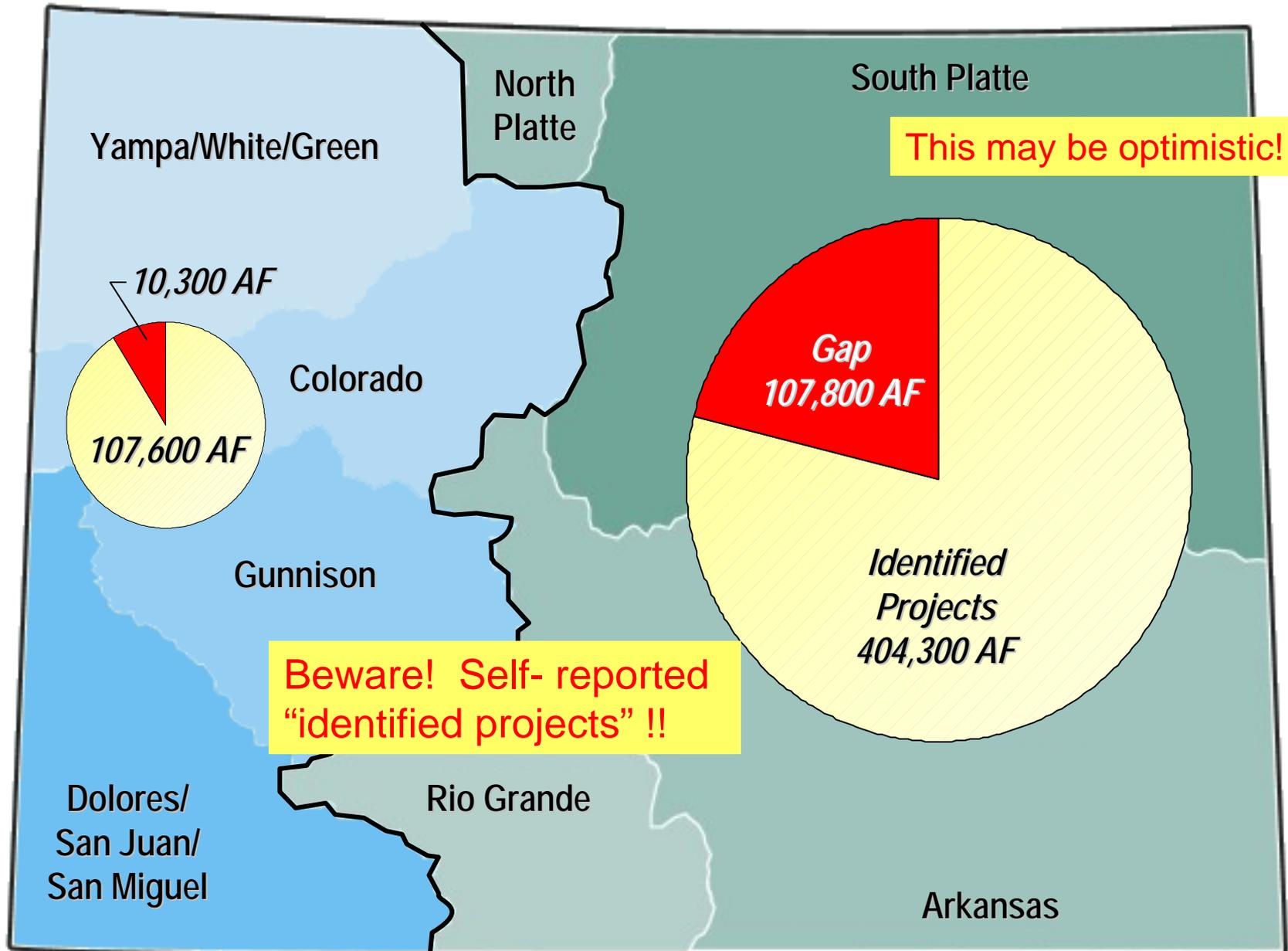
Colorado Front Range

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



Slide by Tom Dickinson, IBS and Geography, Source: National Agriculture Imagery Program (NAIP), USDA-FSA Aerial Photography Field Office

2030 M&I Water Demands and Gaps (SWSI slide except for comments)



It seems so simple in the U.S. -- just buy the water from the farms... But the water is used many times. Water not consumed is returned to the stream and claimed by others. Traditional water law protects them, but makes transfers slow and costly -- can we do better? And can we ease the change and sustain farming and rural life?

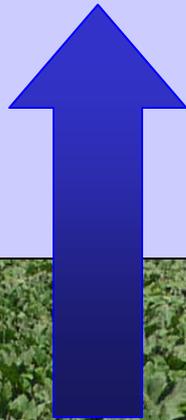
"It is frequently argued that a reallocation of just 10 percent of agricultural water to municipal uses could augment municipal supplies West-wide by 50 percent." (Nichols et al. 2001: xii-xiii: Water and Growth in Colorado, C.U. Natural Resources Law Center).

"Irrigation agriculture continues to be the focal point of discussion on sources of water to meet growing demands. Calls for conservation have come from several sources, apparently prompted by assumptions that the magnitude of agricultural water use is associated with inherent inefficiencies in current use and that minimal efforts toward conservation could yield the water required for alternative uses." (Smith et al, 1996, Irrigation Water Conservation: Opportunities and Limitations in Colorado, C.S.U. Water Resources Research Institute.)

Why is moving water so complicated?

Consumptive Use

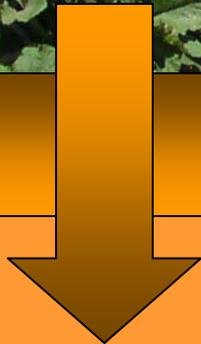
THIS is what can legally be transferred



Surface Return



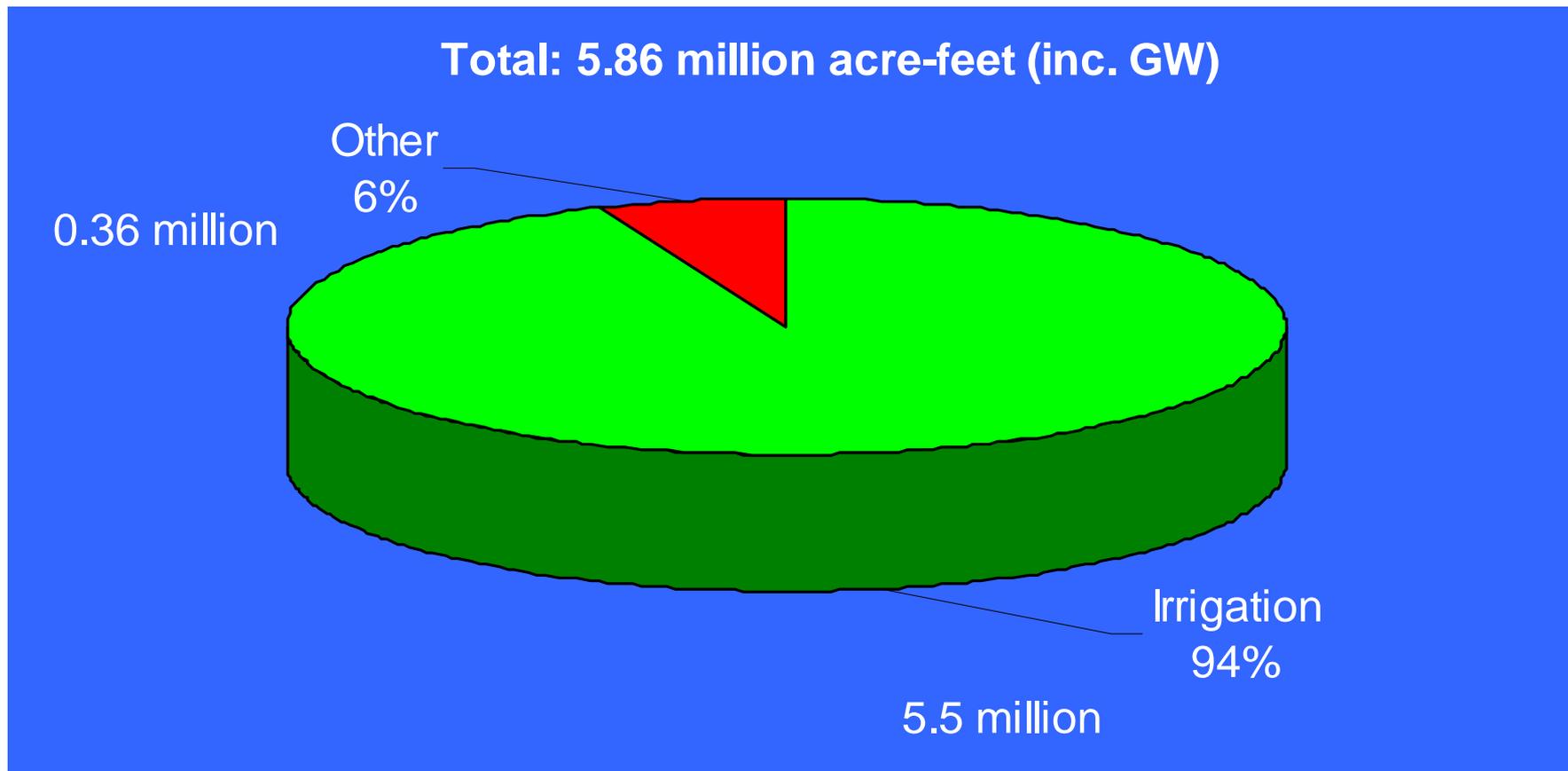
THESE parts are owned by others, in other water rights



Subsurface Return

Colorado Consumptive Water Use (1995)

94% of consumptive use of water was in irrigation – a little lower now



Hey! **Ag water is still cheap!** Get it from the irrigators!

Table VI.1. The Range of Cost Estimates for a Variety of Water Management Options (from Denver Water IRP)

Type of Project	Cost Range, \$ per Acre-Foot of Yield
Water Conservation	\$4 to \$8,000
Acquisition/Change of Irrigation Rights	\$700 to \$12,000
System Refinements	\$700 to \$16,000
Reservoir Enlargement	\$1,400 to \$10,000
Exchange/Augmentation	\$4,600 to \$10,200
Conjunctive Use	\$7,400
Nonpotable Reuse	\$8,000
New Transbasin Diversions	\$4,300 to \$11,700
New Reservoirs	\$5,300 to \$19,500
Indirect Potable Reuse	\$14,000 to \$16,000

This is for the sale of water rights, not one use or a lease

From Denver Water Integrated Resource Plan, and in Luecke et al., 2003, What the Current Drought Means for Colorado... (on-line from Trout Unlimited, Colorado)

Urban consumers already pay more than the value of water as an input to almost all commercial farming in Colorado.

Pueblo Chieftain Survey November 2005 - Retail Water Rates						
City					Without block increase, charge for 325,000 g – one acre-foot	
Front Range City		150,000 g				
Golden		\$645			\$1,397	
Highlands Ranch		\$632			\$1,369	
Aurora		\$590			\$1,278	
Thornton		\$511		<p>This is likely not correct - with inclining block rates, prices may be higher in most if not all cities.</p>	\$1,107	
Broomfield		\$498			\$1,079	
Westminster		\$490			\$1,062	
Northglenn		\$475			\$1,029	
Arvada		\$472			\$1,023	
Colorado Springs		\$471			\$1,020	
Pueblo		\$452			\$1,020	
Boulder		\$432			\$936	
Lafayette		\$409			\$886	
Pueblo West		\$374			\$810	
Englewood		\$354			\$767	
Denver		\$352			\$763	
Louisville		\$345			\$747	
Pueblo		\$327			\$708	
Based on annual use of 150,000 gallons and 1-inch meter rates. Figures are rounded.						

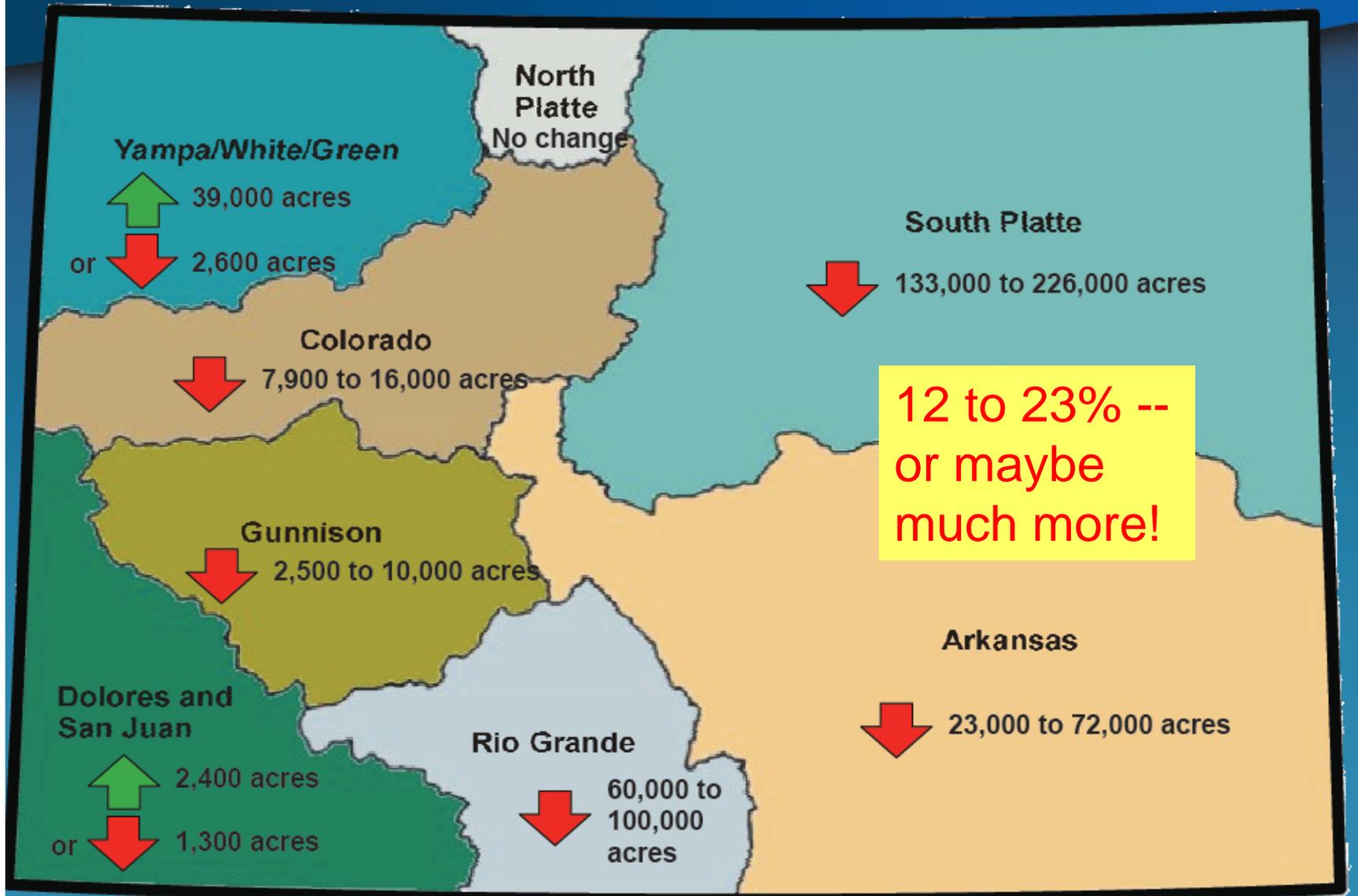
Major Trans-basin Diversions to the Arkansas and other Colorado basins

How about just moving more water over the mountains?



West Slope has hit its limits, it says... strong political pressure against more transfers... They want some left to grow on – and the growth rate is faster than the Front Range!

Potential Changes in Irrigated Acres (2000-2030)

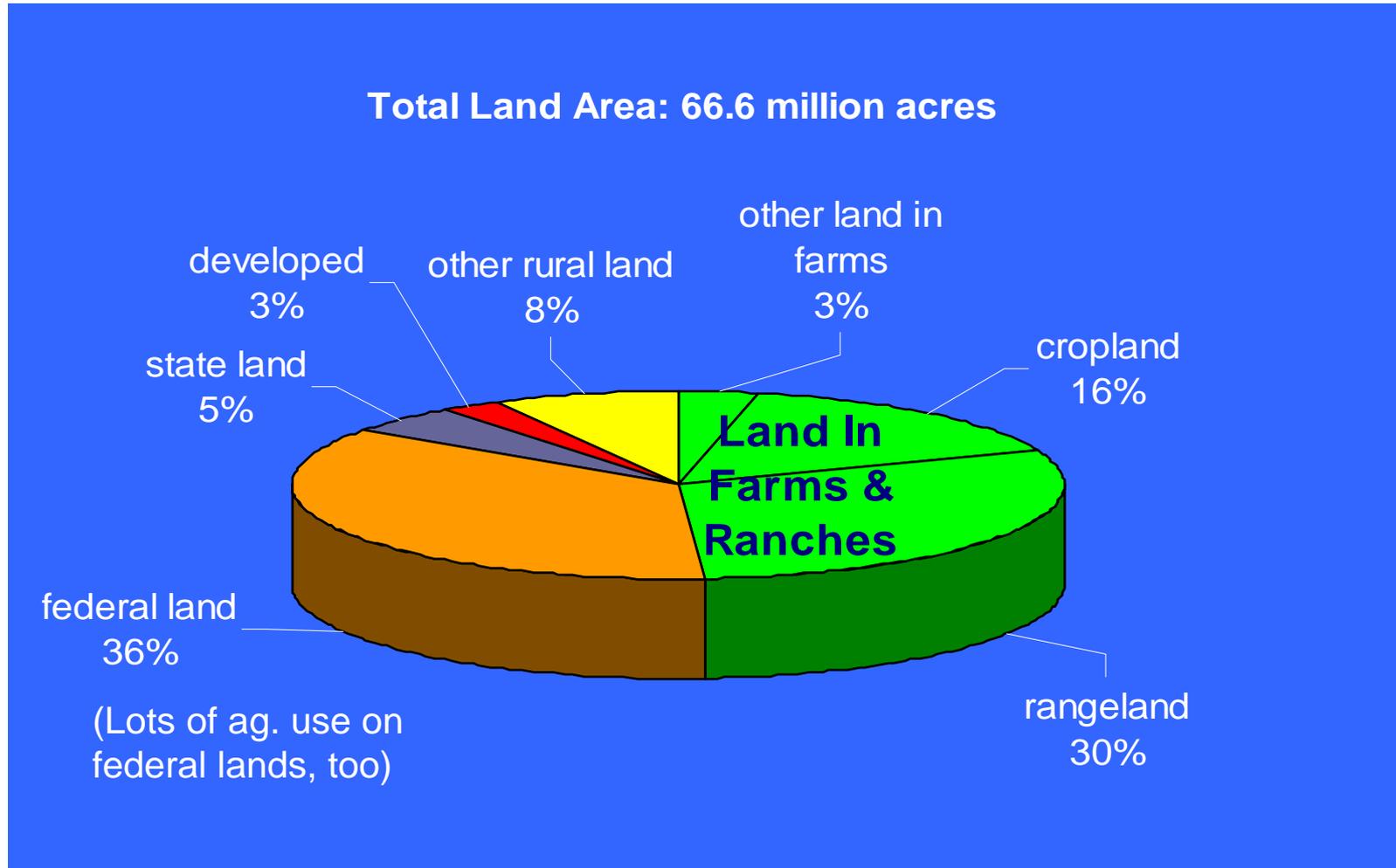


SWSI slide

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

Colorado Land Use (1997)

49% of all CO land and 85% of open private land is in agriculture

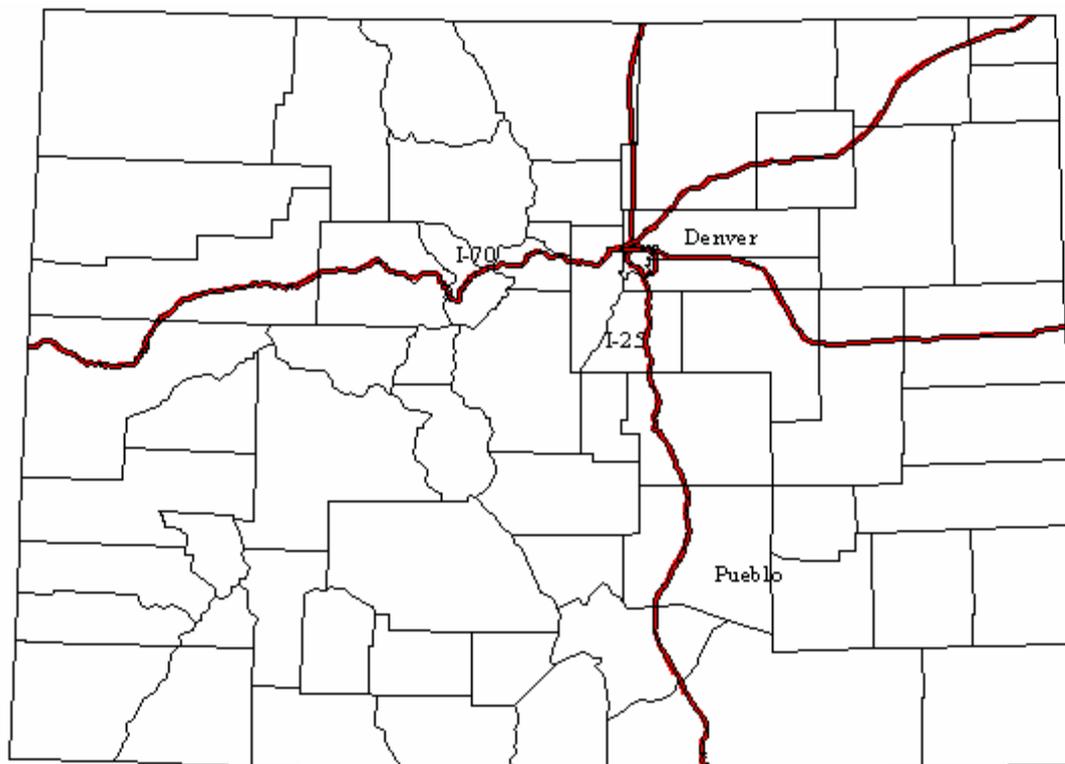


Colorado Dept of Agriculture, National Agricultural Statistics Service(USDA), Natural Resources Conservation Service(USDA) -- slide from David Carlson, Co Ag. Statistics.

Prime Farmland in Colorado

Only 2.5% of Colorado's land is prime (all of it irrigated)...

...but the precise location of this land is unknown.



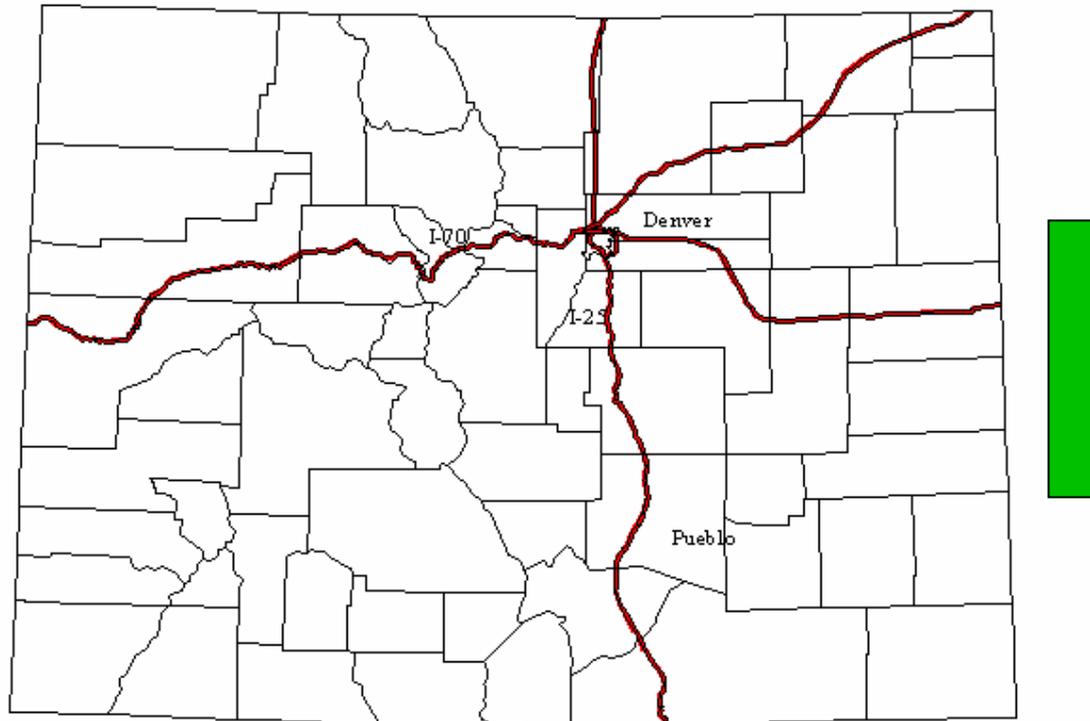
How much
is left?



Colorado Dept of Agriculture, National Agricultural Statistics Service(USDA),
Natural Resources Conservation Service(USDA) - slide mod. from David Carlson

Magnitude of Ag Land Conversion (1987-97)

2.5% of Colorado's land has been converted from ag to other uses over a 10-year period (1.4 million acres) – BUT, the rate of conversion is increasing!



Colorado Dept of Agriculture, National Agricultural Statistics Service(USDA), Natural Resources Conservation Service(USDA) - slide modified from David Carlson

Great Plains Farmland and # of Farms (1930-1990)

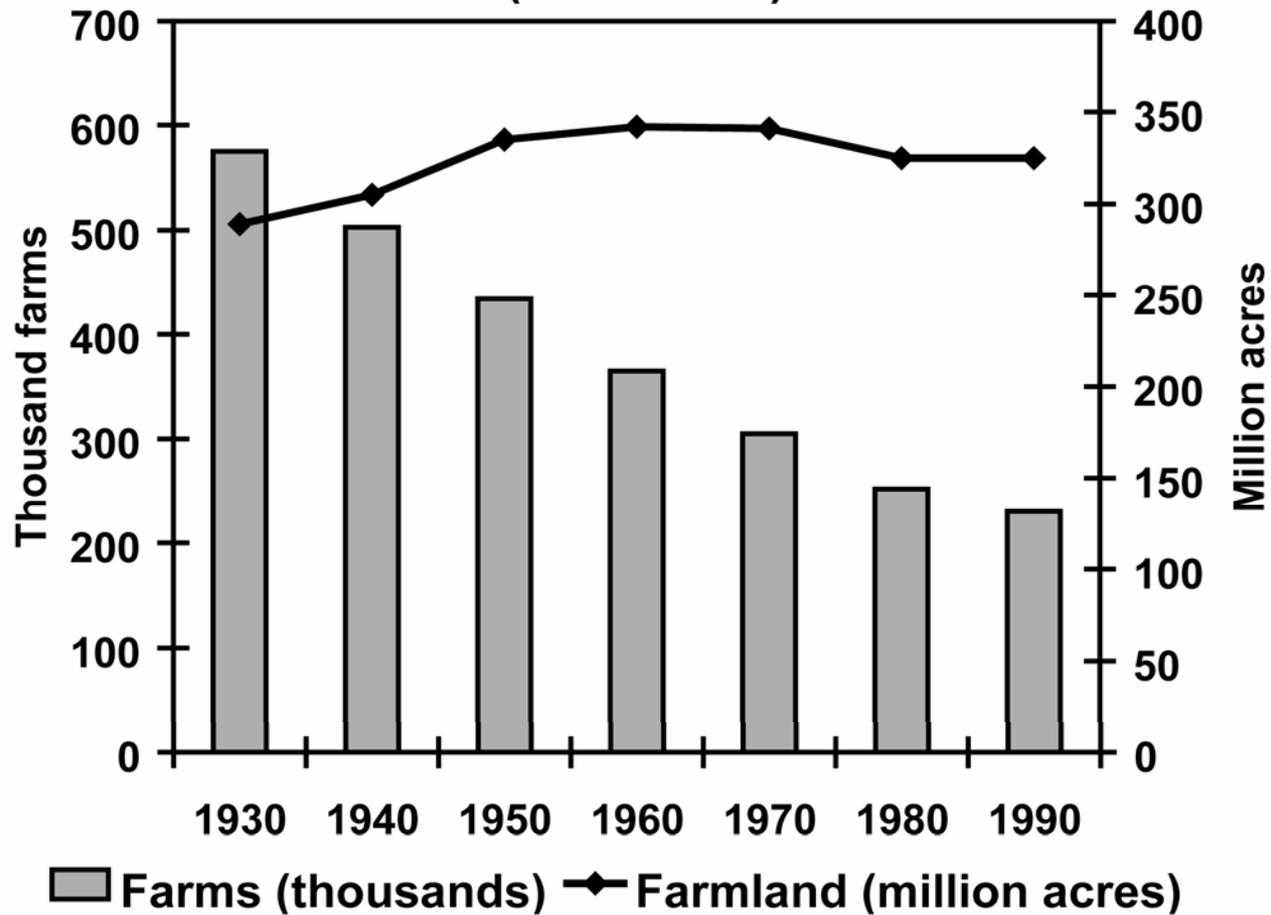


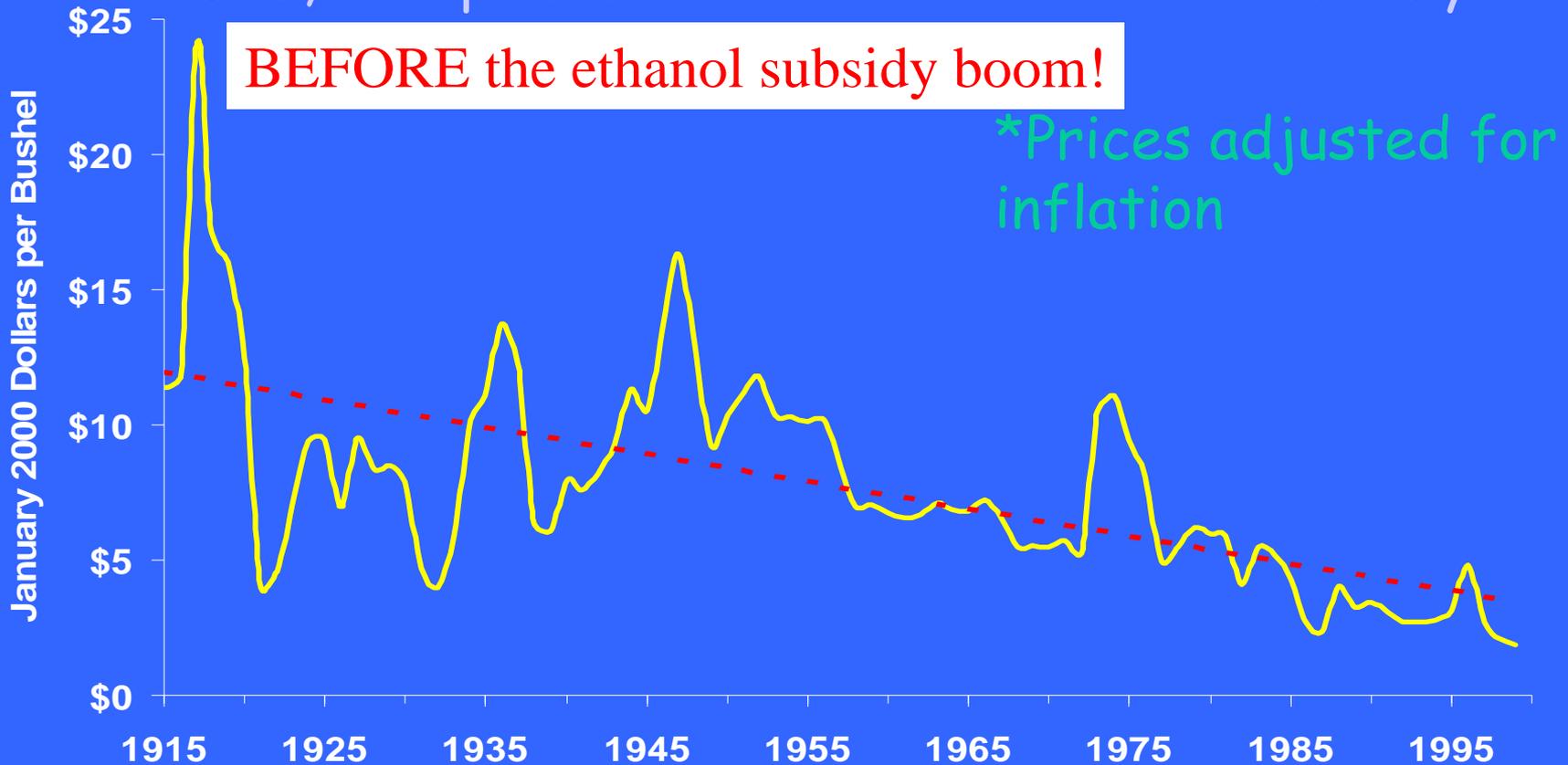
Fig. 1-2: The number of farms (left axis) in the Great Plains has been decreasing over the last 70 years, however, the area in farms (right axis) has remained relatively steady during the same period. (Source: University of Texas Population Research Center 1998)

Pressure on Agricultural Water

- The general financial squeeze on farms
- Water for municipal growth in Colorado, (and the urbanizing West in general)
- In the South Platte Basin, with most of the Front Range cities - Fort Collins to Denver, Ag. used 2.8 million acre-feet in 1998, when cities used only about 0.7 MAF.
- Future climate? Likely lower water supply
USGCRP Great Plains, Rocky Mountain-Great Basin Regional Assessments.

Real* Prices of Colorado Corn

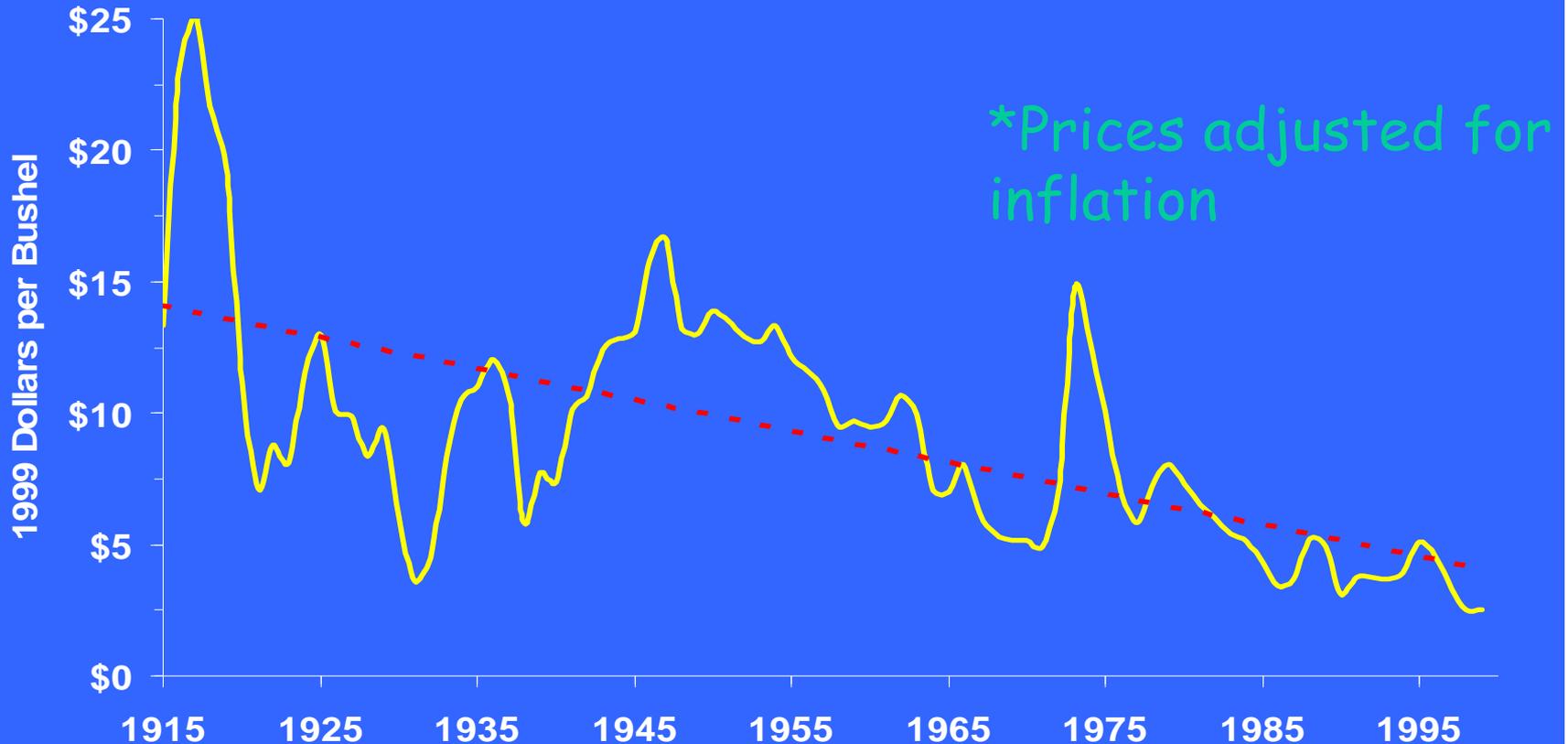
Since 1915, real prices have decreased 10 cents/bu/year



Prices from the Colorado Agricultural Statistics Service/USDA, various years. Inflation adjustments calculated using the Consumer Price Index (CPI).

Real* Prices of Colorado Wheat

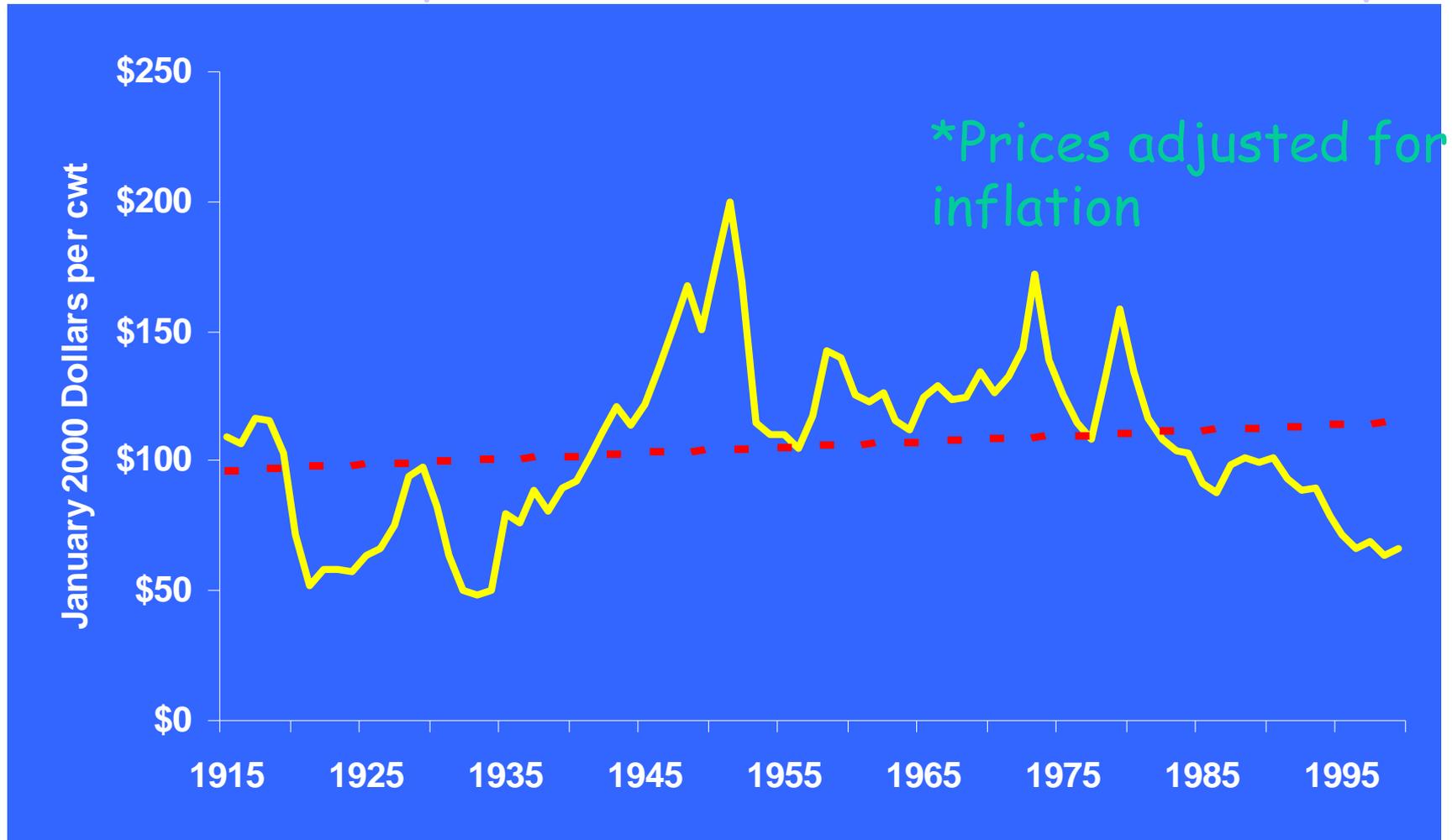
Since 1915, real prices have decreased 12 cents/bu/year



Prices from the Colorado Agricultural Statistics Service/USDA, various years. Inflation adjustments calculated using the Consumer Price Index (CPI).

Real* Prices of Colorado Beef Cattle

Since 1915, real prices have increased 2.5 cents/cwt/year



Prices from the Colorado Agricultural Statistics Service/USDA, various years.
Inflation adjustments calculated using the Consumer Price Index (CPI).

The Importance of Agricultural Water in Colorado -- Environmental Benefits

- Boulder Creek Case study:
 - <1% of water body surface is natural
 - 18-20% of riparian vegetation supported by the ditches and canals
 - (Bob Crifasi, Boulder, Water International 2002)
- South Platte: More than 10% of stream miles are “ditch and canal” (Dickinson, p.c., 2004); over 4200 miles (Crifasi 2007, p.c.)
- Urban and suburban environmental amenity from ditches and reservoirs
- Real estate value with tax effects

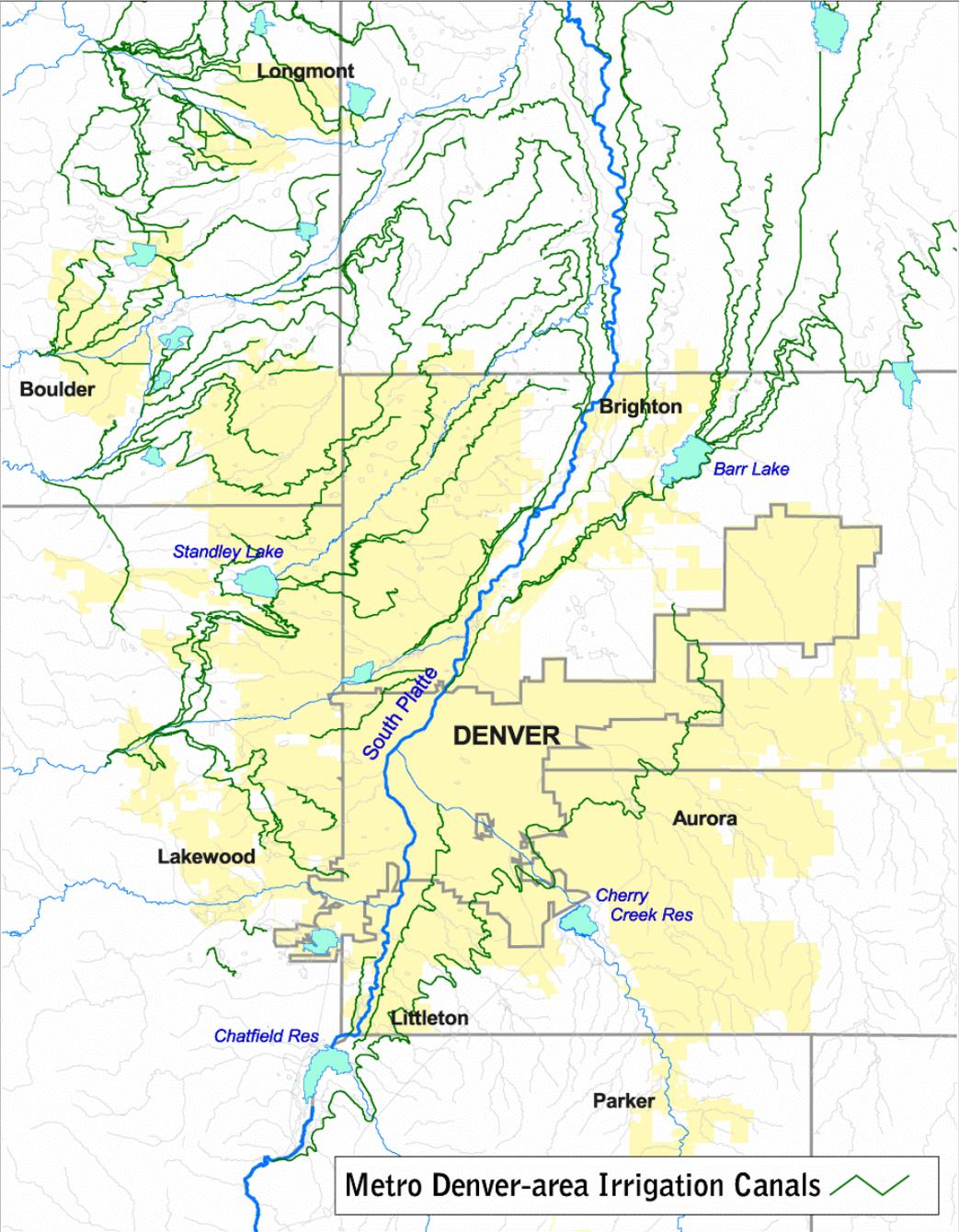
Small Farms but Big Land Management!

- A LOT of land is in family-supported farms
- U.S.: the 2% paradox:
 - 2% of farms produced half of 1997 sales
 - But, 56% of farms produced only 2% of sales
- Colorado: about the same... large land area!
 - 47% of “farms” make 1% of sales -- on 13% of land in farms
 - **73% of farms get 5% of sales off 43% of farmland**
 - 4% of farms make 73% of sales
 - (Source: USDA ERS; 1997 Ag. Census, U.S., Colorado highlights Farm Structure “briefing room”)

Newcomers and Exurban Development

- The “ranchette” phenomenon -- **currently 4 times** the area occupied by all the **cities and towns** in Colorado -- but **forecast to double** in 30-40 years (Theobald et al.)
- Part of the confusing picture of land management by non-farmers and people whose interests are not commercial
 - Bad news -- plenty of horror stories of over-grazing and weed farms
 - Good news -- many can afford good management, and don't need to make money here
- But -- are they going to be good neighbors? (Tax-wise, their services cost \$1.13-\$1.60/\$1 of tax paid...)
- Biologically, impacts may be disproportionate to area occupied
- **NO tradition** of agricultural information access for most!

The water “distributary” infrastructure is environmentally important in the dry West -- even in the “metro” areas!



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
- Recent 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
- IPCC Fourth Assessment, 2007 – various reports on website
- US Climate Change Science Program, forthcoming 2008 – draft at www.sap43.ucar.edu/documents/ and see CCSP website

Two Constants and the Low-Cost 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!
- **Suppose you owned all the pieces?** What could you do to maximize the outcomes?
 - Answer tells what you want to maximize (pie flavor)
 - 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** - have some... but underfunded? Low reliability water rights? Missing reaches?
 - **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 of 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** limitations on private land – riparian recreation and amenity values underused and under-subscribed -- worth money
- Just beginning to consider **pay for timing** of flows - not yet done? **Paid** agreements in some cases to help fishery, rafting; RICD should not be only means of securing interests; conservation easements are not all of the answers
- **Increasing role** of recreational economy – residences - “agritourism” booming

Under-Invested Interests - Local

- Local **amenity and quality of life** issues
- **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...

Under-Invested Interests - Agricultural?

- Irrigation produces **animal 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**
 - difference between “raw land” versus platted, permitted, or marketed -
- how much new value should be kept by whom?
 - Local costs (e.g. to counties) much bigger than local benefits (Coupal, R. and A. Seidl, 2003, <<http://dare.agsci.colostate.edu/extension/pubs.html>>
- **Agricultural water may be valued in ways that fail to maximize value**
 - 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 for the small and medium-sized farms, limits ability to reorganize and adapt...

The usual ideas of a “Water Bank”

- Can be for “native” water and surface water, stored water only, or can be for groundwater only, or more than one kind.
- Temporary transfers become practical because can be quick
- Big reduction in costs of transfers
- Makes possible many small changes otherwise too costly
- Makes experiments possible to involve many interests now very expensive to organize
- The interruptible supply/dry year options idea – market flexibility
- Agriculture-to-agriculture transfer and agriculture-to-other uses
- Big controversy and fear: Just another way to take our water? What about out-of-basin transfers? Taking our future!
 - Pro: Highest prices might be from out-of-basin, and this way, transfers need not be permanent or constant
 - Con: Any transfer out of basin is threatening (but in-basin transfers away from agriculture are not resented)
- It’s my 401k – my Private Property, my right to sell!

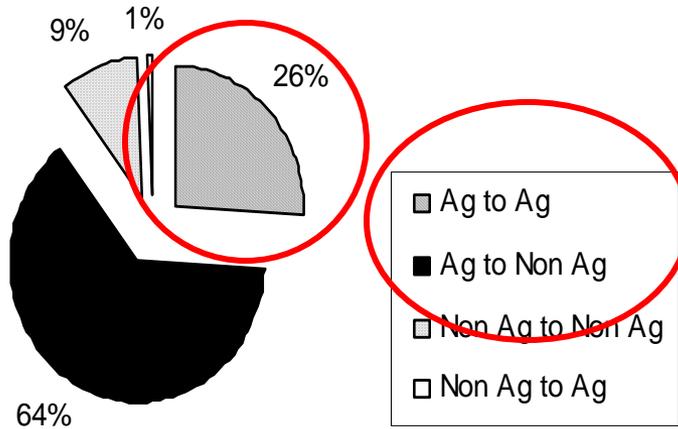
The Legislative Goals in the Colorado Water Bank Experiment and some subsequent legislation

- *Simplify* and improve approval of **leases, loans and exchanges, including interruptible supply agreements** for stored water
- Reduce *costs* of transactions
- Increase availability of water-related *information*
- Assist farmers and ranchers to **realize the value** of their water rights assets **without forcing severance** from land
- Avoid material injury to other water rights users
- Make no other changes to water law
- Arkansas River Water Bank Pilot Program: HB01-1354 (CRS 37-80.5-101 et seq.); rules effective 2002; website and operational date January 2003, operated by Southeastern Colorado Water Conservancy District
- HB03-1318: Water Banks in other basins, but no out-of-basin transfers
- Other bills in 2003: Interruptible Supply Contracts can be out-of-basin, but very limited duration and conditions of use; **emergency** and some other **temporary substitute water supply plans** can be allowed... BIG increase in flexibility but still some missing pieces of the puzzle...

Why Want Agriculture to Agriculture Transfers?

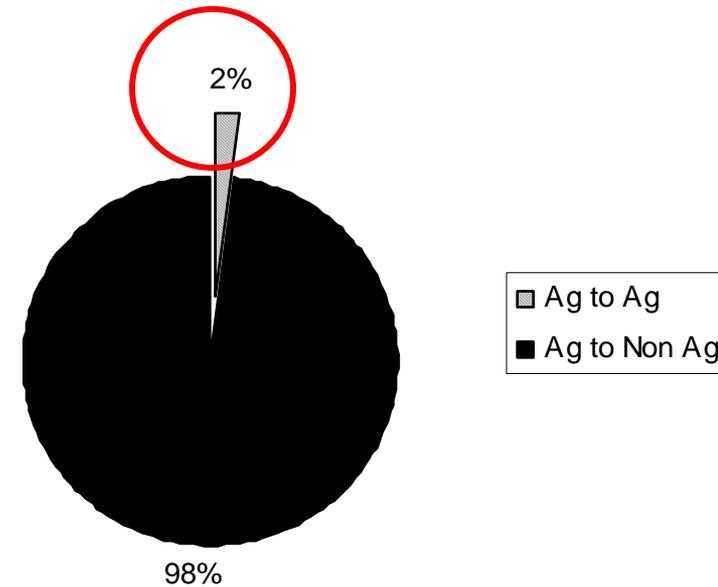
- Why it “should” happen -- factor mobility in market
- The example of the Northern Colorado Water Conservancy District -- about 1/3 of transactions, 26% of volume of water transferred is “ag-to-ag”
- Sustainable agriculture: better make more
- Direct Sales and Organics -- highest growth rates in the agricultural sector (USDA reports)
- Capitalizing the new ventures -- how?
 - E.g. Subsurface drip irrigation- \$800-1300/A?
 - high-efficiency center pivots -\$50-80K/127A?

NCWCD
PERCENTAGE OF WATER TRANSFERRED BY TYPE



The Northern CWCD imports about 270,000 A'/yr -- the Southeastern CWCD imports about 69,000 A'/yr

ARKANSAS VALLEY
PERCENTAGE OF WATER TRANSFERRED BY TYPE



From Howe and Goemans, Colorado Water 2002

Rich South Platte, Poor Arkansas

- Average irrigated field size in South Platte: 127 A
- Average in Arkansas: 37 A
- Realized Net Farm Income from farms in 2002:
 - Northeast (South Platte) region: **\$241,099,000**
 - Livestock sales: \$1,910,709,000
 - Crop sales: 414,500,000
 - Southeast (Arkansas) region: **\$ 82,758,000**
 - Livestock sales: 442,999,000
 - Crop sales: 120,465,000
 - State total: **\$386,995,000**
 - Livestock sales: 3,573,664,000
 - Crop sales: 1,241,500,000

From the literature and analysis: 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]

Long-Term Rotational Crop Management

- Very **long-term** is ideal -- stability for all
 - Planned locations of fallow/etc
 - Farm incomes and financing improved?
- **“Base-load”** predictable water supplies
- Only **Up-front** infrastructural costs (e.g., diversions, conveyance) – financed; **no revegetation** mess
- **“Pay-as-you-go”** acquisition, **not** bonding, (save 50% at 3.25% interest for 30 years), better match of costs and benefits
- **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))

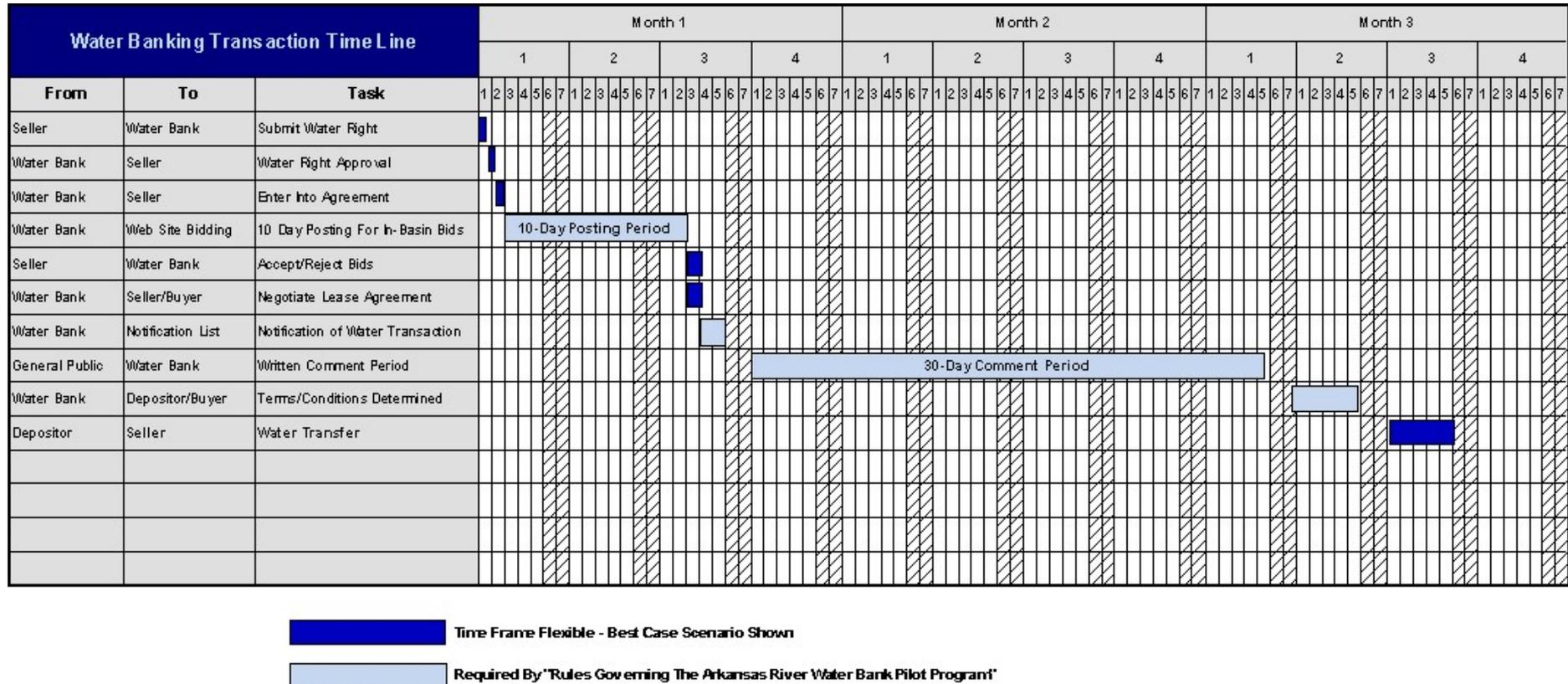
Long-Term Interruptible Supply

- 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!

Looking for Trouble... the Big 3 of What Can Go Wrong

- Municipalities have to **buy in, represent all constituency interests** (That \$3.8 B voted for open space and ag in public projects doesn't include the huge private contributions and efforts)
- Irrigators need to know they won't lose **other incentives** and opportunities
- Everyone needs to know that the new deals have **certainty – please see handout**
 - Avoiding surprises means adequate info -- especially cumulative impacts
 - State support means adequate investment in administration

Water Bank Timeline... Quickest is 3rd Week of 3rd Month -- NOT fast! And longest was limited by “sunset” in 2007...



From Southeastern Colorado Water Conservancy District website: Colorado Water Bank, How it Works

Note that this timeline chart, involving the in-basin preference dropped by law in 03 was still posted as of 08Mar05

Problems with the Arkansas River Water Bank Pilot Program

- **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 ag. innovation
- Lack of **price discovery**
- The “**SHEEEP**” factors
- E.g. **Fear** loss of future

So... what went wrong?

- Compare what was authorized for program development with what is recommended for program development by Cooperative Extension Services
- Best model because best developed program of innovation promotion aimed at voluntary participation by rural and agricultural participants working in markets, not seeking academic or other rewards
- Agency Staff did **very** well, considering... but...
 - Far too little time for public participation given fear and confusions
 - Far too little time and effort for public education
 - Schedule legislatively fixed, unresponsive to events
 - Tiny funding available for staff effort, outreach, and reiterations, field testing, and consultations
 - Critical aspects of the design (e.g. stored water only limitation) were a compromise to cope with lack of capacity to do more; delays to allow notice and possible objections cost a lot of possible uses...

SHEEEP -- Fail to count them at your peril!

- **Social** conditions -- demographics, trends, cultural characteristics, major social issues?
- **Historical** -- previous efforts by agencies?
Major relevant events?
- **Economic**-- income base and levels, poverty rates, stability and long-term trends?
- **Educational**-- levels and values for education, innovations?
- **Emotional**-- aspects of public issues, concerns, threats?
- **Political**-- at any relevant level?

SHEEEP vs CO Water Bank Experiment

- **Social** -- Enormous resistance to the transfer of water out-of-basin, VERSUS counter-principle of “private property!” applies - “My 401K”
- **Historical** -- The painful and well-understood impacts of previous big transfers, and then well-users getting “caught” and required to augment (buy water to replace depletions)
- **Economic** -- Lost farms, lost and hurting small towns, outside acquisition of farms with minimal local business linkages, and then drought and continuing speculator efforts to buy water for sale
- **Educational** -- experience of “betrayal” by water agencies and state, after the well users were forced into compliance with new rules at big expense
- **Emotional** -- Oh, yeah... “Evil” is frequent description of out-of-basin water transfers... “Once they get it, it’s never coming back...”
- **Political** -- Everyone knows where the money and power is in Colorado...

So... what went wrong? Dismal as a diffusing innovation by Rogers' five attributes that affect adoption

- Relative Advantage?
 - Great in theory; but no experience; violates traditional understandings
- Compatibility with current practice?
 - Huge problem because of critical role of ditch companies, which have complicated and ambivalent legal status; and are vulnerable;
 - Big threat to those skeptical of the idea
- Complexity?
 - Seems complex because of internet bulletin board, differences from traditional practices, and dependence on administration by agency
- Trialability?
 - Very low in practice until ditch companies digest and decide; individuals fear solo attempt -- maybe most important problem?
- Observability?
 - Insufficient observability of benefits, high visibility of trying it first...
- NORMAL EXTENSION “DEMONSTRATION” APPROACH NOT TRIED, SO FAR, DESPITE SOME KNOWLEDGE OF ANALOGUE (Northern Colorado Water Conservancy District) CASE

JACOBS 2002: CONTEXT CHECKLIST: why information may not be applied to problems (Connecting Science, Policy, and Decision-making)

- FORMAL blocks? Laws and regulations? Rigidity of institutional context? -- **Pretty good progress on this!**
- INTERNAL INSTITUTIONAL blocks? Policies, procedures, precedents? Decision rules? -- **Ditch companies are critical and have been far too overloaded to tackle this, so far...**
- DECISION-MAKER INCLINATIONS? Training, traditions, peers, incentives? -- **Ditch companies, and fear of the “ag ratchet”**
- DECISION-MAKER CAPACITY to act in response to the information? In response to crisis? Opportunity? **Crises already, overloaded!**
- PERSONAL RELATIONSHIP/HISTORY between information source and user? (Wiener adds: “the more technical, the more personal”) -- **None between scientists and potential users... only extension**
- PRACTICAL CHOICES DIFFERENT FROM THEORETICAL? **Yes.**
- RECURRING ISSUES? **The social/historical/political context...**
- EXTERNAL INFLUENCE ON DECISIONS? **Same.**

NOWAK (1992) INABILITY VERSUS UNWILLINGNESS TO ADOPT -- UNWILLINGNESS

- INFORMATION CONFLICTS OR INCONSISTENCY?
 - Huge social controversy -- newspaper, some water leaders
 - For many, just plain disbelief -- and quick change by legislature hurt, too
- POOR APPLICABILITY AND RELEVANCE? -- no.
- CONFLICT WITH CURRENT GOALS?
 - Depends on farmer goals versus ditch company versus regional/community goals?
 - Perceived urban goals of predation
 - IGNORANCE? -- Everyone knows something, but often misinformed about the water bank pilot program. Astounding range and depth of information on many topics, but not clear how topics not “covered” by usual pathways enter thinking.
- INAPPROPRIATE FOR PLACE? -- doesn't seem applicable.
- INCREASED RISK? -- Compared to what? Critical “framing” point, and big controversy
- BELIEF IN TRADITIONAL PRACTICE? Not much love lost for slow failures...

NOWAK (1992) INABILITY VERSUS UNWILLINGNESS TO ADOPT -- INABILITY:

- INFORMATION LACKING?
 - Seems relevant to the case
- COSTS TOO HIGH? -- no.
- COMPLEXITY TOO GREAT? -- maybe -- perceived fears of political situation?
- SYSTEM TOO EXPENSIVE? -- no.
- LABOR EXCESSIVE? -- no.
- BENEFITS TOO FAR AWAY? -- Maybe. Not said, but hard to rule out.
- LIMITED AVAILABILITY OF SUPPORTING RESOURCES?
 - Seems relevant because no “outreach” available after first few meetings
- INADEQUATE MANAGERIAL SKILL?
 - Seems relevant because ditch companies will have to manage, account, etc. Maybe part of larger picture of undercapitalized, undertechnical ag?
- INSUFFICIENT CONTROL OF DECISION?
 - Maybe? This was the biggest fear: “No matter what `they’ say, it’s all a scheme to get water away from us...”

The Short Answer: Ignoring Knowledge and Then, Drought – then lack of post-audit

- All of what we know from 125 years of the Extension and Demonstration Tradition was just not considered!
- Rule-making was really negotiations over threats of instant lawsuit
- No real outreach – decide, announce, defend
- “They never talked to us!”
- No follow-up to see what was not working (except some guy from the wrong university with funding from the wrong agency and very little capacity to engage the extension people)
- 2001 law amended in 2003 – again, no systematic feedback except the political pressure against out-of-basin transfers
- Idea still favored, but implementation as a contact sport is just ignored – STILL!
- Cultural problem with the way water institutions work – finally some progress in the Basin Roundtable processes... accidental answer –

But, too late for “water banks”? Not clear yet... a new hope now with similar problems, though much larger financial support... maybe...

Arkansas River Basin in Colorado

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



Arkansas River Hydrographs (Canon City)

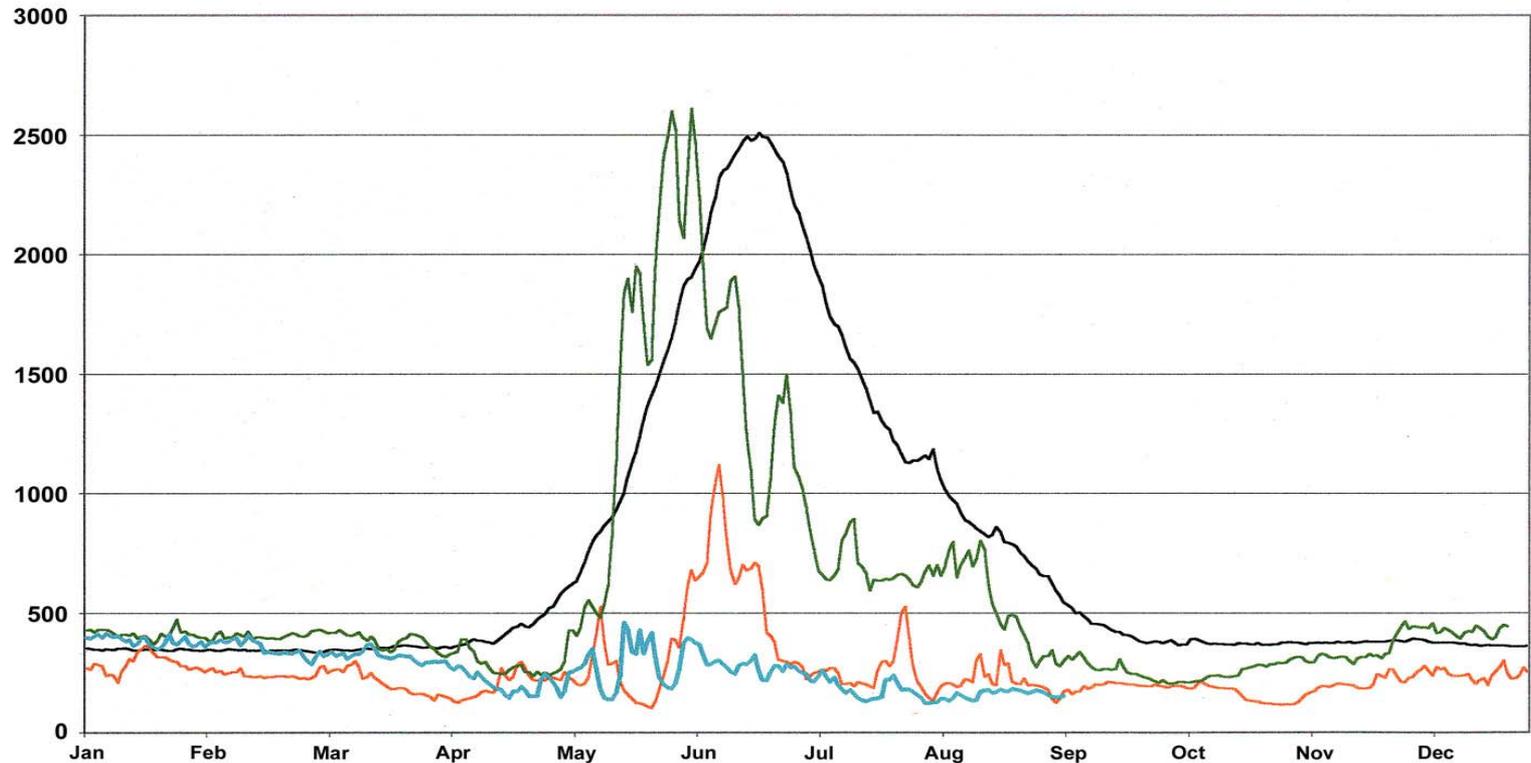
Mean, 1977, 2001, 2002

(Office of the State Engineer)

Flows were very low all year long in 2002 and after

Arkansas River at Canon City

— Mean — CY-1977 — CY-2001 — CY-2002



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

Douglas Kemper Photo



Arkansas River, May 2002

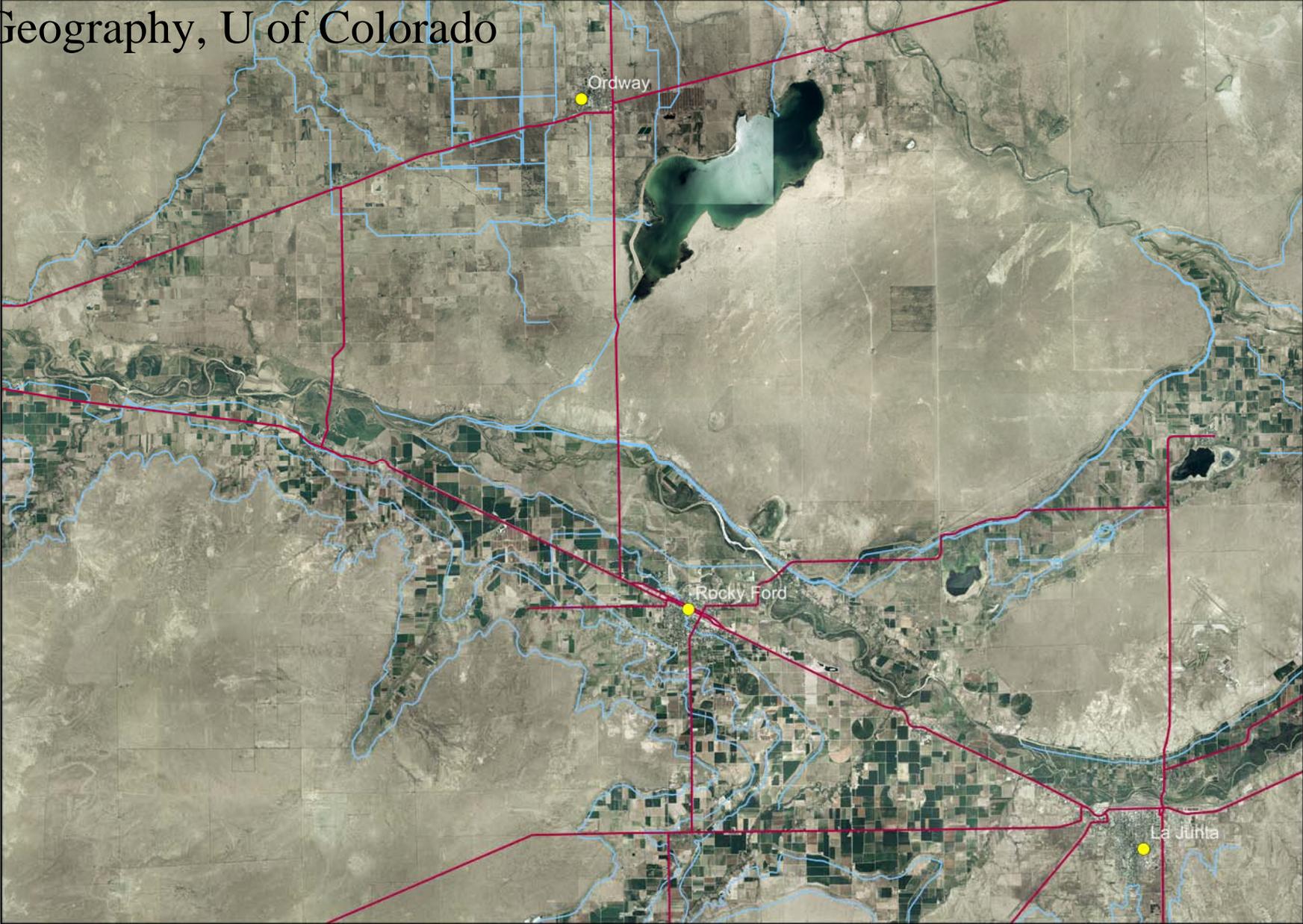


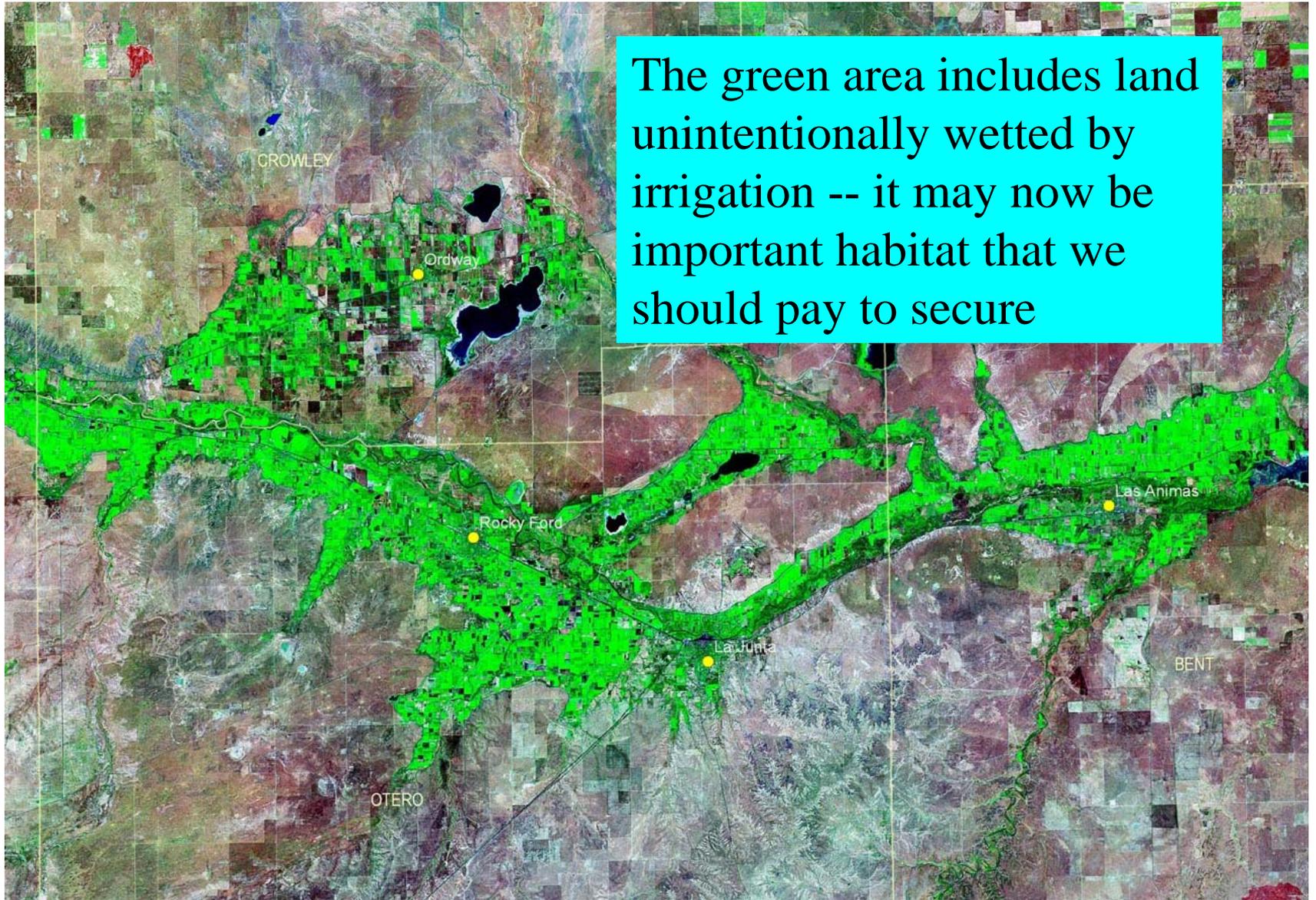
Holbrook Canal Headgate Works -- May 2002

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



Slide of aerial photos, by Tom Dickinson, IBS and Geography, U of Colorado





Data source: Landsat Enhanced Thematic Mapper, 2005.
Map by Thomas W. Dickinson, Institute of Behavioral Science,
University of Colorado at Boulder

“MICRO-MARKETING is the performance of activities which seek to accomplish **an organization’s** objectives by anticipating customer or client needs and directing a flow of need-satisfying goods and services from producer to customer or client.”

McCarthy and Perreault 1984: 11

“MACRO-MARKETING is a **social process** which directs an economy’s flow of goods and services from producers to consumers in a way which effectively matches supply and demand and accomplishes the objectives of society.”

McCarthy and Perreault 1984: 13

“Universal Marketing Functions”

- MARKETING term
- Buying
- Standardize
- Selling
- Storage
- Transportation
- Finance, Risk
- Informing Market
- CLIMATE APPS.
- Funding research and applications
- QC, Credibility, Uncertainty Mgt.
- Technology transfer
- Institutionalize
- Communication
- Investment by all
- Public education, Outreach to targets, Use of established pathways

3 "paradigms" of who is served

Who can initiate programs?

	Continuous	Variables	(not sharply	different	points)
"Beneficiary Paradigm"	Duration of link	Obligation	Motive	Public Interest, Equity Issues	Other Factors
Adopter	one-shot; "loading dock"	Science → intermediary or user as scientist function	benefit user, Or, profit from sale	Public Interest in user success?	Employs social networks for diffusion of innovations
Customer or client	As long as mutually agreed	Only as agreed; maybe depends on achieving results sought in adaptation to customer case	benefit user, public interest in user success? Or, profit from sale of the service as well as the product?	Public interest in user success and perhaps more emphasis on continued user viability and production of beneficial externalities?	Often employs promotional efforts directed to consumer or user to create demand
Constituent	relatively permanent	Agency serves constituent; may also serve to identify potential benefits	Motives for particular programs are specified or agreed by constituents	Even more emphasis on sustaining beneficial externalities (e.g. good resource management) ?	May operate service for public goods, externalities reasons, or Equity-based reasons

What would be “climate responsive water management”?

- Has to be within water law
- Has to include climate variation and change as one of many conditions
- OUGHT to help achieve at least goals **in** water management
- OUGHT to help achieve goals **affected by** water management
- WON'T succeed without engagement and acceptance by those involved
- After SWSI, focus on agriculture-urban transfers -- “the new last water hole” (apologies to Dr Tyler!)

Goals **in** water management

- Optimal use -- max economic benefit --
 - return on use of water -- need capacity to do better -- **big progress by others in climate applications in agriculture**
 - flexibility to respond to changes in social and physical environment -- need will and authority to do better
 - complication: long-term valuation problems -- soil...
- Optimal use -- certainty to support investments and planning
 - certainty of supply or adequate substitute
 - for water providers -- no real substitute
 - for agriculture -- may be partial substitute
 - complication: variability of supply and demand
 - need storage and flexibility in re-allocation

Goals **affected by** water management

- **Optimal use -- max social benefit --**
 - complication: valuation of “third-party” interests
 - complication: participation of third-parties helped or hurt by changes
 - complication: public interest identification and public participation
 - complication: recreational and amenity interests; SWSI non-consumptive needs assessment partly answers
- **Optimal Use -- maintain environment**
 - water quality; SWSI non-consumptive needs assessment partly answers
 - habitat - problem: “hybrid ecology”
 - avoid cumulative impact thresholds

Conditions for success

- Meet transferor goals, transferee goals
- Develop answers with participants
 - Even the legislature can't innovate without adequate engagement; expand participation (in all ways - \$ too)
- Introduce innovations in the accepted ways
 - water providers' technical evaluation and leading utility demonstrations
 - agricultural innovations work through extension and demonstration
- Get the new ways figured out before all the water needed is transferred in the old ways!
- Progress so far... please see summaries

Well Irrigated Alfalfa



Colorado Now (Feb. 2008)

- Statewide Water Supply Initiative in last phase – nonconsumptive needs assessment; a great deal posted now
- Interbasin Compact Process with Basin Roundtables into third year – but hard to find progress beyond building relations
- Hope strong for getting to collaborative process, BUT THE MARKET MOVES ON
- And, rule-making in the old-fashioned way – another huge conflict brewing...

Adaptation Opportunity for Extension

- Demand for environment information, including by small acreage owners as well as others and extension itself
- Political Issues Education needed! Cultivate support, and engage research/academics
- Team development for issue programming and communications targeting/marketing improvement
- Critical role for Extension in collaborative process management
- Extension tradition of knowing stakeholders
- Extension history of working for public in “scholarly engagement”
- Extension tradition of on-farm demonstration works
- Avoid loss of clientele/constituency!

Holbrook Canal above Sand Sluice

May 2002

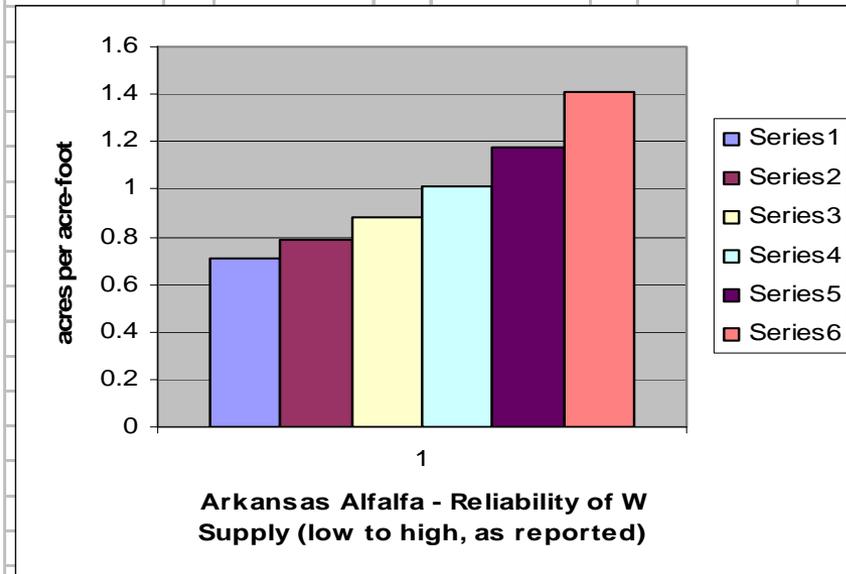


Holbrook Canal, May 2002



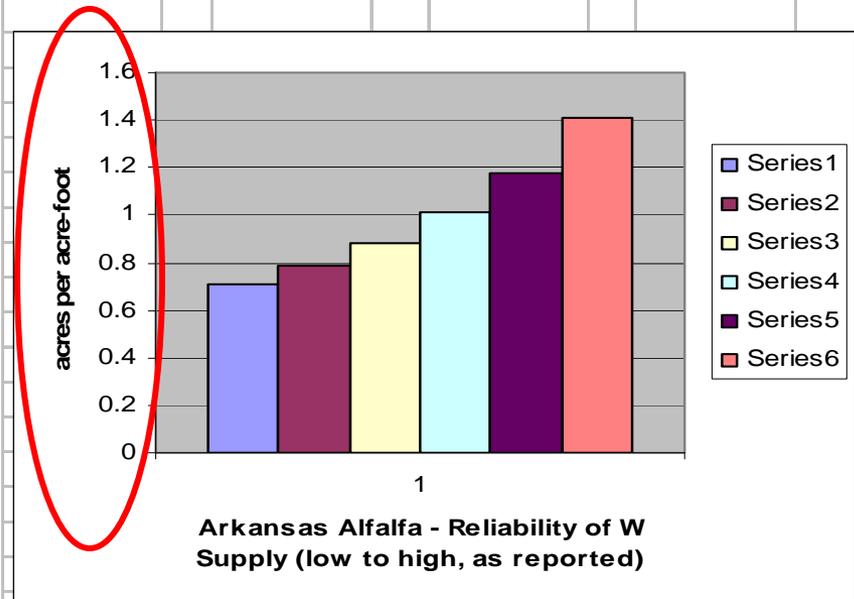
The reliability data are 1997 reports on 1996 farming - in the end of very wet times and by those choosing to report to CSU. How much of the 46% with 10/10 reliability has been sold by now? We only find out in water court - long after deals are made. So how much land will be “out of ag” by the next deals ???

Arkansas reported reliability	Percent of acres that level of reliability	Arkansas Water applied - alfalfa	inches/A	acres/ acre-foot
10 of 10	46	17	17	0.705882
9 of 10	6	17	15.3	0.784314
8 of 10	14	17	13.6	0.882353
7 of 10	14	17	11.9	1.01
6 of 10	2	17	10.2	1.176471
5 of 10	9	17	8.5	1.411765
< 5	10	17		?



How Much Land Will be Affected?
 Reliability of Water Right Has Important Effects -- This is the case of Arkansas Valley irrigated alfalfa land. Not much of a surprise, but as the senior water rights leave the market, more and more land is affected by a transfer.

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

Corn
seedling
dying
from
lack of
irrigation
- Denver
Post, 18
May 06,
Brian
Rutherford



Surprise
loss of
snowpack
led to
revocation
of permit to
pump 440
wells, 200
farms...
middle of
South Platte