

Meeting Long-term Agricultural Demands: More than Water is Needed

John D. Wiener

University of Colorado Institute of Behavioral Science

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Other presentations on website: www.colorado.edu/ibs/eb/wiener

john.wiener@colorado.edu (possibly not able to answer until mid November)

PLEASE NOTE: There are many references and some discussion in “Speaker’s Notes” area of the slides. Be cautious printing because of the extra pages.

Big Ag and Small Ag have Two Sets of Problems

- For the **small** operations with **60% of US Farmland** but only 16% of sales... and **7% of net farm income**: HIGH VULNERABILITY
 - Urbanization, rural residential development – tremendous **land loss**!
 - Inability to finance resilience to climate and “markets”!
- For the **Big conventional** Ag: Sustainability Doubtful...
 - **Erosion of soil, soil quality losses** already very serious!
 - Herbicide and other **resistance evolving fast**; no till at risk!
 - Input prices out of control, net being squeezed, “treadmill”
 - Water quality worsening with more corn, new land in crops?
- “THE SMOKING GUN”: 25 years (1982-2007) : same # acres but **22% are not the same** acres! **DISPLACEMENT** FROM BEST LAND onto lower quality... and now, very rapid “sod-busting” again
- FOR EVERYONE: **CLIMATE VARIATION AND CHANGE** – higher intensity precipitation events, more frequent extremes with cumulative impacts... **destructive sequences**...

Herbicide-resistant Weeds Threaten Soil Conservation Gains: Finding a Balance for Soil and Farm Sustainability



Back to pre-emergent and post-emergents.... Tillage... Stay with the package, just buy more stuff...

But make the package more complicated... And, see National Research Council 2012 Summit

On managing resistant weeds... http://www.swcs.org/en/publications/managing_agricultural_landscapes_ii/;

National Research Council, 2012, National Summit on Strategies to Manage Herbicide-Resistant Weeds: Proceedings of a Symposium. Washington, D.C.: National Academies Press

Agribusiness Is BIG – Is this your competition?

- Cargill is one of the largest private companies in the world, and “has a wide-ranging business that includes everything from growing and processing crops, to blending and shipping biofuels, to making food products.”
- Cargill Website (www.cargill.com): \$136.4 Billion sales in 2013; net earning \$2.3 Billion.
- Archer Daniels Midland is big - #27 in Fortune 500, with 2014 est \$1.342 B profits...
- John Deere Inc. is #80... \$3.5 Billion profits in 2014
- Tyson Foods, Inc., #93, had only \$778 M profits in 2014
- ConAgra #184 of Fortune 500 – 2014 est profits \$774 million, on \$15,491 million in sales...

Where to find Basics on Conventional Agriculture Unsustainability

- The excellent syntheses on agricultural issues: -- these are major assessments by hundreds of scientists
 - 2009: International Assessment of Agricultural Science, Knowledge and Technology for Development (“IAASTD”)
 - 2010: U.S. National Research Council
 - 2011: United Kingdom Government Office for Science: Foresight: The Future of Food and Farming
- For global scale modeling and analyses: a small sample from Proceedings of the National Academy of Science: Special Features
 - Inter-sectoral Impact Model Intercomparison Project, Vol 111 no 9 (2014)
 - Agricultural Innovation to Protect the Environment, Vol 110 no 21 (2013)
 - Livestock and Global Change: Emerging Issues for Sustainable Food Systems Vol 100 No 52 (2013)

And see brand new: Journal of Soil and Water Conservation 69(6) (2014)

(And, also recommended: World Resources Institute, World Bank and others: Creating A Sustainable Food Future – two parts public at time of writing (Searchinger et al., 2013, and Winterbottom et al. 2013).

Climate impacts on US agriculture see: [Walthall et al. 2012 – USDA contribution to National Climate Assessment – cite below](#); and new: [Hatfield et al. 2015](#), and [Brown et al. 2015](#). The news is not cheerful!

Vose et al. - Climate impacts on US Forestry... USDA contribution to National Climate Assessment

Range: Polley, H.W., D.B. Briske, J.A. Morgan, K. Wolter, D.W. Bailey, and J.R. Brown, 2013, Climate Change and North American Rangelands: Trends, Projections, and Implications. Rangeland Ecology and Management 66: 493-511. DOI: 10.2111/REM-D-12-00068.1

Range: Joyce, L.A., D.B. Briske, J.R. Brown, H.W. Polley, B.A. McCarl and D.W. Bailey, 2013, Climate Change and North American Rangelands: Assessment of Mitigation and Adaptation Strategies. Rangeland Ecology and Management 66: 512-528. DOI 10.2111/REM-D-12-00142.1

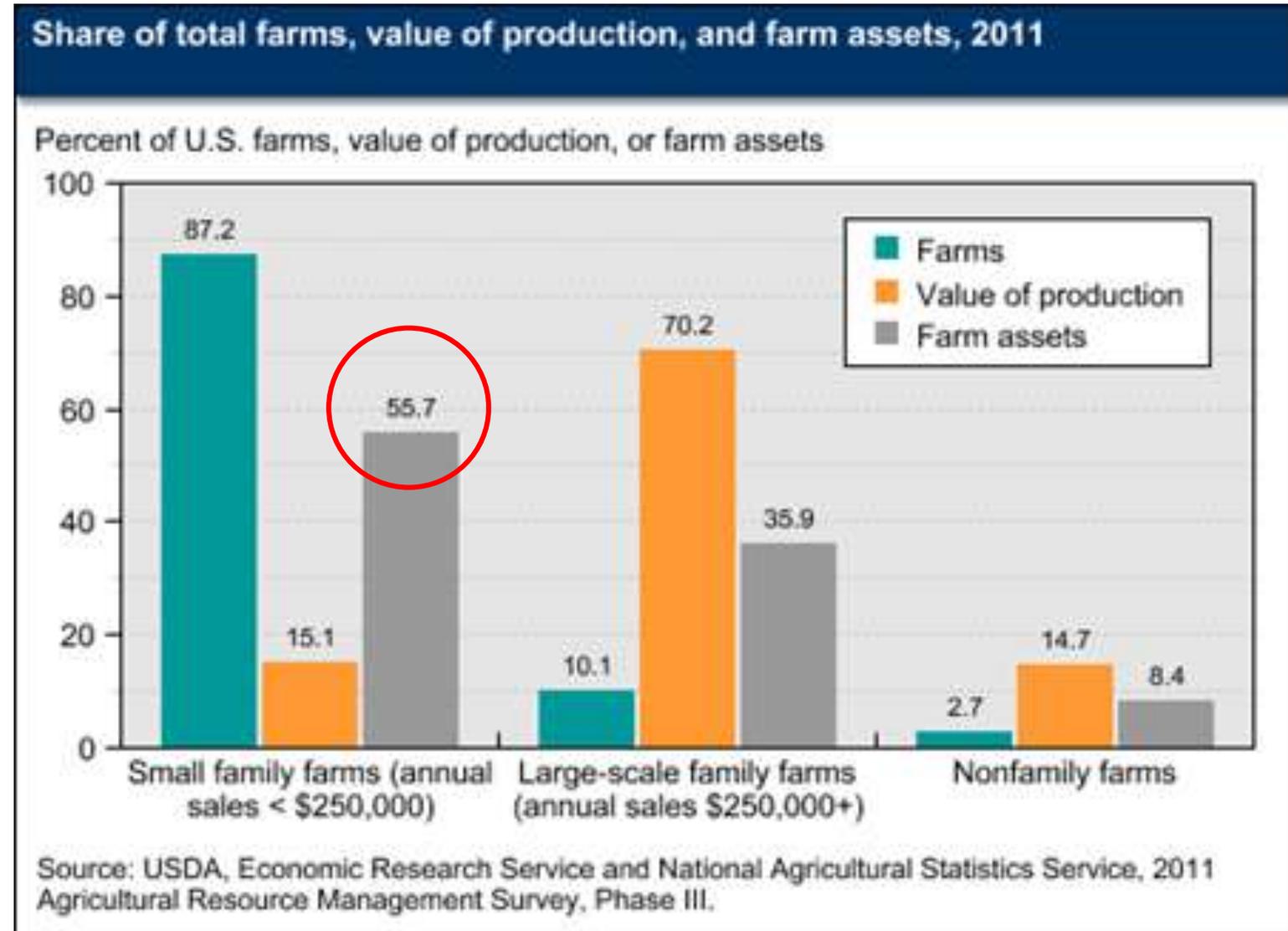
[More and full citations in “speaker’s notes”](#)

On soils and unsustainability,: DeLong, C., R. Cruse, and J. Wiener, 2015, The Soil Degradation Paradox: Compromising Our Resources When We Need Them the Most. Sustainability 2015, Vol. 7: 866-879. (doi: 10 3390/su7010866.) (Open Access).

“Small family farms account for most U.S. farms and a majority of farm assets” -- But they take in **only about 7 % of net farm income!**

(USDA Chart of Note, 06 Feb 2013)

This may have been updated
With 2012 Census of Ag.
Data, or likely will be soon.



The Real Goal: Conserve **inherent** agricultural capacity

A working definition:

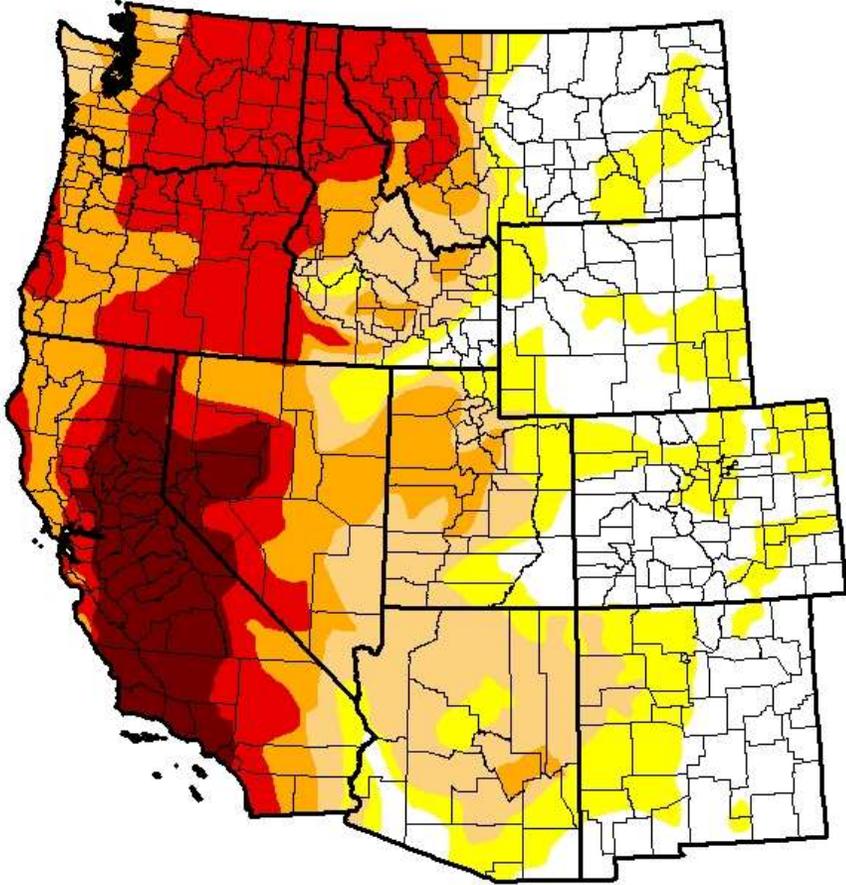
Capacity of agricultural resources, including soils, techniques, crafts, and skills, live true-breeding seeds and livestock, to produce food, feed and fiber with inputs only from local and regional agricultural and related activity.

Right now, the only piece of the puzzle we are burning faster than good soil is farmers!

Argument:

- Threats to future agricultural productivity are quite large and worse with climate change
- But Big Ag does not look like it has motivation to change...
- Pretty soon, problems in Big Ag make the **Small Ag land base much more important** in the future
- Transition toward more reliable and resilient agriculture is critical for the farming families and the **ecosystem services** provided
- Transition may require **new self-organization** for a great deal of potential productive capacity
- The Cities are the missing partners – their role must be much better than just buyers! Cities are used to planning – especially for water – we just have to get them on the big picture.

WATER OBSTACLES -- WHAT CAN YOU PLAN ON?



WATER, DROUGHT, changes in snow and melt timing
– The biggest threats to western US irrigated farming? –

And Colorado River Basin droughts vs Colorado's water uses...

WEATHER IS ALREADY HIGHLY VARIABLE – before climate change, despite a fairly benign period late 20th Century...

SO MANY OBSTACLES TO LONG-TERM SUCCESS FOR MEDIUM AND SMALL IRRIGATED FARMING IN THE WEST – not only water...

PLAN FOR MANY STRESSES INTERACTING

DIVERSITY OF PRODUCTION FOR RESILIENCE TO SHORT-TERM MARKET VOLATILITY AND WEATHER EXTREMES

AND FLEXIBILITY TO ADAPT OVER THE LONG TERM

YOUR CAPACITY TO PRODUCE IS YOUR ASSET – HOW TO STAY?



COLORADO CLIMATE CHANGE VULNERABILITY STUDY

A report submitted to the Colorado Energy Office

EDITORS

Eric Gordon, University of Colorado Boulder

Dennis Ojima, Colorado State University



Released – free, on-line, February 4, 2015

Vulnerability in Agriculture:

WATER and SOIL MOISTURE

HEAT vs field crops, livestock

PESTS and INVASIVES

HAY/FEED PRICES vs livestock

Lots of good information summarized...

See slide 3 above, on conventional ag and climate stress

ALL STRESSES INTERACT!

MISSING: SOILS VULNERABILITY IS NOT WELL UNDERSTOOD!

LAND LOSS TO MISUSE AND OTHER USES...

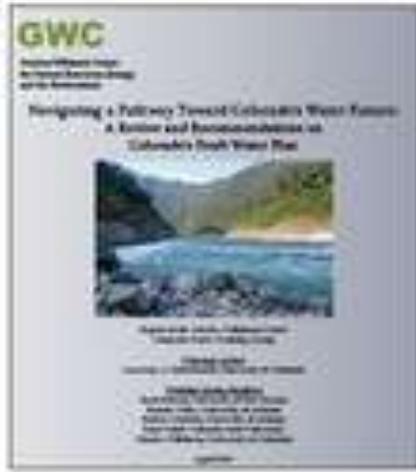
**PLAN ON A LOT OF VULNERABILITY
PLAN TO REDUCE RISKS – PLAN FOR A
RANGE, NOT A TARGET!**

Keeping Water in Colorado Ag is Necessary But Not Sufficient

- **ATMs – NEEDED, BUT...** most of the Alternative Transfer Mechanisms **lack PERMANENCE AND LACK SUPPORT FOR LONG-TERM ADAPTIVE AGRICULTURE --\$\$ FOR CHANGES THAT WILL TAKE A LONG TIME TO WORK THROUGH SAFELY**
- **See Colorado Water Plan for discussion of Alternative Water Transfer Mechanisms, and other materials on website of Colorado Water Conservation Board.**
- **CITIES WANT PERMANENCE – WHY NOT GET SOME FOR FARMERS AND FARMLAND TOO?**
- It will take a lot of talk, think, re-think... but it's worth it! **Imagine City partners:** they want the water and they have **rate-payers and 30-year bonding** to support transition to farming that keeps families on the land... and all the things we love about farming... And farming pays taxes; rural residential development costs more than it pays.

Navigating a Pathway Toward Colorado's Water Future

A Review and Recommendations Colorado's Draft Water Plan



SAYS "ATMs" ARE NECESSARY – AND SHOULD PROVIDE
ADDITIONAL REVENUE TO HELP FINANCE EFFICIENCY

SAYS CLIMATE CHANGE WILL PUT EVEN MORE DEMAND
ON THE MOST SENIOR WATER RIGHTS...

AND LIKES A FOLLOWING-LEASING PROGRAM BUT DOES
NOT DEMAND COVER CROPS AT ALL TIMES... SHOULD!

Principal Author

Lawrence J. MacDonnell, University of Colorado

Working Group Members

Reed Benson, University of New Mexico

Bonnie Colby, University of Arizona

Robert Glennon, University of Arizona

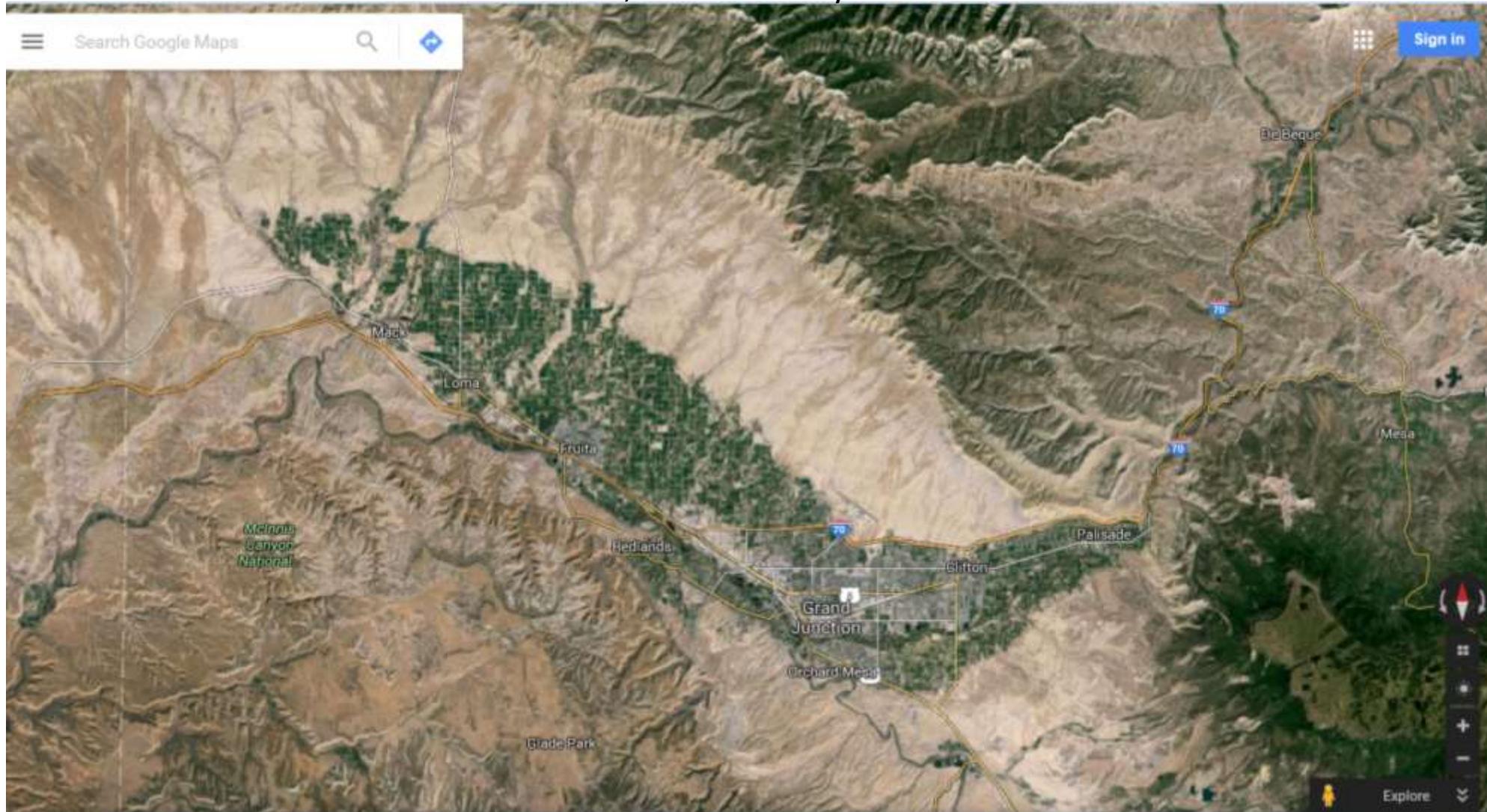
Brad Udall, Colorado State University

Charles Wilkinson, University of Colorado

http://scholar.law.colorado.edu/books_reports_studies/

April 30, 2015

What's at stake? The qualities we love about the Grand Valley, for example... this was just sage brush before irrigation and reservoirs... See MacDonnell, L.J., 1999, *From Reclamation to Sustainability: Water, Agriculture and the Environment in the American West*. Niwot, CO: University Press of Colorado.



THIS IS AN
OASIS
MADE
BY
IRRIGATION
AND THE
MICRO-
CLIMATE
AND THE
SOILS AND
THE WILL
TO FARM
--
CAN IT
LAST?

<https://www.google.com/maps/@39.1348026,-108.6084942,60264m/data=!3m1!1e3> -- this view provided 12 OCT 15.



**IRRIGATED
LAND IN
GRAND VALLEY
(not current)
THEY'RE NOT
MAKING ANY
MORE**

An easy “grab” from CDSS Map Viewer – With no analysis, and no training, great maps available.

The engineers are doing amazing things, and this may help you work with them more easily.

<http://cdss.state.co.us/Pages/CDSSHome.aspx>

QUALITY OF LAND IN US FARMING: 25 years, about same acreage in crops, but **displacement** of farming... Note: this before the ethanol boom in new land – AND this does not address usefulness of the land in terms of landscapes...

Table 4

Share of land use that remained the same, 1982-2007

	5-year periods					25-year period
	1982-87	1987-92	1992-97	1997-02	2002-07	1982-2007
	<i>Percent</i>					
Cropland	93	92	95	93	96	78
Pasture/rangeland	95	96	95	96	98	86
Forestland	98	98	98	98	99	92

Source: USDA, Economic Research Service calculations based on USDA's Natural Resources Conservation Service, National Resources Inventory data (2009).

Cropland may about the same in area but IS IT THE SAME QUALITY?

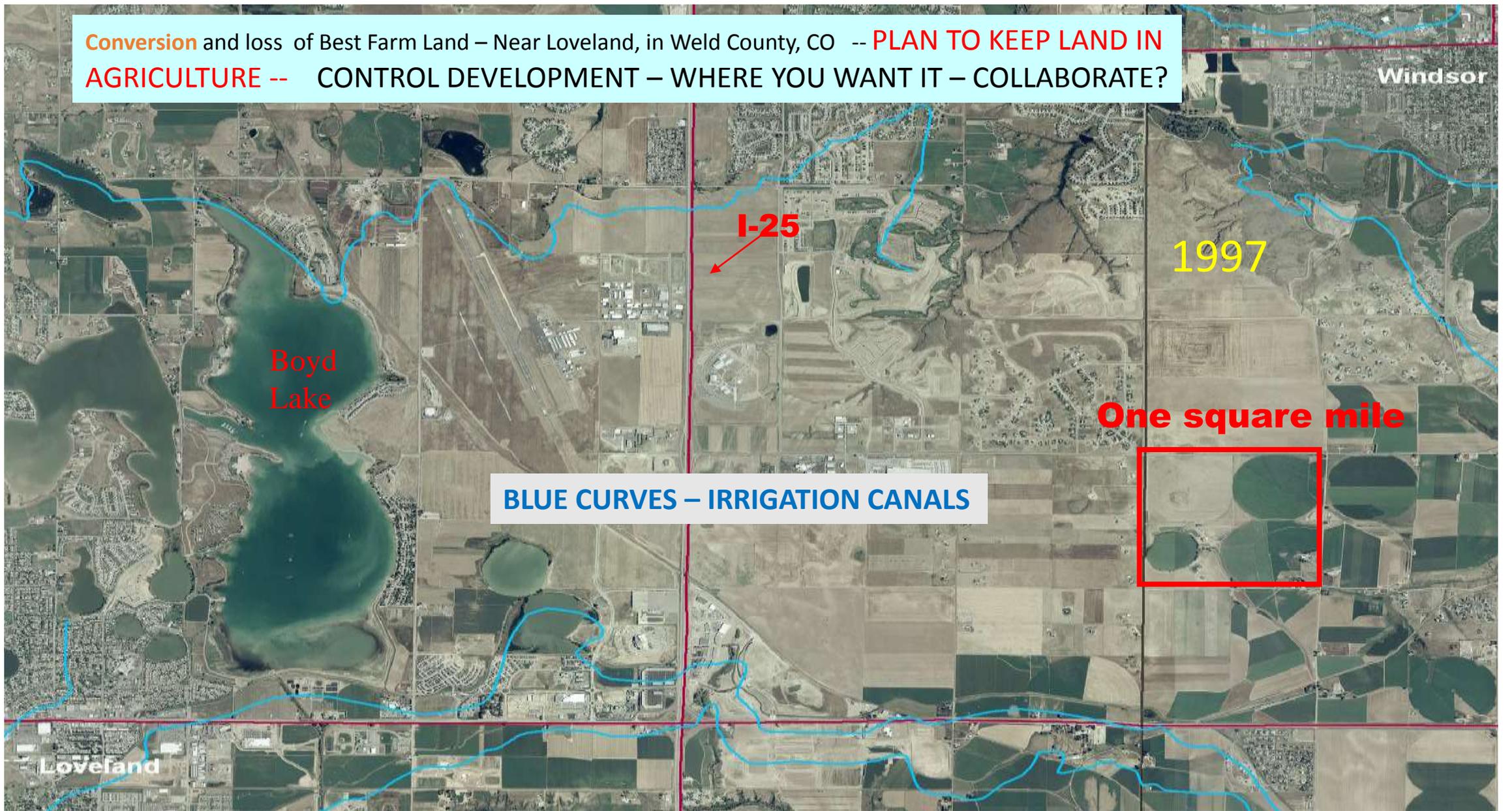
Recent: Francis et al. 2012 arguing, NOT AS GOOD... KILL THE BEST FIRST ?!?!?

LARGE AREAS ARE BECOMING HARDER TO FARM

From the USDA National Agricultural Census for
COLORADO -- acres

	1982	1992	2002	2012
NUMBER OF FARMS	27,111	27,152	31,369	36,180
LAND IN FARMS	33,537,998	33,983,029	31,093,336	31,886,676
AVERAGE SIZE OF FARMS	1,237	1,252	991	881
IRRIGATED LAND	3,200,942	3,169,839	2,590,654	2,516,785
HARVESTED CROP LAND	6,036,679	5,532,964	4,346,955	5,182,628
CORN FOR GRAIN	759,680	891,720	708,197	1,011,151

Conversion and loss of Best Farm Land – Near Loveland, in Weld County, CO -- **PLAN TO KEEP LAND IN AGRICULTURE** -- CONTROL DEVELOPMENT – WHERE YOU WANT IT – COLLABORATE?



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

Conversion of Best Farm Land
near Loveland, in Weld County, CO

2011

Windsor

Boyd
Lake

I-25

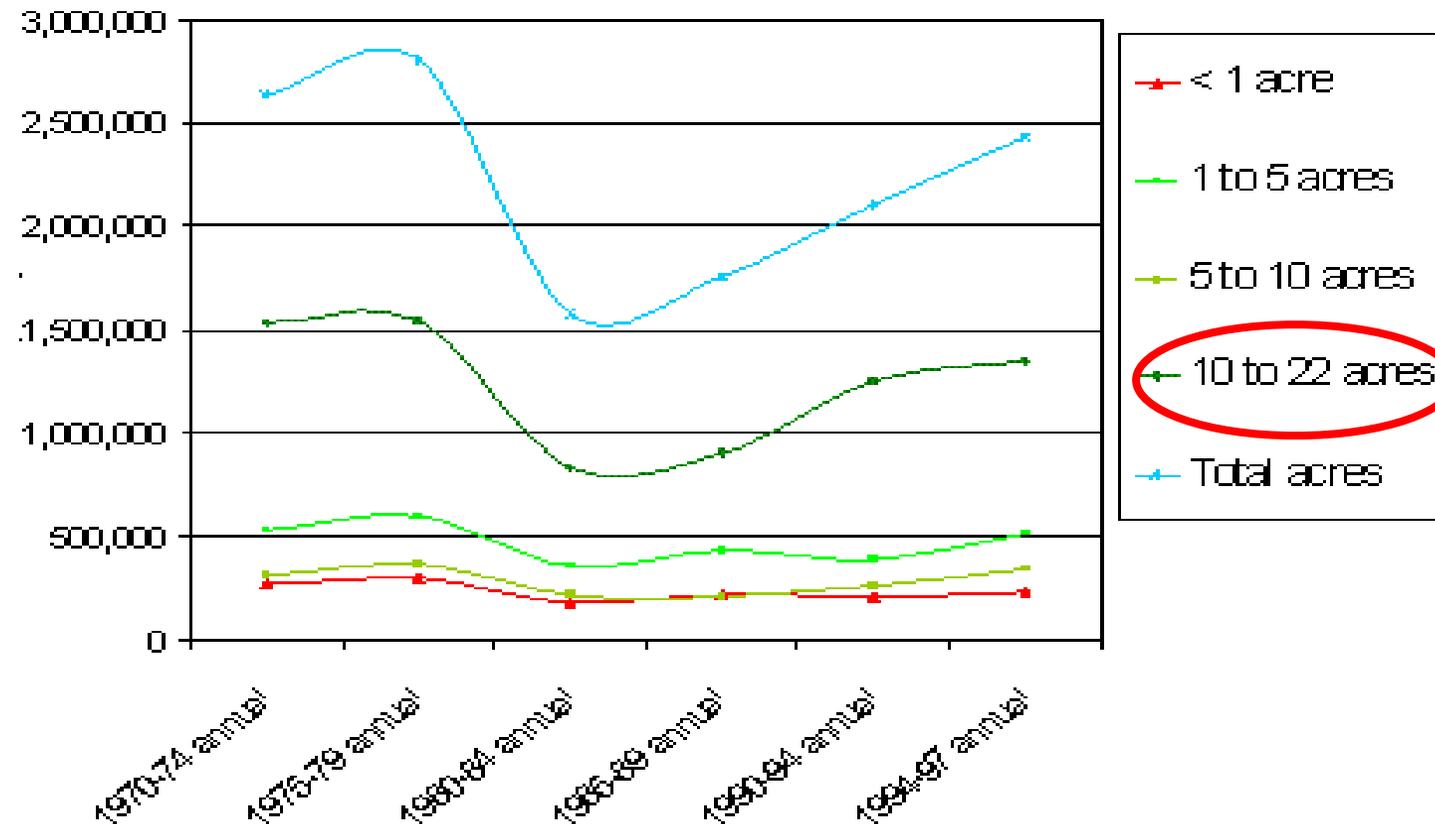
One square mile

Loveland

Rural Residential Development eats farmland AND “parcelizes” land and fragments it into pieces harder to reorganize and adapt – **not just urban sprawl** taking land out of production (National information; Colorado tax information)

**Gross annual additions to housing area, by lot size
1970-1997**

Acres per year



“Farms....”

But not supporting the family.

This is

“Ranchettes”

and horse

properties – and

\$1.62 in costs to the Counties per \$1 of Revenue (2003) in Colorado

EROSION has Big impacts! 

Losing Ground

SEE NEW USDA CLIMATE CHANGE
AND U.S. AGRICULTURE, 2012;
TECH. INFO. BULLETIN NO. 1935,
WALTHALL ET AL.

Craig Cox
Andrew Hug
Nils Bruzelius

April 2011



Craig Cox*, Andrew
Hug, and Nils
Bruzelius, 2011,
Losing Ground

*Director of Soil and Water
Conservation Society for many years

**THIS IS IOWA – THE
HEARTLAND OF
CONVENTIONAL AG!**

Soil erosion is likely
already considerably
more than had been
estimated

SOILS ARE
TOO
LOCAL TO
BE CAUGHT
IN THE
MODELS –

YOUR SOIL
IS WITHIN
YOUR
CONTROL

Climate Effects on Soils

- Higher soil temperatures alter nutrient and carbon cycling by modifying the habitat of soil biota, which in turn affects the diversity and structure of species and their abundance.
- Heavier downpours in some regions will lead to increased soil erosion. In addition increased precipitation will result in water-logging of soils, thereby limiting oxygen supply to crop roots and increasing emissions of nitrous oxide and methane. Altered rainfall, whether through increased or decreased precipitation, will affect soil chemistry and biology.
- Soil water retention capacity will be affected by rising temperatures and by a decline in soil organic matter due to both climate change and land-management changes. Maintaining water retention capacity is important to reducing the impacts of intense rainfall and droughts, which are projected to become more frequent and severe.
- Prolonged spells of heat and drought between rainy periods may cause wilting, desiccation, and soil salinization, which may in combination reduce crop yields.
- Increased temperature and decreased moisture tend to accelerate the decomposition of organic material in soils, leading to a decline in soil organic carbon stocks and an increase in CO₂ emissions to the atmosphere.

Joint Statement of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, 2011

As well as whatever management does... Climate affects....

habitat of soil biota... diversity ... abundance

downpours... increased soil erosion...

affects soil chemistry and biology...

water retention capacity... soil organic matter...

impacts of intense rainfall and drought...

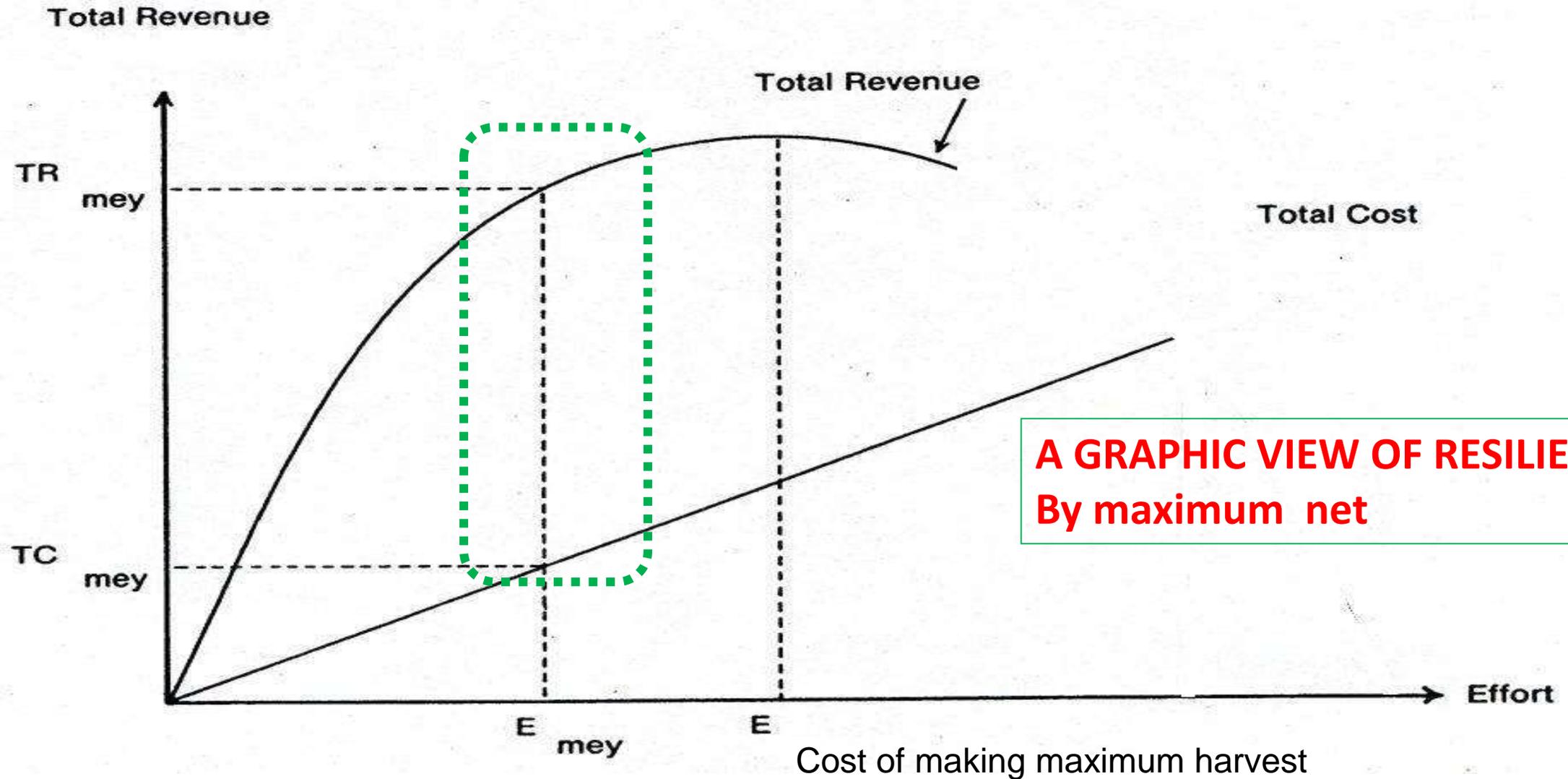
PLAN TO SAVE YOUR SOIL AND PRODUCTIVE CAPACITY

See also Crop Science Society of America, 2011, Position Statement on Crop Adaptation To Climate Change.

(More climate and impacts: see slide 3 above, and other reference lists this set)

DeLong, C., R. Cruse, and J. Wiener, 2015, The Soil Degradation Paradox: Compromising Our Resources When We Need Them the Most. *Sustainability* 2015, Vol. 7: 866-879. (doi: 10.3390/su7010866.) (Open Access).

Maximum economic yield rather than maximum revenue – getting off the treadmill of maximum possible production makes sense! LONG-TERM – how to get there?



**A GRAPHIC VIEW OF RESILIENCE
By maximum net**

The Landscape Scale – BENEFITS!!!

- Landscape scales for **ECOSYSTEM SERVICES** , habitat values, connectivity – AVOID ESA, RECOVER DIVERSITY, SUPPORT TRANSITIONS...
- Farm **INVESTMENT** “right-sizing” in equipment and purchases
- Farm output marketing – **RISK MANAGEMENT** and production sequencing to meet demands
- **STABILIZE AGRICULTURAL LANDSCAPE!** Be able to use a long-range planning horizon. (large set of references in “speaker’s notes”) **Reduce landscape perforation!**
- **Resilience from flexibility of management** – organize to stop perforation and conversion of the best land -- Maybe climate info can stimulate?
- **TIME TO GET OFF THE GRID!!!** See Dosskey et al, various... design for multifunctionality, for agroecology, for diversity and CUT LOSSES – close the loops... **The rectangular land division is no longer sensible! How to change?**
- **By working with the landscape; it will take cooperation...**

The Landscape Scale – BENEFITS from cooperation

- Landscape scales for **OFF-FARM BENEFITS** – avoid environmental and water quality troubles, keep open space values, etc.
- Farm **INVESTMENT** - “right-sizing” for the best deals
- Farm sales – **RISK MANAGEMENT** and more products
 - E.g. production sequencing to meet demands
- **STABILIZE AGRICULTURAL LANDSCAPE!** Long-range planning horizon
- **Flexibility** -- stop perforation and conversion of the best land
- **TIME TO GET OFF THE GRID?** What’s best for keeping the land productive?
- **Does not mean we have to start consolidating... How about cooperating?**

The Landscape Scale

- Managing Agricultural Lands for Environmental Quality II (2010): Nowak and Schnepf, Eds. – see Sassenrath, Wiener et al. and rest of book
- Conservation Biology – Landscape scales for **Eco-system services**, habitat values, connectivity
- Farm **investment** “right-sizing” in equipment
- Farm **output marketing** – **risk management** and production sequencing to meet demands
- **Stabilize the agricultural landscape!** Be able to use a long-range planning horizon. (large set of references in “speakers’ notes”)
- **Resilience from flexibility** of management – organize to stop perforation and conversion of the best land -- Maybe climate info can stimulate? We have to try!

Thinking out of the farm-scale box

- My argument: farmers and ranchers need to use all their assets, with water as key, AND...
- Re-Think at the landscape scale – diversify, get out of monocultures, and “close the loops” of nutrient flows... get past failing alone.
- Cities and water managers are critical partners
 - Where states don't act or are self-crippled
 - Citizens have far wider interests than water rates
 - Water suppliers have foresight! They plan far ahead
 - And cities have cheap long-term capital

Beginning Points

- An emerging challenge: to take the idea of **maximum economic yield** (not the same as maximum yield of an output, but best return on investment of inputs)... and apply that to the long planning horizon!
- **RIGHT-SIZING** – best scale for a given combination of operations... (e.g. best scale for an on-farm energy need not same as for export) – **economies of scale**.
- **AND INTEGRATED MULTIFUNCTIONAL AGROECOLOGY** – combine sets of right-sized operations, resources, and projects to achieve higher levels of resilience... (e.g., sets of renewable energy sources and scales of farms and cooperating groups of farms and ranches). (long note!)

That Multifunctional Diversified Agroecology Idea...

How would it really work? GET OFF THE GRID

- Concentrated flow paths – Mike Dosskey and others... Drainage does not follow a grid – so why should buffers and filters?
- Water in streams – does not follow a grid
- Wind? Windbelts that make sense?
- Wildlife? Conservation loves corridors and connectivity, not straight lines
- Pests and Integrated Pest Management refugia?
- Pollen?
- Pollutants?
- SO, ON TO THE LANDSCAPE SCALE!

Managing Agricultural Landscapes for Environmental Quality II

Achieving More Effective Conservation



Pete Nowak and Max Schnepf, Editors

Ecosystem services values...

- Nitrate REMOVAL from drinking water costs US \$1.7 B/year... Remove 1% from source water, save >\$120M/yr.... See also USDA CEAP summaries
- Water-related benefits of preventing sediments/erosion \$1.5 to \$7/ton
- Land Trust Alliance, American Farmland Trust, National Assn. Homebuilders:
 - Open space costs \$0.35/ \$1 in tax revenue
 - Residential development costs \$1.16/\$1 in tax revenue (Colorado, 2003: \$1.62/\$1!)
 - Consumer will to pay for trails, open space, amenity, quality of life...
- Trust for Public Land, 2010: **Long Island NY: 10-fold ROI on Agricultural Conservation Easements**; > 23 States now purchase... some tax credits, too
- NYC: Paying for clean watersheds; avoiding filtration plant... 1.1 BGD!
- EARTH ECONOMICS – NGO that wants to help you with this!
- Huge developments in valuation and policy impacts
- So... the right thing looks better even with BCA – why is it rare?

NEED TO KNOW MORE: What are the economics of transition?

- Want: Enterprise Budgets for some paradigm cases of diversified farming with new rotations –
 - E.g. EcoSun Prairie Project – J Soil and Water Conservation 2014
 - E.g. Land Institute – full cost accounting and energy accounting (Baum et al. 2009)
 - E.g. National Research Council 2010 case studies, and 1989
 - **NOT one crop conventional versus alternative year one – need soil recovery time and farmer experiment time! (see next slide)**
 - **NOT yields but NET**
 - **NOT one crop versus alternative version over long term alone**
 - **SYNERGIES and restoration of capacity**
 - **Permaculture and agroforestry --**
- **MULTI-FUNCTIONAL DIVERSIFIED AGROECOLOGY – messy! But good...**
- a few hundred years of pretty good results to bear in mind...
- Getting people off the treadmill – stop playing by Giant Ag rules!

4 critical areas for research:

- The real, long-term comparisons of conventional monoculture versus polyculture with low or no off-farm inputs with time for soil recovery and time for farmer experiment and adaptation (e.g. transition to agroforestry and covercropping)
 - Not comparison of too short a time (Badgeley et al. 2007, Seufert et al. 2012, Crowder and Reganold 2015) (see notes).
- The multi-year risk management benefits of diversified production: what if the goal is “stay okay every year” without loss of capacity?
- The sequences for transition from square field monoculture to more sustainable diversified polyculture (e.g. agroforestry, complex rotations)
- The sequences of complex rotations that are climate-flexible so that year 1 can be adjusted in anticipation of a strong forecast, and year 2 hedged, etc.

Energy and Water Efficiency Research Needs

- There is a very substantial body of research on improved water efficiency from improved soil qualities; start with the major assessments and almost every issue of The Journal of Soil and Water Conservation, for example...
- Energy efficiency is harder to measure because it is hard to decide how much of the story to tell. When do you start? Mining the ore to make machinery and the energy embodied, or at the farm gate? Energy in the production of fertilizers, herbicides, pesticides...? Energy in the transport of inputs and outputs? Energy in pollution control and waste management?
- Two critical studies: Attempted “full story” accounting for an experimental farm (the Land Institute) by Baum et al., 2009, and more recently, organics versus conventional farming, more limited comparisons, by Smith et al. 2015

Practical Steps Now

- Collect and guard the **traditional knowledge** of diversified farming on the West Slope:
 - The **cultivars** that were bred for particular conditions
 - The **combinations** that were successful or not
- Begin the **discussions** about your area: what if you were determined to keep the farms viable for the next 100 years?
 - Viable? Makes **a decent living** for the families
 - Keeps its **inherent productivity**; map the possible!
- Find **the ways to talk** about this – e.g Mesa Land Trust for the Grand Valley? Ditch Companies for other places?
- Bring in the **other interests**: who benefits from the quality of life, low services, and how can they help secure what they want? What is the best deal to **keep what is wanted?**

What to do? THREE FUNDAMENTALS from the desk view:

- Work for **NET yield** (not the same as maximum output) and the **LONG** planning horizon!
 - **WHAT DO YOU WANT IN 50 YEARS ON THE LAND YOU WORK?**
- **RIGHT-SIZING** – best scale for a given combination of operations – **economies of scale can be by groups; different for different things**
- **AND WORKING WITH GRAVITY AND NATURE** – Not just in ditches but in the rest of farming – Landscapes!
- A lot of science calling for “**transformational change**” – not just incremental progress in a little bit here and there...

Thinking out of the farm-scale box – Toward the long term...

- “If it was just losing the water, why did we lose so many farms in the wet years?”
- Stop playing by giant agriculture rules!
- Instead, use all the assets, with water as key but not only water...
- **Cities and water managers and other urban interests, NGOs should be critical partners**
 - Where state will not act
 - **Citizen have far wider interests** than water rates
 - **Water suppliers have foresight** and are supposed to plan long
 - And cities have **cheap long-term capital**
 - **NGOs can help** broker and arrange deals



Agroforestry:

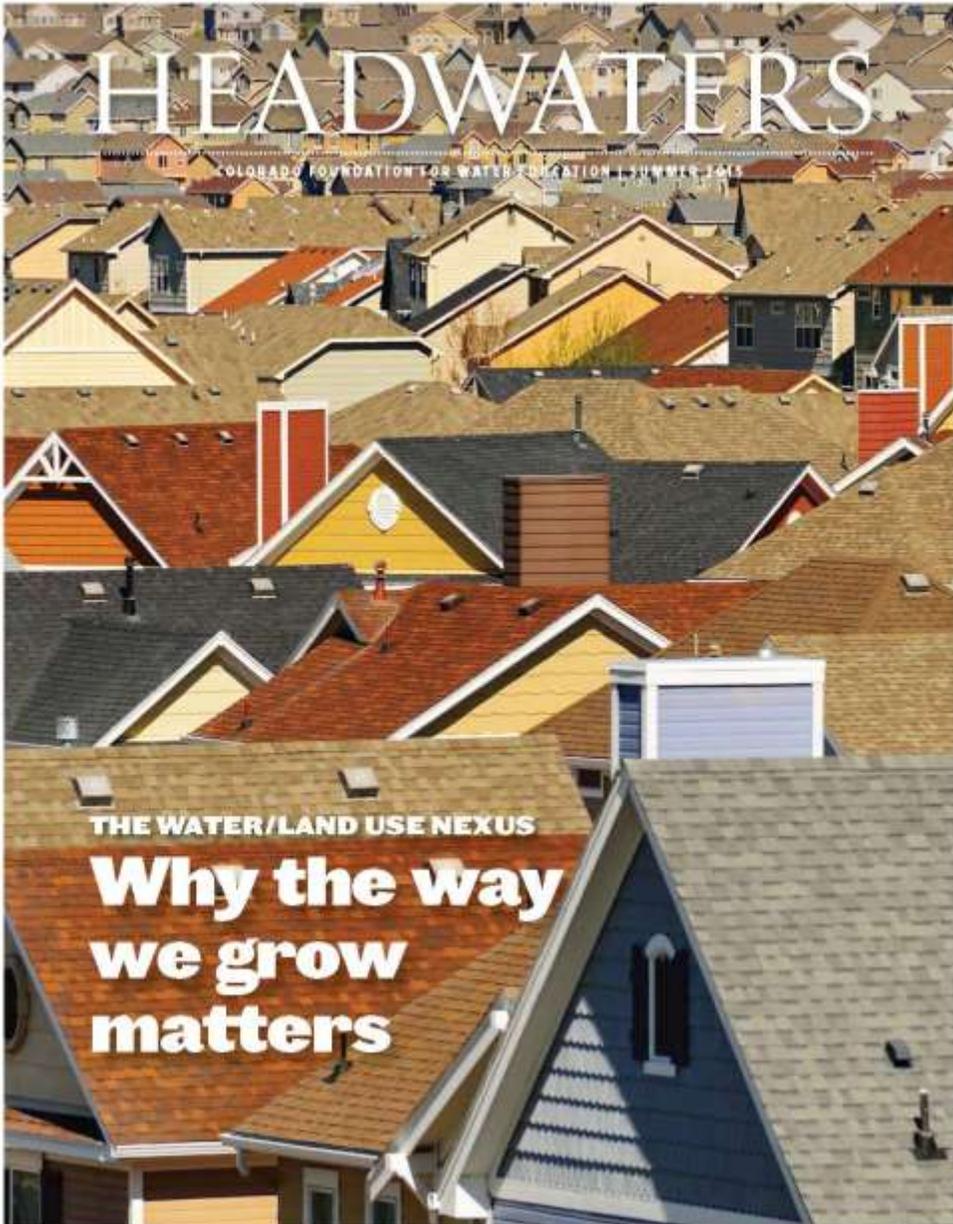
USDA Reports to America,
Fiscal Years 2011–2012—In-Brief

FOR EXAMPLE, HERE ARE KEY
IDEAS FROM THE US
DEPARTMENT OF AGRICULTURE
AGROFORESTRY PROGRAM

USDA Program Aid 2143A
October 2013
For brief and full reports, see
<http://nac.unl.edu/>

NOTE THAT BUFFER IS WHERE
IT DOES BEST JOB FOR THE
ACTUAL DRAINAGE AND
STREAMBANK

This image of agroforestry practices across a landscape was designed by USDA National Agroforestry Center scientists using CanVis software.



If there will be population growth, what should it look like?

“The 2014 draft of Colorado’s Water Plan estimates that irrigated acres statewide could decrease from 3.5 million today down to to 2.7 million due to both water transfers and growth.”

Joe Frank, irrigator and Chair of the South Platte Basin Roundtable, estimates that “around 20 percent” of South Platte irrigated acres are already owned by municipalities but still being farmed until the water is transferred... How well can you farm if it’s just a short-term future?

WHAT DO PEOPLE LOVE? -- OPEN SPACE, BEING NEAR WATER, ACCESS TO PLACES THEY FIND RESTFUL AND PLEASING... AND EASY ACCESS TO SERVICES THEY NEED OFTEN -- **SMART GROWTH – saving money is good, too!**

See www.eartheconomics.org for great help on valuing those things!

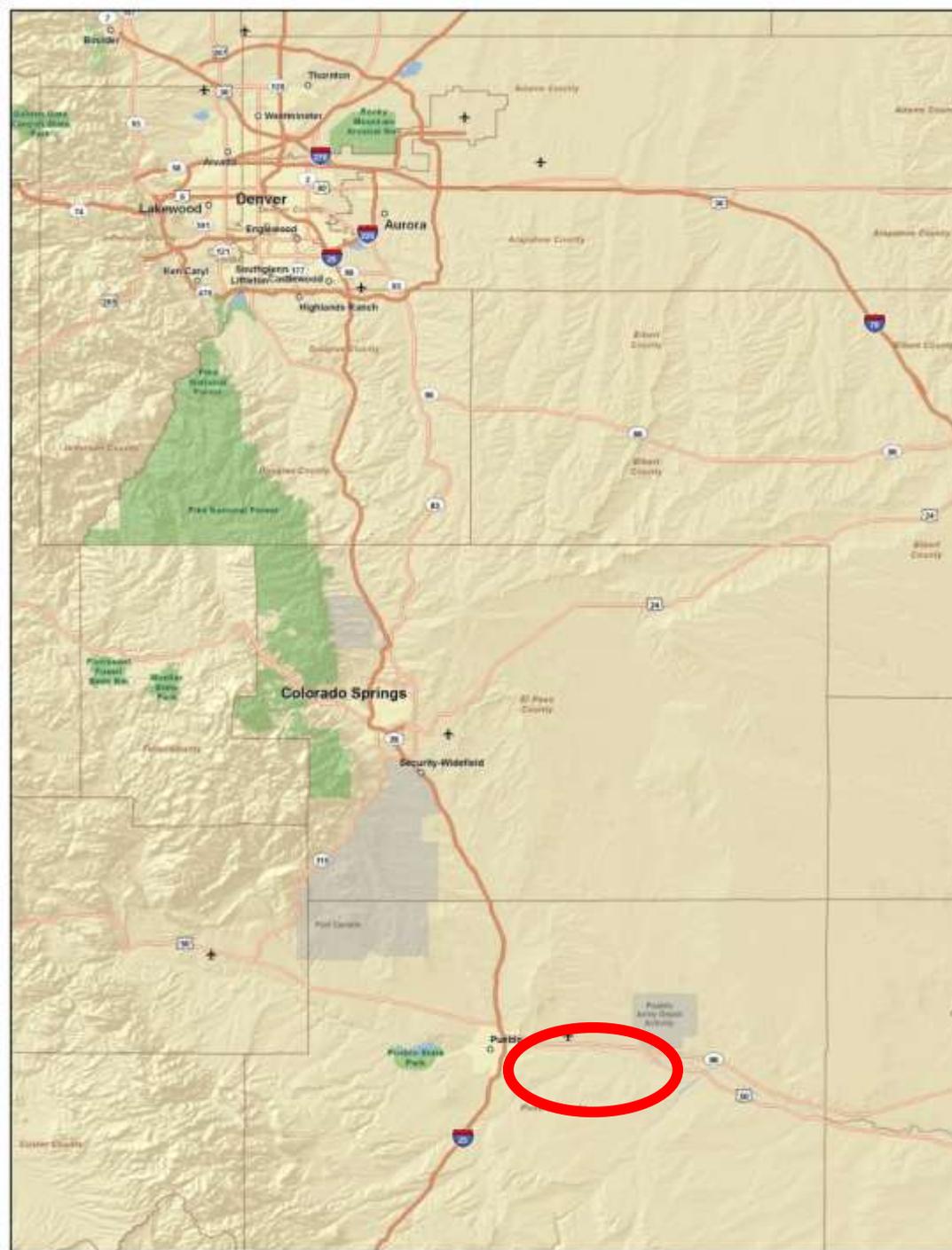
(JOE FRANK, P 21, Headwater Summer 2015, Colorado Foundation For Water Education’s magazine (available on website: <https://www.yourwatercolorado.org/cfwe-education/headwaters-magazine/summer-2015-water-land-use>. Cover image used with permission.

Practical Steps Now

- Collect the **traditional knowledge and seeds** of diversified farming on the West Slope (great student projects here...)
 - The **cultivars** for different conditions – keep ‘em all!
 - The **combinations** that were successful or not in the past
- ASK CSU and USDA for **long-term comparisons** of single-crop versus multiple crops and complex rotations... alternatives look better and better with more research but still lack multi-year budgets, etc.
- Find **the ways to talk** about this – e.g Mesa Land Trust for the Grand Valley? Ditch Companies? Ditch and Reservoir Company Alliance?
- Bring in the **other interests**: who benefits from the quality of life, low services, and **how can they help** secure what they want?

Locator Map --
Bessemer Ditch is
adjacent to and
East of Pueblo,
Colorado - About
20,000 irrigable
Acres, water source
is excellent, but City
of Pueblo has bought
about $\frac{1}{4}$...

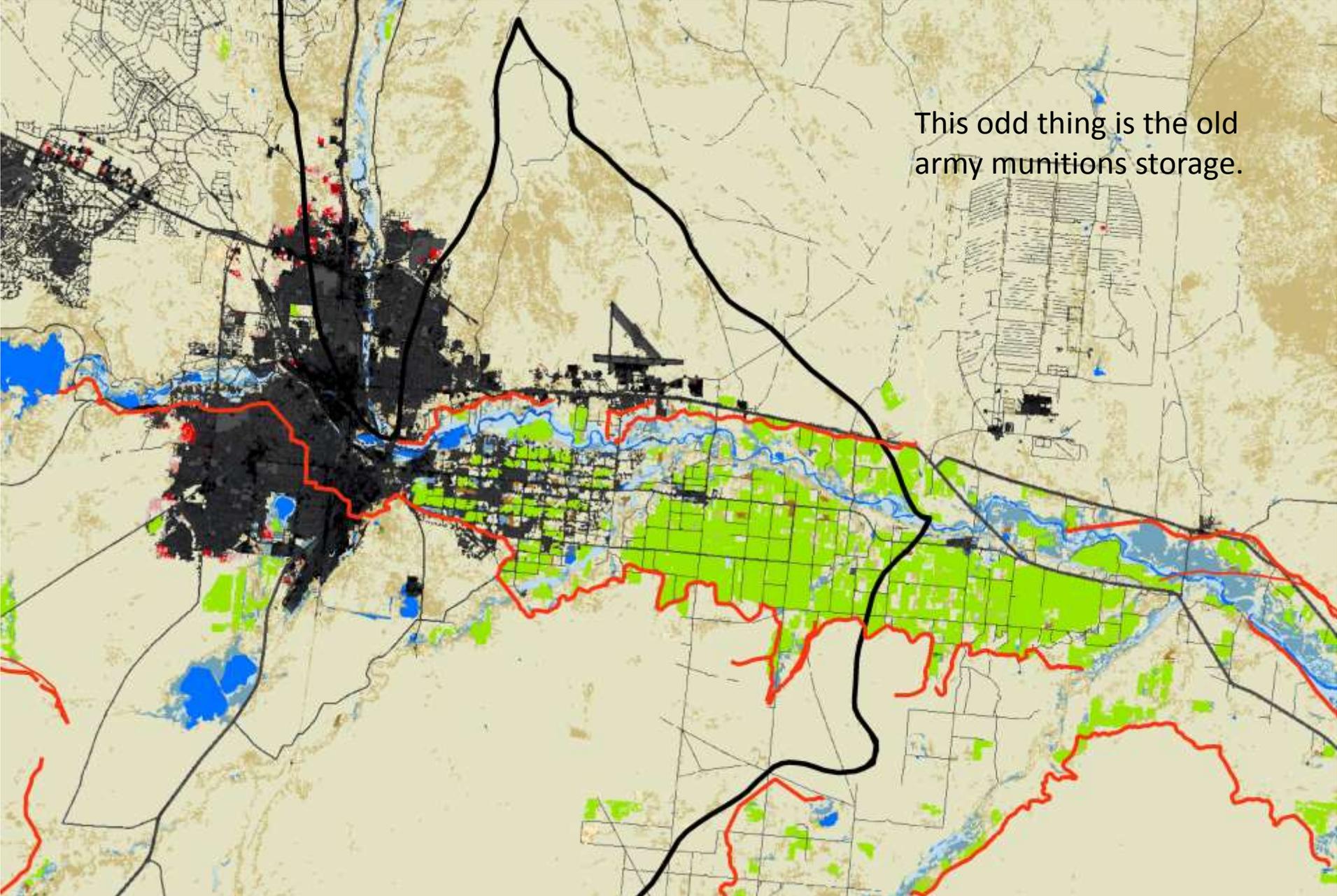
What if Pueblo were
a partner, buying
food for schools and
growing fuel for busses
and plows...



Details and the
estimates used
are available in a report
on Wiener's website.

What if flood irrigated
alfalfa land and water
were switched to winter
Canola, which takes far
less water at different
times and produces oil
for fuel or food and a
high-quality feed too?

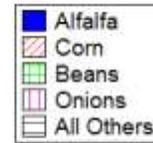
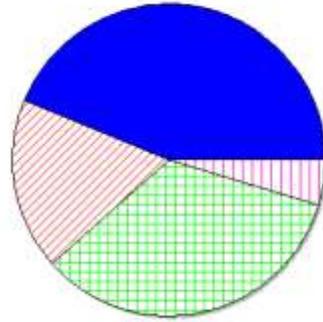
Pueblo –
The black
urban land
use and the
green is the
irrigated
land –
Red lines are
Ditches.



This odd thing is the old
army munitions storage.

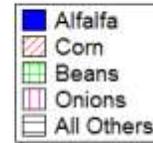
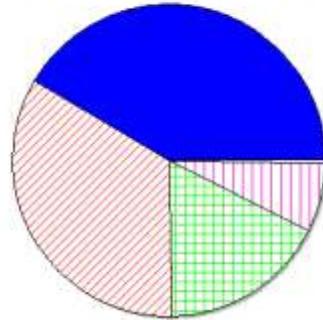
1981

Bessemer East Flood



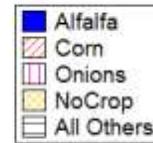
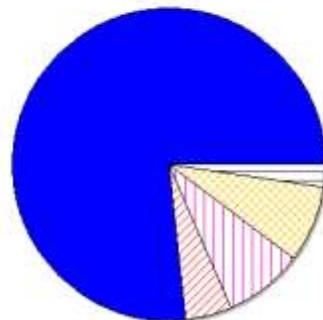
1981

Bessemer Central Flood



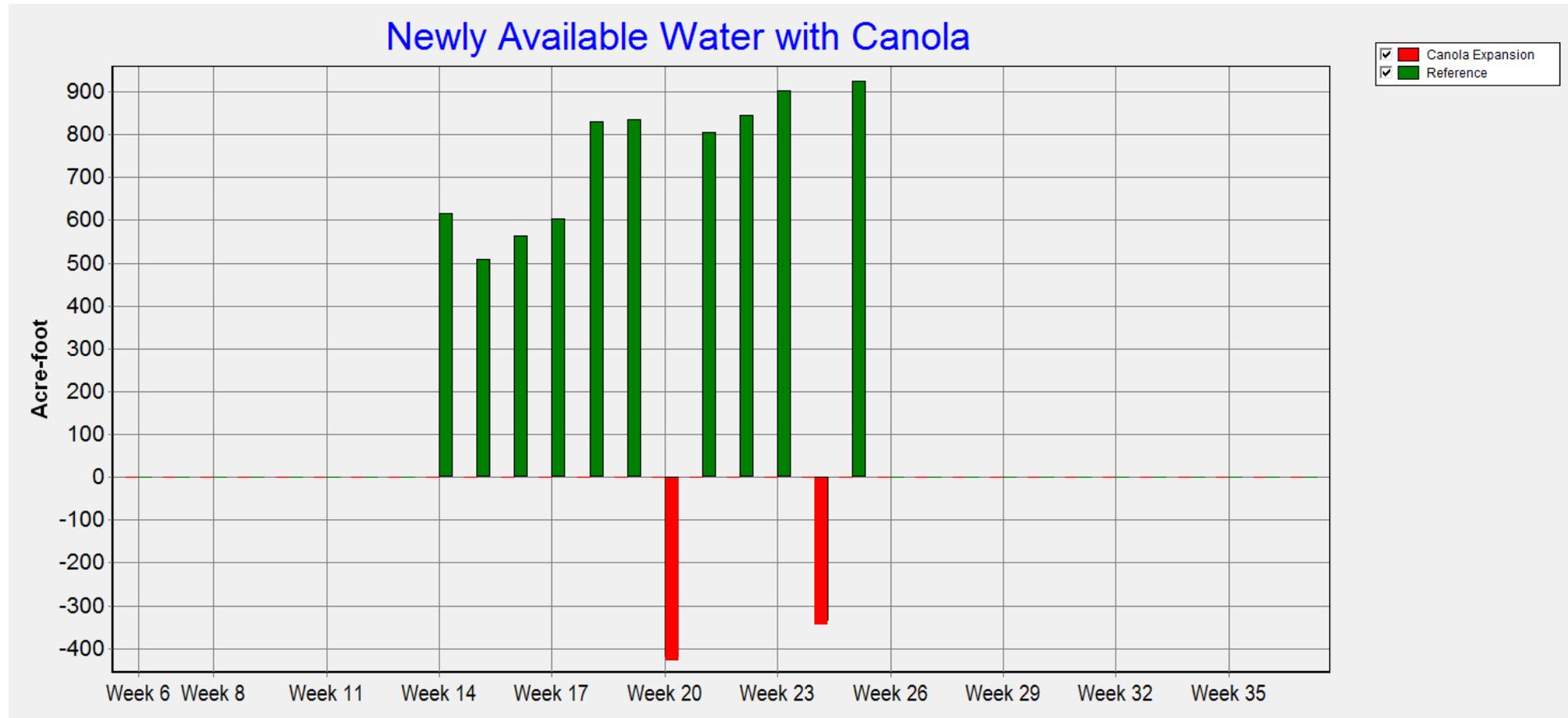
1981

Bessemer West Flood



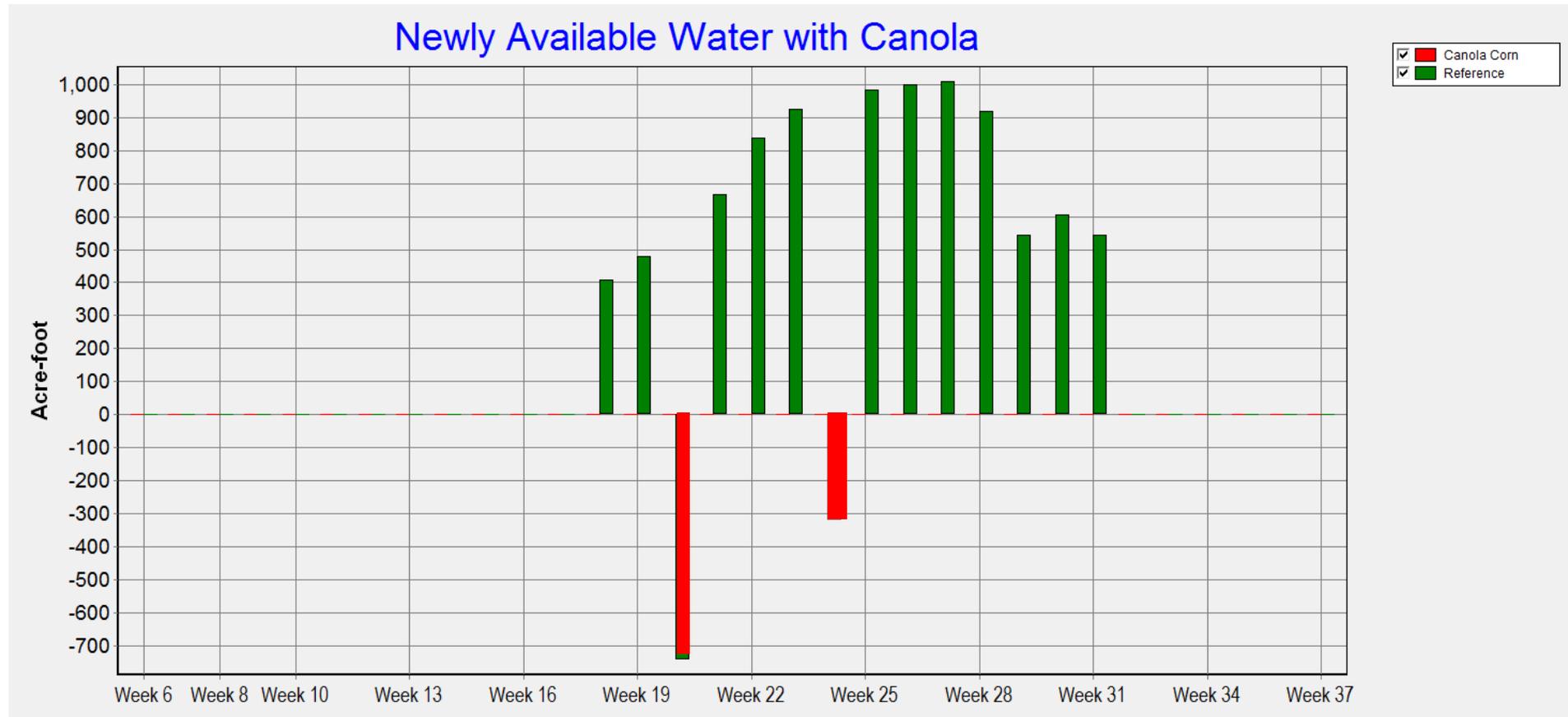
Lots of Alfalfa was being grown with flood irrigation in the Bessemer (this is old data from last public info. available, used for modeling to avoid privacy intrusion)

Suppose switch Canola for 1/2 of Alfalfa? – Farmer gets \$ for water use AND canola use Farmers and city partner get cheap canola fuel or sell the oil as good grade... and the residue is high-fiber, high-protein feed supplement...



THE TIMING OF WATER APPLICATION HAS ECONOMIC VALUES AS WELL AS THE VOLUME –
This provides a lot of early-season water that might be valuable for municipal supply as well as for other higher-value crops... Lots to explore!

Canola (just read “Price-stabilized biodiesel fuel and high-protein feed”) instead of Corn?



Putting in winter canola instead of the corn (4130 A) makes water available early and later in the season... this may be what the municipality needs.

These areas do several things:

First, they work with wildlife and wetlands goals, so as to **AVOID HASSLES with ESA**, etc..

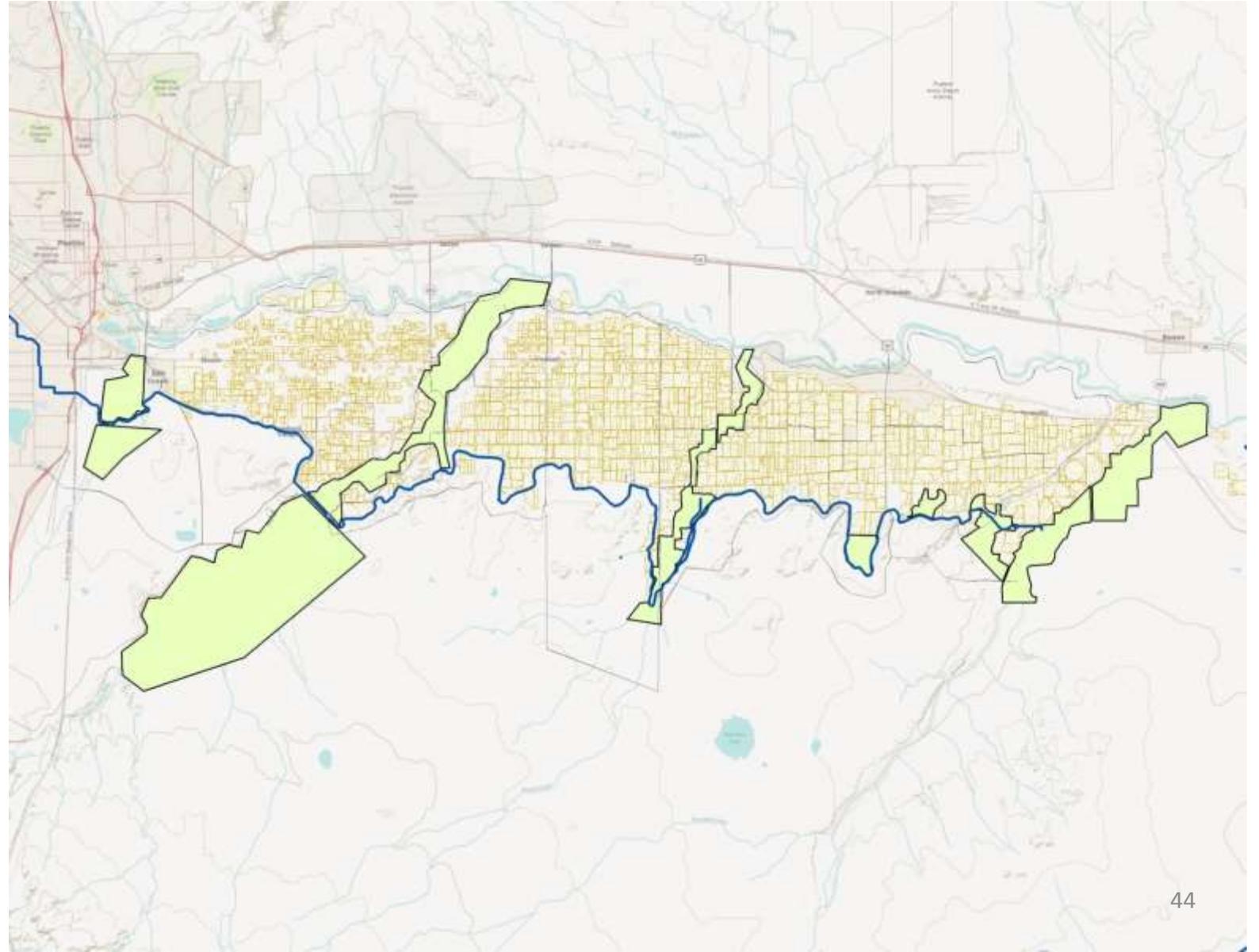
Second, they are good for the **recreational and amenity benefits** that should bring in money!

Third, they are **drainage** areas that help to avoid water quality problems and the **hassles of TMDLs** if they are in place.

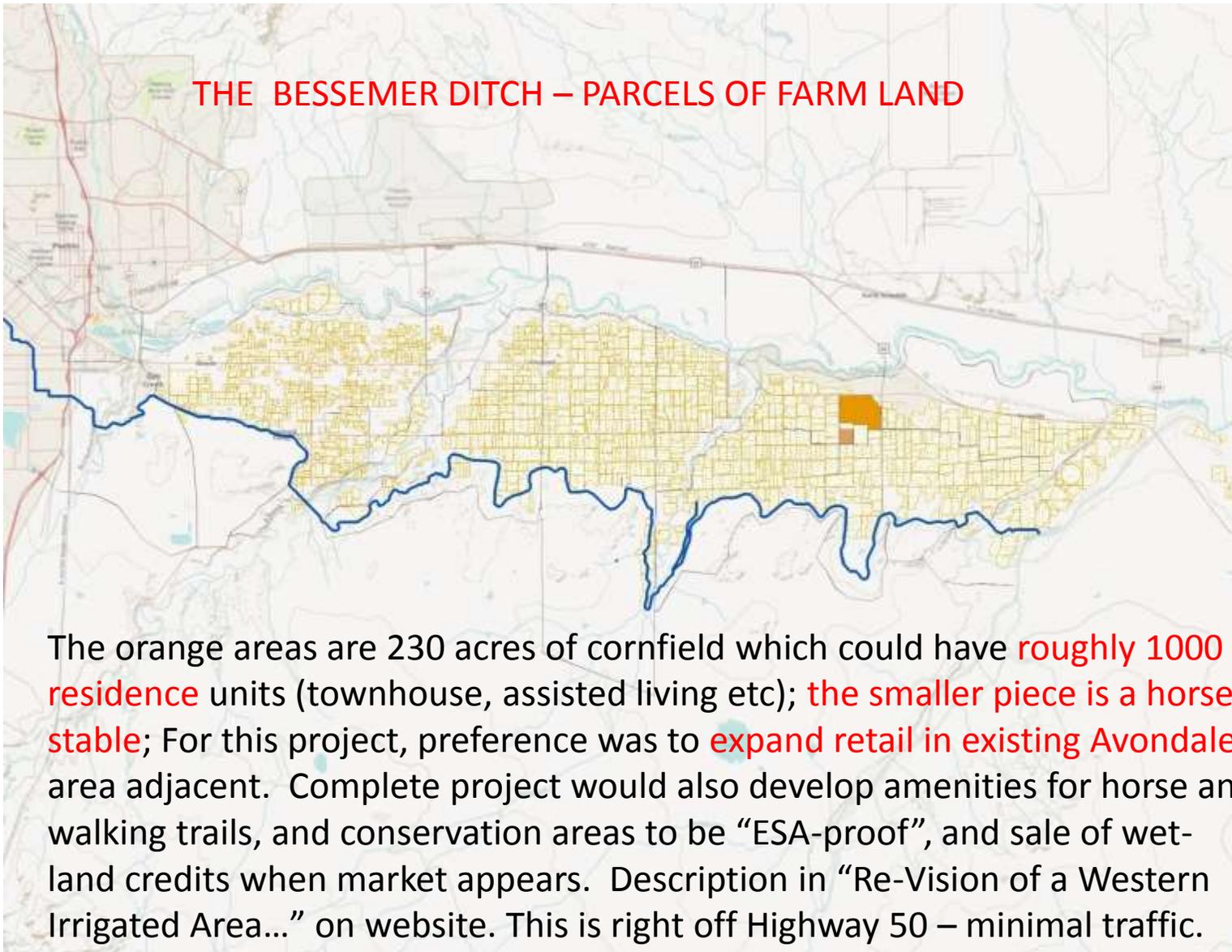
Fourth, **wetlands banking?** May be a lot of \$\$ in the future

Amortize – get there slowly without too much pain

Conservation Areas



“Smart Growth” Suggested – Farmers Cooperate to Concentrate it in One Location – government not the owner, government not the designer!



Smart growth has huge benefits for
Cost of residence , Energy savings
Water savings Quality of life
Water quality
And it stops poking holes in the landscape!

AND FOR THOSE WHO OWN THE LAND?
Where do you want to retire?
What facilities would you like nearby?

MONEY to help make other changes possible

HASSLE TO WORK THIS FAIRLY? Yes! Possible?
Also yes!

Transferable Development Rights... David Carlson model for Colorado: Protective Development Associations

Start thinking about all the ways to divide interests in land and farming... water law is a small set of choices, but farm and water partnerships could be a far bigger set!

OWNERSHIP (single agency)	PARTNERSHIP	LEASE	CONTRACT – COMMON or PES?	COMMUNITY SUPPORTED AGRICULTURE
Fee simple – total JUST BUY IT	As defined OWN IT BUT NOT ALONE	Land for long term; some places called “ground lease” for building investment	Crops – commonly VERY tightly controlled by Non-farm party – 40% of US AG NOW!	Non-farmer rights vary with deal; commonly a variable portion of mixed outputs
Permanent easement – usually RIGID land uses, especially if TAX Breaks involved (Fed Estate, State)	CAN BE Flexible and Contingent	Farming Rights – often called plain leasing, for specified duration usually a few years or less	Share of crops, historically tightly controlled by land owner	Can include obligations beyond payment or a mix; Farmers set the terms
Transferred Development Rights	Multiple Parties, Multiple Interests (can implement a coalition)	Water Banks/Etc: -- where legally allowed – wide variation, purposes may be constrained, or duration	Payment for Ecosystem Services can be contract or more like partnership	Can include access for amenity, recreation, and philanthropy
E.g. TDR for Smart Growth Clustering	E.g. Water sharing permanent deal	E.g. Idaho Snake River. Working water markets	E.g. New York City watershed protection for >1 BG/day	Hundreds are florescing! Often also with direct sales such

A last thought –

- Please **forget “normal”** – things are changing, the rate of change is changing, and we are not going to save enough with “business as usual”
- Please **forget “cyclical”!** There has always been variation, and the weather in a more stable climate would look like it was in cycles... But we can’t rely on that now...
- So, please don’t try for a single target – diversify, hedge your bets, and remember that your knowledge of your farm is priceless – no one else has it



Nobody in the driver's seat... this is "development" of some of the best farm land in the US