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United States Senate

Oversight Hearing
On
"The Status of Drought Conditions Throughout the Western United States and Actions States and Others are Taking to Address Them."

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Good morning Chairwoman Murkowski, Senator Cantwell and Members of the Committee.

My name is Cannon Michael, and on behalf of the Family Farm Alliance (Alliance), I thank you for this opportunity to present this testimony on a matter of critical importance to our membership: the Western drought. The Alliance is a grassroots organization of family farmers, ranchers, irrigation districts, and allied industries in 16 Western states. The Alliance is focused on one mission: To ensure the availability of reliable, affordable irrigation water supplies to Western farmers and ranchers. We are also committed to the fundamental proposition that Western irrigated agriculture must be preserved and protected for a host of economic, sociological, environmental, and national security reasons – many of which are often overlooked in the context of other national policy decisions.

The Family Farm Alliance has a long history of collaboration with constructive partners in all levels of government, conservation and energy organizations, and Native American tribal interests who seek real solutions to water resources challenges in the West. We seek to advocate for a proper role for the federal government on water matters, a vision that focuses on research and development; full integration, coordination and maximum sustainable use of resources; and planning that is driven from the "ground up." The Alliance also has a well-established relationship with Congress, with 45 invitations to testify before Congressional committees on Western agriculture, water and environmental matters in the past decade.

This testimony will illustrate the problems Western farmers and ranchers face in the current drought, outline what producers like me and other Westerners are doing to address these challenges, and provide policy recommendations that we believe lay the foundation for effectively addressing current and future droughts in the Western United States.

Personal Background

I manage the Bowles family farming operation, which is a long-time member of the Family Farm Alliance. I am the 6th generation of my family to be involved with California agriculture. My great-great-great grandfather came over from Germany as a young man and was able to start a cattle business on some of the same land that we now farm today. Starting at age 13, I began to work on the farm during the summer months. I learned about efficient irrigation practices, operation of farm equipment and gained experience with many aspects of managing an integrated farming operation in California's San Joaquin Valley. I met my wife in Los Banos in 1999 and we now have three sons. I live on the farm with my family and cannot imagine a better environment to raise my children. We farm in an area that has a very historic water right, but that has not spared us from the impacts of the ongoing drought.

I'm a farmer and I'm here to talk about what I know best: farming, and farmers and ranchers in California and elsewhere in the West have been hit hard by the drought. But farmers know that the impacts to our industry and to our communities are only part of the picture. Water shortages affect all sectors of the Western economy, creating problems for cities and towns, manufactures, builders, service providers, and individual citizens that are just as challenging as the difficulties faced by farmers and ranchers. The environment, too, is stressed by drought. In many areas of the West, species both plentiful and endangered are struggling to adapt and survive in extremely harsh conditions. The weeks and months ahead will bring wildfires, shortages of electric power and drinking water, business failures, unemployment, and other drought-related consequences, including harm to fish and wildlife, that will linger far into the future.

Water connects us all – farms, cities and the environment – and while drought presents unique problems for each sector, our solutions should be interconnected and mutually beneficial -- not divisive. That requires a willingness of all parties, including federal agencies, to be creative and flexible. That is happening in some places. In other places, it's not. The most helpful thing that Congress can do for drought-stricken states is to encourage, demand and mandate, where necessary, creativity and flexibility on the part of federal water management and regulatory agencies.

The Family Farm Alliance is an organization made up of farmers and ranchers in the West, but the drought problems we face vary by region, topography, climate, soil conditions, hydrology, and crop. These problems have some elements in common, including inadequate or deteriorating water storage infrastructure, inflexible or outdated operational requirements and regulatory conditions, and agencies that are not nimble enough, or not motivated, to seek out and embrace better ways of doing things to ensure the most benefit for the broadest suite of public interests. Solutions also vary by state and region, but they, too, are characterized by certain common elements, including creativity, flexibility and balance.

I will discuss drought conditions and problems in a few different areas of the West, as well as some examples of successful solutions and potential solutions. I'm a Californian so I'll begin there.

Coping with the California Drought

My home state of California is suffering the worst drought in recorded history. After four years of hot and dry weather, more than 44% of California is now experiencing "exceptional" drought conditions, which are characterized by widespread crop and pasture losses, and shortages of water in reservoirs, streams and wells. The record dry conditions of the past few years, coupled with water supply reductions related to regulatory actions, resulted in water supply reductions or constraints for most sectors even before California Governor Jerry Brown issued an executive order in April that imposed a 25% reduction on the state's 400 local water supply agencies over the coming year. The Governor's order focused on municipal, industrial and domestic water use, and he was criticized because the order did not apply to agriculture. But Governor Brown rightfully acknowledged that many farmers and ranchers were already experiencing severe water supply reductions. In 2014, vast areas of farm land in the San Joaquin and Sacramento Valleys received no surface water at all – a 100 % reduction. Those same areas were again zero-ed out in 2015. Overall, agricultural water supplies have been cut by 70% in the Central Valley.

Currently, 44% of California's 9.6 million acres of irrigated farmland are receiving zero surface water allocations from state, federal and local irrigation projects, according to the California Farm Water Coalition Agricultural Water Supplies Survey. Almost 75% of the state's irrigated farm land, nearly seven million acres, will receive 20% or less of its normal surface water supply. According to the California Department of Water Resources (DWR), 692,000 acres of farmland were fallowed in 2014 because of water shortages.

Individual farmers and irrigation districts with the oldest water rights in the State are experiencing severe reductions this year. On the Merced River in the San Joaquin Valley, irrigators in the Merced Irrigation District are receiving no water supplies for the first time in more than 150 years. Districts in the Kings River watershed, where runoff is only about 16% of average, will get so little water that some will not make irrigation deliveries for the first time in almost a century. Districts along the Feather River will see their water allocations decreased by 50% this year, the first cuts since 1992. Tuolumne River water rights holders in the Modesto and Turlock Irrigation Districts received minimal irrigation supplies this year, but there will be no water left for irrigation or municipal deliveries next year if current conditions don't improve - although water to meet fishery requirements will be released to the river.

For the second year in a row, many agricultural water users are receiving no allocations at all from the federal Central Valley Project (CVP), one of the largest water projects in the world. Table 1 shows the allocations for CVP for 2014 and the initial allocations for 2015. In both 2014

and 2015 no surface water supplies were allocated to water users on the Tehama-Colusa Canal, and in the San Luis Unit and Friant Division of the CVP. Settlement contractors, primarily agricultural water users, have water rights that pre-date the federal project, making them priority rights on the system, yet even allocations to those senior water rights holders are being reduced.

Table 1. Central Valley Project Water Allocations (2014 & 2015)

Contractors	***Percent Supply***	
	05/13/14	*02/27/15*
North of Delta		
Agricultural Contractors (Ag)	*0%*	*0%*
Urban Contractors (M&I)	*50%*	*25%*
Wildlife Refuges	*75%*	*75%***
Settlement Contractors / Senior Water Rights	*75%*	*75%***
American River M&I Contractors	*50%*	*25%*
In Delta-Contra Costa	*50%*	*25%*
South of Delta		
Agricultural Contractors (Ag)	*0%*	*0%*
Urban Contractors (M&I)	*50%*	*25%*
Wildlife Refuges	*65%*	*75%***
Settlement Contractors / Senior Water Rights	*65%*	*75%***
Eastside Division Contractors	*55%*	*0%*
Friant – Class 1	*0%*	*0%*
Friant – Class 2	*0%*	*0%*
***** - May be reduced if dry conditions persist***		

Source: Bureau of Reclamation 2015

Almost as large as the federal CVP, California's State Water Project (SWP) will cut agricultural deliveries by 80 percent in 2015.

In most areas where surface water supplies have been severely reduced or eliminated, farmers have turned to groundwater to maintain their permanent crops – grapes, tree fruits, nuts, citrus – that represent a lifetimes' investment. But groundwater supplies are not infinite and were severely depleted in 2014 in areas that received no surface water. Groundwater also isn't cheap. Wells cost upwards of $200,000 each and they are expensive to run, so many farmers pump only enough water to keep their trees alive, but not producing. Often, farmers tear out mature, productive trees and vines and replace them with saplings that won't produce a crop for years, but require far less water to keep alive now. And in some places, mainly the citrus belt in the Friant Division of the CVP, there is no groundwater at all. The many small farms there, which

produce most of the nation's oranges, had their surface water cut off for the first time in 60 years last year. Most of those farms will receive no surface supplies again this year, and as a result decades-old orchards are being bulldozed out of existence.

In 2014 our family fallowed more than 15% of our farm. This year, we have a quarter of the farm abandoned or fallowed. When one hears that land is "fallowed" it might only seem that the impact is to the farmer, but that is definitely not the case. Every acre of farmed land generates jobs, economic activity and products. That is why the drought is so devastating to the rural agricultural communities of the Central Valley.

If I leave an acre fallow, my workers have less work and I use my tractors less. If I use my tractor less, I buy less fuel, lubricants and parts and tires, which means the local businesses that supply these things sell less and their companies suffer. When I don't purchase inputs for the land (fertilizer, seeds, amendments, etc.), the local companies that sell these items suffer reduced sales and the truck drivers who deliver these items have less work. With fewer trucks running fewer routes, fuel and parts purchases are reduced. If that one fallowed acre was intended to be a tomato field, those tomatoes would not be trucked to market or the processing plant.

As you can see, there is a huge interconnection between agriculture and many other industries. Recent press reports will acknowledge that California agriculture is a $46 billion-dollar industry, but then try to minimize this impact by suggesting that it is "only" 2% of the GDP of the state. The oft-reported $46 billion number is only the farm gate value of the products. It does not include all the other industries that benefit from the trucking and processing of the agricultural products (and all the fuel, parts, etc., from the activities). Clearly, agriculture is a huge economic driver for my state, particularly in rural communities. A recent report by the University of California shows that the food and beverage industry contributed $82 billion and 760,000 jobs that are directly and indirectly linked to agricultural products.[1]

Fallowing 25% of our land has had a very significant impact on those who have worked on those lands in the past. My family is doing everything it can to keep our employees working. Right now, we are trying to keep farmworkers on the payroll by putting them to work on two new solar projects that will be used to provide more affordable power to drive the extensive drip irrigation systems we have installed in recent years. This year, we are installing even more drip systems.

This is a very scary time for me and my family, since substantial investments are being made, primarily with the intent of converting more of our operation to drip irrigation, which we hope will stretch limited water supplies. Those investments will be for naught if the current drought / regulatory paradigm persists into the future and there is no water to conserve.

My fellow California farmers are doing their best to offset the devastating loss of water. For example, producers have been forced to buy water, when available, from other sources. In certain

[1] http://giannini.ucop.edu/media/are-update/files/articles/V18N4_3.pdf

instances, farmers had no choice but to buy water at a rate more than 25 times what they normally would pay. In the absence of once reliable surface water supplies, California farmers have looked to groundwater, where available, which is not sustainable. Central Valley producers have been trying to get ahead of a much feared, but anticipated, drought for years. Notably, they've spent about $3 billion to install more efficient irrigation systems on almost 2.5 million acres from 2003 to 2013, according to information compiled by the California Farm Water Coalition. These investments will continue as farmers strive to stretch their water supply.

California Drought: Myth vs Reality

Five years ago, reservoirs in California were brim full of water. Since then, much of that stored water – which had previously supplied Central Valley farms for decades – has been allowed to flow out the Golden Gate by federal fisheries agencies, with no apparent benefit for the fish species it is intended to protect.

"The reality is that farm water has already been rationed for more than two decades by the ascendant green politics, starting with the 1992 federal Central Valley Project Improvement Act", the *Wall Street Journal* recently reported. "Federal protections for the delta smelt, salmon, steelhead and sturgeon (2008-2009) further restricted water pumping at the Sacramento-San Joaquin River Delta, so 76% of inflows, mainly from the Sierra Nevada mountains, spill into San Francisco Bay."

Here are some other facts that are often overlooked in recent media coverage of the California drought:

- Crop production per acre-foot of water has risen 43% in California between 1967 and 2010.[2]
- California agriculture grows more than 50% of America's fresh fruits, nuts and vegetables across 78,000 farms, 400 crops and 450,000 jobs. California's value of agricultural output was $46.7 billion in 2013, with total U.S. output valued at $269.1 billion.[3]
- California is the country's largest agricultural producer and exporter. Agricultural products were one of California's top 5 exports in 2013, totaling $13.7 billion.[4]

Much of the initial media accounts since the Governor's announcement also advanced the decades-old myth that farmers consume 80% of water supplies in California and other parts of

[2] USDA National Agricultural Statistics Service, California Department of Water Resources
[3] California Department of Food and Agriculture, Gianinni Foundation of Agricultural Economics – University of California, USDA, Assembly Committee on Jobs, Economic Development and the Economy
[4] Assembly Committee on Jobs, Economic Development and the Economy

the West. But if we look at the "water footprint" in the same way as we have come to talk about the "carbon footprint," we get a different picture, particularly in California. Numbers from the California DWR provide perspective. According to the Department, statewide water use breaks down as follows: 10 percent urban use; 41 percent agricultural use and a majority of 49 percent use for environmental management: wetlands, Delta outflow, wild and scenic designations, and instream flow requirements.

Others in the media suggested that the shift in crops towards higher value crops like nuts and wine grapes have led to an increase in agricultural water use. For a few weeks, almonds were the preferred villainous target of these reports. But according to California DWR, the total amount of agricultural water use has held steady since 2000 and actually declined over a longer period.

I appreciate this opportunity to provide my first-hand observations of the drought challenges we are facing in my home state. However, the organization I am representing includes farmers and ranchers from across the West who are experiencing their own drought struggles, developing innovative solutions, and who are seeking assistance to create long-lasting fixes to allow them to better cope with future droughts.

The Western U.S. Drought Crisis

Unusually dry weather has dominated much of the West for the past three to four years, resulting in significant hydrological (low lake, reservoir, and stream levels) and agricultural impacts. Almost all of the West Coast continues to have record low snowpack this year, according to data from the fourth 2015 forecast by the United States Department of Agriculture's Natural Resources Conservation Service. Historically, April 1 is the peak snowpack in the West. This year, the peak came earlier. There was little snow accumulation in March, and much of the existing snow has already melted. In Western states where snowmelt accounts for the majority of seasonal water supply, information about snowpack serves as an indicator of future water availability. Streamflows in the West consist largely of accumulated mountain snow that melts and flows into streams as temperatures warm in spring and summer. A consequence of the early snowmelt is that Western states will have reduced streamflow later this spring and summer.

As noted previously, California's Sierra snowpack is at record low levels but is relied upon as the primary source of the summer water supply. With very little snow melt runoff, the current reservoir contents will essentially be the only amount of water available for use this summer. The major storage reservoirs for California are at roughly 50% of capacity and have very little opportunity to gain additional water.

The Colorado River Basin covers about 246,000 square miles, including parts of the seven "basin States" of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming and also flows into Mexico. The river supplies water to more than 30 million people, irrigates nearly four

million acres of cropland in the U.S. and Mexico, and supplies hydropower plants that generate more than 10 billion kilowatt-hours annually.[5] Much of the Colorado River Basin is facing multi-year drought conditions. In Arizona, the snowpack has melted out about a month earlier than normal, and streamflow forecasts have been further reduced. Colorado snowpack has prematurely transitioned to early spring-like conditions, with lower and some mid-elevation snowpack seeing significant melting. In Nevada, the April 1 snowpack was the lowest ever recorded at nearly every measuring site statewide (including three sites with over 100 years of data). Water year precipitation is also nearing record low amounts, which reinforces predictions of record low streamflow volumes this summer.[6] Predicted near-term Colorado River water supply scenarios are dire enough that drought contingency planning has been initiated in the Colorado River Basin. These efforts place a strong emphasis on demand reduction as one of the tools to stave off critical water shortages. If dry conditions continue, diminishing reservoir levels in Lakes Powell and Mead will have extremely negative consequences for water and power users throughout the watershed, especially urban areas outside of the Basin that rely on Colorado River trans-basin diversions for their water supplies.

In the State of Colorado, all river basins experienced peak snowpack in early March with the exception of the South Platte which, due to mid-April storms, was able to achieve a snowpack peak close to normal. Basin-wide snowpack follows the same storyline: while the South Platte snowpack is at 96 percent of normal on May 1, statewide snowpack is at 61 percent of normal. Snowpack in the Rio Grande River Basin is the lowest in the state, at 25 percent of normal on May 1. This means that mountain snowpack this year will only provide three quarters of the typical snowmelt to contribute to streamflow. However, snowmelt is not the only factor that determines spring and summer streamflow. Monthly precipitation has been well below normal in nearly every basin for the last two months, during which Colorado typically receives the most monthly precipitation amounts. Statewide April 2015 precipitation was only 71 percent of normal, while the South Platte April precipitation was the anomaly at 110 percent of normal. These factors, among others, currently paint a below normal streamflow forecast picture for much of the state heading into spring and summer of 2015.[7]

Snow packs in Utah are melting quickly and streamflow response has been poor. About 70% of all snow measurement sites in Utah had no snow as of May 1. Those that did – didn't have much and won't have that for very long. As an example, the Weber River has lost about 75% of its total snow pack to date and has produced a paltry 8.5% of its normal April-July streamflow. Low snow years typically melt out earlier (about 2 to 4 weeks), generate lower peak flows which also come earlier in the season and substantially lower accumulated flow. For most watersheds in low snow years, about half of the April-July flow is generated post snow melt out which will occur on most basins within the next two weeks. This means that – for most areas – April-July streamflow will likely be in the 20% to 40% of average range. Lower elevation watersheds are

[5] WaterSMART Colorado River Basin Focus Area Study, USGS 2012
[6] Nevada Water Supply Outlook Report, USDA NRCS, May 2015
[7] Colorado Water Supply Outlook Report, USDA NRCS, May 2015

already melted out and are in hydrograph recession. The year to date precipitation is below normal statewide at 64%. Current soil moisture saturation levels in runoff producing areas are near peak for the year and will quickly begin drying. Reservoir storage in 46 of Utah's key irrigation reservoirs is currently at 65% of capacity statewide. General runoff conditions are extremely poor in all areas of the state. May-July stream flow forecasts range from 6% for Salt Creek at Nephi to 54% of average for the East Fork of Smiths Fork near Robertson. [8]

It has been nearly five years since hydrologic conditions in New Mexico have been favorable, with extreme drought conditions now tolerable as some welcome moisture has fallen in northern New Mexico and across the western and eastern side to help fill streams and reservoirs. While most watersheds in the state show improvements in the April – July runoff forecast they are still only averaging between 25% and 68% of the 30-year average. The southern portion of the state remains vulnerable to drought conditions with the largest reservoir in the state, Elephant Butte, at only 13% of full capacity. Water from this reservoir feeds the Elephant Butte Irrigation District (EBID) and El Paso County Water Improvement District No. 1 in Texas. Currently, EBID farmers have been allotted only eight inches of water for the 2015 irrigation season, just over 20% of what a normal full allotment would be.

As of April 1, 76% of Oregon's long-term snow monitoring sites were at the lowest snowpack levels on record. In a typical year, most sites would be near their peak snowpack at this point in the season. This year, more than half of all snowpack measurements across the state recorded bare ground on April 1. Snowpack across Oregon peaked 40% to 90% below typical peak levels this winter, which will lead to reduced water supplies in the coming summer.[9] The Oregon Water Resources Department has a variety of tools it can use to exercise emergency water rights authority following a Governor's drought declaration, including issuance of emergency permits, temporary transfers (authorizing changes in type of use, place of use, or point of diversion of an existing water right, including "split season" transfers), and temporary instream leases to convert all or a portion of a water right to an instream lease. The state can also authorize temporary substitution of a supplemental ground water right for a primary surface water right and temporary exchanges of the source of water allowed under a water right, such as moving from a direct flow right to a stored water source. Under a drought declaration, the state can also grant preference of use to water rights for human consumption or livestock. All of these emergency actions involve a review process that includes an abbreviated public interest determination and a test for injury to existing water rights.

A dry April compounded with warmer-than-normal spring temperatures is deteriorating Idaho's water supplies. Snow water content levels peaked a month early and are now melting a month earlier than normal causing streams to peak in early to mid-May rather than mid-May to early June. Moderate snow melt rates and another dry month led to significant decreases in streamflow forecasts from last month. The highest forecast are for 80% of average for the rivers that flow

[8] Utah Water Supply Outlook Report, USDA NRCS, May 2015
[9] Oregon Basin Outlook Report, USDA NRCS, May 2015

into Idaho from Montana and the lowest are at only 1% to 30% across basins in northern, central and southern Idaho. With more of the snowmelt water percolating into the ground and not showing up in the rivers, most river systems are operating under reduced irrigation allotments resulting in surface irrigation shortages that are expected across southern Idaho this summer and fall. Current snowpacks are melted out or nearly melted out in the Owyhee, Weiser, Oakley, Little Wood, and lower elevations in eastern Idaho. Snowpacks are only 10% to 15% in the Little Lost and Mud Lake area and increase to 20% to 40% across parts of southern, central and northern Idaho. The Salmon and Boise basins snowpacks are 40% to 50% of median while the highest snowpacks are 50% to 65% in the Clearwater, Henrys Fork and Snake above Palisades Reservoir. Idaho reservoir storage varies across the state and the status of each reservoir filling is a function of which phase of the hydrologic cycle the watershed is in. The story remains the same; there are ones that won't fill, others that will fill but won't be full for long with limited inflows, and others that are already on decline because of the early and high irrigation demand. By summer's end or before, many water storage facilities will be at their minimal storage levels.[10]

Extremely low snowpack continues across the state of Washington. Combined with an early melt during a warm March, streamflows for the spring and summer are expected to be correspondingly low.[11] With snowpack at historic lows, rivers dwindling and irrigation districts cutting off water to farmers, Governor Jay Inslee last month declared a statewide drought for Washington. The Washington Department of Agriculture is projecting a $1.2 billion crop loss this year as a result of the drought. To protect permanent crops in the state's most productive agricultural region, the Yakima River Basin, pro-ratable irrigation districts (those with junior water rights) are scheduled to receive only 44% of normal water deliveries, and are turning off water for weeks at a time to try to extend water supplies longer into the summer. In the Walla Walla region, water is being shifted from creek to creek to keep water flowing for steelhead, Chinook and bull trout. Fish are even being hauled farther upstream to cooler water. As things continue to dry out, the Department of Natural Resources expects more early-season and higher-elevation wildfires. The Bureau of Reclamation, which manages water for the Yakima Basin, has tapped into reservoir storage two months earlier than normal, and with snowpack melted and gone those reservoirs will not produce enough water to meet all demands downstream. Farmers and communities facing hardships may qualify for drought relief funds. Money can be used to drill water wells, lease water rights and acquire pumps and pipes to move water from one location to another. The Department of Ecology has been leasing water rights to boost stream flows, partnering with other agencies to evaluate fish passage problems and monitoring groundwater wells.

In Wyoming, snowpack and streamflow forecasts are below normal throughout the state. Fortunately, a recent wet pattern has taken hold across the Great Basin and Central Rockies. The

[10] Idaho Water Supply Outlook Report, USDA NRCS, May 2015
[11] Washington Water Supply Outlook Report, USDA NRCS, May 2015

precipitation outlook calls for continued elevated changes of above normal precipitation across Wyoming through July may help to alleviate drought conditions in the southwest part of the state. Below normal snowmelt streamflow volumes (50% to 65%) are expected across almost all major basins across Wyoming.[12] The significant wildland fire potential outlook for July and August shows there will be a higher than usual likelihood that wildfires will occur and become significant events across the northern two-thirds of Wyoming.

Key Challenges

The key challenges Western irrigators face in times of drought include competition for scarce water supplies, insufficient water infrastructure, growing populations, endangered species, increasing weather variability/climate change, and energy development. Across the West, several key water policy challenges stand out:

1. **Water management in the West is becoming increasingly inflexible.**

We need a new way of looking at how we manage our limited water resources, one that includes a broader view of how water is used, along with consideration of population growth, food production and habitat needs. The goal should be to integrate food production and conservation practices into water management decision making and water use priorities, creating a more holistic view of water management for multiple uses. We must begin to plan now in order to hold intact current options. Planning must allow for flexibility and consider all needs, not just focus on meeting future needs from population growth.

In many parts of the West, litigation stemming from citizen suit provisions of environmental laws including the ESA and Clean Water Act (CWA) is producing federal court decisions (or court approved "settlements") that direct federal agency "management" of state water resources. Congress should recognize that this type of litigation and resulting settlements can actually harm the overall health and resilience of landscapes and watersheds by focusing on single species management under the federal Endangered Species Act (ESA). We should seek solutions that reflect a philosophy that the best decisions on water issues take place at the state and local level. Finding ways to incentivize landowners to make the ESA work is far more preferable than what we have been seeing in recent years, where the ESA has been used by special interest environmental groups and federal agencies in court as a means of "protecting" only a single species (such as the Sacramento-San Joaquin River Delta smelt in California) without regard for other impacts, including those on other non-listed species.

Litigation and the manner in which certain federal agencies administer the ESA are very much driving water management decisions these days, at least in the West. And adversarial, single-purpose approach is not helping the agencies recover very many species. Recent research into

[12] Wyoming Basin Outlook Report, USDA NRCS, May 2015

litigation associated with federal environmental laws is beginning to uncover some unsettling facts: the federal government appears to be spending about as much money funding plaintiffs' environmental lawyers as it does to directly protect endangered species. Certain tax exempt, non-profit organizations have been consistently awarded attorney fees from the federal government, for suing the federal government. These same environmental groups are receiving millions of tax dollars in attorney fees for settling or "winning" cases against the federal government.

Droughts occur routinely in the West; that is why the Bureau of Reclamation made such important investments in water supply infrastructure over the past century. However, this infrastructure was never designed to meet the burgeoning demands of growing communities and environmental needs, while continuing to help farmers, ranchers and rural communities make it through periodic droughts. Unfortunately, droughts in the West are predicted to be deeper and longer than we have historically experienced in the 20th century. We believe Congress should provide federal agencies with more flexibility under environmental laws and water management regulations to respond to drought condition. And where such flexibility currently exists, Congress should demand that agencies use it promptly and with a minimum of bureaucratic nonsense.

For example, during drought emergencies the Federal Energy Regulatory Commission (FERC) has the authority to adjust licensing conditions for hydropower projects that affect water storage and fishery requirement. FERC has been pro-active in exercising that authority, but the federal fishery agencies, which set the flow and fishery conditions on hydropower licenses, are reluctant or slow to cooperate, or they impose out-scaled demands for 'mitigation' of emergency actions.

In some cases, water project operators are forced to release water in 'pulse flows' that may benefit fish species during normal times, but are of no value whatsoever during droughts when the species intended to benefit from the flows is not present in the river. Nevertheless, federal fishery agencies insist that the flows be made, the result being no benefit to the species and a great loss of scarce water that could be used by towns and farms.

Despite record-breaking dry conditions in California in 2014, and the Governor's declaration of a state-wide drought emergency, the Bureau of Reclamation, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service refused to invoke existing emergency authorities under the ESA that would have provided increased operational flexibility for the CVP and the State Water Project while still protecting listed species. When local water agencies pressed the federal agencies to use their existing emergency powers, they were told that it would likely result in the imposition of harsh "mitigation" measures.

The Corps of Engineers operates dozens of water projects throughout the West, and it regulates the operations of many non-federal dam and reservoir projects according to criteria that in many cases were established decades ago and have not been updated to reflect changed conditions or new technology. As a result, projects are sometimes forced to waste large amounts of water in

order to adhere to the letter of a flood-control plan that no longer has a basis in reality. The Corps has existing authority to make short-term adjustments to operation criteria during droughts, but the agency rarely does so on a proactive basis.

The Alliance also believes Congress should rein in the environmental litigation "industry" that so often is the cause of inflexible federal decision making in water resource management.

2. **Environmental water management needs to be held to a higher standard of accountability.**

We must manage water to meet all needs but in a manner that "shares the pain," not creates winners and losers, especially when the losers are the very beneficiaries the federal water projects were originally built to serve. The past federal management of water in California's Bay-Delta, which has redirected under the ESA millions of acre feet of water away from human uses and towards the perceived needs of the environment, with no documented benefit to the ESA listed fish intended for protection, is a prime example. Similar concerns relate to recent flow management decisions on the Klamath-Trinity River system in Northern California / Southern Oregon, driven by misperceptions of the much-publicized Klamath River salmon die-off that occurred in 2002. That die-off event proved to be the catalyst for many of the actions taken on the Klamath / Trinity system in the past decade, where a "flow-centric" philosophy of certain downstream entities and the U.S. government has been exercised over the past decade with little apparent benefit to the fish. After a decade of providing flow augmentation in the Klamath / Trinity River system, there has been no scientific evidence produced by any state, federal, tribal, regional, private, or non-governmental organization that flow augmentation has prevented a fish disease outbreak. Meanwhile, California and Oregon water and power customers have suffered enormous, unmitigated losses due to this "management by perception" approach.

To Central Valley Project agricultural water contractors, the loss of 123,000 acre-feet of Trinity River water that could have been diverted to the CVP for drought relief in today's water market equates to nearly a $250,000,000 replacement value. And this calculation doesn't account for the other known socio-economic impacts resulting from fallowed acreage, lost production, lost sales, lost employment, and increased need for social services throughout the San Joaquin Valley's communities, many of which are considered disadvantaged under federal and state laws.

Good water management requires flexibility, as well as adaptive management. More regulation usually reduces this flexibility. Federal agencies managing the competing demands for water in the West have in some cases failed in creating opportunities for more flexible water management during times of drought.

3. **The Endangered Species Act needs to be implemented in a new way to better benefit species and rural communities.**

The original intent of the ESA - stated in the Act itself - was to encourage "the states and other interested parties, through federal financial assistance and a system of incentives, to develop and maintain conservation programs which meet national and international standards." Of special importance to the Family Farm Alliance is that the ESA explicitly declared that it was the policy of Congress that "federal agencies shall cooperate with state and local agencies to resolve water resource issues in concert with conservation of endangered species."

The authors of the ESA clearly believed in applying the ESA in a way that would foster collaboration and efficiency of program delivery, in an incentive-driven manner. Unfortunately, implementation of the ESA has "progressed" in recent years toward an approach that is now driven by litigation and sometimes the inappropriate, inconsistent and incorrect interpretation of the law by federal agencies. As far as the Act itself is concerned, little to no progress has occurred to keep this 40-year-old law in step with the modern era. The ESA has not been substantially updated since 1988.

At the heart of the Family Farm Alliance's concerns with the ESA is the ever present potential of serious federal restrictions being placed on the West's irrigation water storage and delivery activities, often using federally developed water infrastructure in protecting listed species. Future endangered species listings are on the horizon, including the Western Yellow-billed Cuckoo and Western sage grouse. That prospect has the Alliance very concerned about potential new federal restrictions being placed on the water supplies that are crucial to the West's $172-billion per year irrigated agricultural economy.

The ESA is an outdated law that is clearly not working as it was originally intended. It needs to be more about incentives and collaboration and less about litigation and regulation. Fewer than 2% of the species ever listed under the Act have been recovered and removed from the list, and the failures under the law far outstrip the successes. Meanwhile, the economic and sociologic impacts of the ESA have been dramatic. From the Alliance's standpoint, the law has really only inflicted harm and generated litigation that uses the Act as a weapon against our members' ability to use our natural resources for farming and ranching, while doing little to help the environment or the very species it was designed to protect.

4. **Aging Water Infrastructure Must be Addressed to Protect Future Water Supply Reliability**

More surface and groundwater storage is still a critical piece of the solution to water shortfalls. Congress should streamline regulatory hurdles to assist in developing new environmentally-sensitive water storage projects and other necessary water infrastructure improvements. Congress

should work to facilitate the construction of new surface storage facilities, providing a more effective process to move water storage projects forward.

Also, new tools to assist in financing major improvements to aging water infrastructure will be needed in the coming years to ensure that farmers and ranchers charged for these upgrades can afford repayment. Water infrastructure is a long-term investment, as are farms and ranches, and long repayment and low interest terms will be crucial in reinvesting in aging facilities to meet the challenges of tomorrow. Such improvements could include investments in everything from new water storage reservoirs (both on- and off-stream), regulating reservoirs, canal lining, computerized water management and delivery systems, real-time monitoring of ecosystem functions and river flows for both fish and people, and watershed-based integrated regional water management. With the advent of the Water Infrastructure Finance and Innovation Act (WIFIA) in the WRRDA 2014, the Alliance believes a similar affordable loan program could be instituted at Reclamation to assist in providing capital for such investments. Also, more flexibility may be needed to allow for private investments at Reclamation facilities in order to attract additional capital to meet future water supply needs.

Western irrigators need flexible, streamlined policies and new affordable financing tools that provide balance and certainty to support collaborative efforts and manage future water infrastructure challenges. Solutions in all of these areas will be crucial to future enhanced agricultural production, conservation and community outcomes in the West.

Innovative Solutions

For family farmers and ranchers, finding solutions to constantly emerging challenges is just business as usual. Nature, the markets and the government are always finding new problems to throw at farmers, and farmers who are not determined, resourceful and innovative do not succeed -- at least not for long.

Irrigators and their local water agencies are responding to the drought with determination, resourcefulness and innovation. They also are bringing those attributes to bear in planning for a future where "drought" may be a long-term or even permanent condition. Throughout the West, farmers, ranchers and irrigation agencies have undertaken creative measures to efficiently manage increasingly scarce water resources. Some of these actions are intended to address the immediate crisis; others have been implemented as part of the broad portfolio of actions that successful farmers are employing to stay profitable in today's fierce economic and regulatory climate. If federal agencies are willing to take lessons from how farmers and ranchers are coping with the drought, the result would likely be better management of water for both economic purposes and environmental uses.

The following are real-world examples that Congress and the Administration should consider when developing legislation and polices to address the current drought and water management for the future.

Employing New Technology: *Elephant Butte Irrigation District (New Mexico)*

With less snow pack runoff and a more intense monsoon season, the Elephant Butte Irrigation District (New Mexico's largest irrigation district) has been instrumental in developing a storm weather tracking system that gives water managers time to react to monsoon events that can bring torrential rain events into the Rio Grande Valley. The new system can detect the storm event 20 miles away from the valley, calculate the rain event and determine the storm track before it hits the valley floor. The District then captures it in the Rio Grande River, diverts it into their canal system to irrigate farm land and into a system of drains that allow the storm water to recharge the underground aquifer.

Collaboration, Ecosystem Restoration, and New Storage: *Yakima Basin (Washington)*

The Yakima River Basin in Washington State does not have enough surface water storage facilities, with over 2.4 million acre feet of water needs annually dependent upon only 1 million acre feet of surface water storage capacity. The Yakima Basin is experiencing increased pressures and demands on our 1 million acre-feet of reservoir storage capacity, while we are now at above average carryover water storage, current water storage capacity cannot make up for shortages in the snow pack. We need more water storage carrying capacity to meet our dry-year demands like those we are experiencing this year, with proratable (junior) water rights estimated to receive only 44% of normal supplies.

To help plan for expanding our access to more irrigation and M&I water storage capacity and to help relieve tensions in the basin over water supply management for all needs, a large cross-section of the water stakeholder interests and the Yakama Nation have worked together over the past several years in developing the Yakima Basin Integrated Plan. The Integrated Plan is a well thought out, long-term comprehensive set of solutions to restore ecosystem functions and fish habitat and improve long-term reliability of water supplies for streamflows, agricultural irrigation and municipal supply. The Integrated Plan was developed in a public, collaborative process involving local, state, federal and tribal governments plus stakeholders representing environmental, irrigation and business interests. The consensus achieved by this diverse group represents a major and unprecedented accomplishment for the Yakima Basin and for water management in the western United States. The Integrated Plan offers a means to avoid a tangle of litigation and hardship for these users in future years. The Yakima Basin Integrated Plan is believed to be the first basin-wide integrated plan in the United States to reach the level of success that it has achieved.

Prior efforts to increase water storage in the Yakima Basin have failed, in part due to a lack of consensus among the key stakeholders. The Integrated Plan offers the best opportunity in decades to resolve long-standing problems afflicting the Basin's ecosystem and economy. In addition, improving water conservation and management, along with making available increased water storage for farms, fish and our communities are key components of the Plan. When implemented, the Plan will greatly improve operational flexibility to support stream flows while

meeting the basin's basic water supply needs under a wide range of seasonal and yearly snowpack and runoff conditions, both now and under possible future hydrologic conditions.

Empower Locals to Develop New Storage: *Sites Joint Power Authority (California)*

Growing concerns about the delays and costs associated with the proposed Sites off-stream reservoir project in the Sacramento Valley of California, as well as the need for a local voice, led to the formation, in August of 2010, of the Sites Project Joint Powers Authority (Sites JPA). The Sites JPA, which includes Sacramento Valley counties and water districts, was formed with the stated purpose of establishing a public entity to design, acquire, manage and operate Sites Reservoir and related facilities to improve the operation of the state's water system.

The Project would also provide improvements in ecosystem and water quality conditions in the Sacramento River system and in the Bay-Delta, as well as provide flood control and other benefits to a large area of the State of California. The formation of local JPA's was included as a key provision in the 2009 California Water Package Water Bond legislation for the purposes of pursuing storage projects that could be eligible for up to 50% of project funding for public benefits.

As the Sites JPA began working with the Bureau of Reclamation and California Department of Water Resources, the JPA took a common-sense approach. The JPA worked with Reclamation and DWR to put together *Foundational Formulation Principles*. In other words, first identifying the needs of the water operations system and then designing the project that would meet those needs. Local project proponents envisioned a project that would be integrated with the system they already had, and one that would also operate effectively regardless of future operational changes to the larger system, such as construction of new conveyance to export water users located south of the Delta. The JPA wanted to maximize the benefits associated with existing infrastructure and provide as much benefit as possible to both the existing state and federal water projects at the lowest feasible cost.

The JPA approached the Sites project with the goal of making the best possible use of limited resources, and in the end, local irrigators believe they have identified a project that is both affordable and will provide significant benefits. The proposed project maximizes ecosystem benefits consistent with the State water bond, which states that at least 50 % of the public benefit objectives must be ecosystem improvements. Other benefits include water supply reliability, water quality improvements, flexible hydropower generation, more recreation benefits and increased flood damage reduction. In short, the JPA approached the Sites project with the goal of generating water for the environment while improving statewide water reliability and regional sustainability in Northern California. They believe they have achieved that goal.

Collaboration, Conservation, Energy and Water Reliability, and Regulatory Assurances: *Deschutes River Basin (Oregon)*

Irrigation districts that comprise the Deschutes Basin Board of Control are important members of the Family Farm Alliance. Since the 1960s, local irrigation districts, cities, counties, and others have undertaken an unprecedented array of voluntary measures to conserve water, return water in-stream for fish and wildlife purposes, and use irrigation water supplies to generate renewable carbon-free energy. District-led conservation projects have reduced diversions by more than 200,000 acre-feet annually, leading to higher in-stream flows in the Deschutes River and its tributaries. Recent projects by four districts alone have resulted in the piping or lining of 58 miles of canals, resulting in a return of 91.5 cubic feet per second of water in-stream. All of these measures are designed to sustain agricultural productivity, reduce diversions and increase in-stream flows in the Deschutes River and its tributaries.

One of the first applications of ESA section 10(j) in the United States by the National Marine Fisheries Service (NMFS) occurred in the Deschutes Basin because of the proactive water conservation and fisheries restoration work completed to date by local irrigation districts, along with cities, counties and others in Central Oregon. These water users have received assurances from NMFS that their lawful use of water supplies will not be at risk to the ESA while this designation is in effect. Many water users in other parts of the West have done much to conserve water, restore ecosystems, and take other actions to steward the environment, and have yet to receive the sort of regulatory "assurances" that the Deschutes Basin districts have. The relationship that exists between the local water users and federal regulatory agencies in the Deschutes Basin should serve as a model for other regions of the West.

Raising wool and beef, and growing alfalfa, grass hay, carrot seed, wheat, and other products requires a sustainable supply of water. Improving instream flows for salmon, steelhead and other fish and wildlife species also requires sustainable supplies of clean water. The efforts underway in Central Oregon are a terrific example of how to preserve our important agricultural economy in places like Deschutes County, while improving habitat in Oregon's iconic Deschutes River.

Fish Reintroduction and Regulatory Assurances: *Yuba Salmon Partnership Initiative (Marysville, California)*

The Yuba County Water Agency (YCWA) is leading a voluntary, science-based initiative with the California Department of Fish and Wildlife, NMFS, American Rivers, Trout Unlimited, and the California Sportfishing Protection Alliance to reintroduce Spring-run Chinook salmon (and possibly steelhead) into the North Yuba River upstream of YCWA's New Bullards Dam, and to enhance habitat for these species in the lower Yuba River. Recognizing the value of collaboration over controversial regulation, these parties are working to establish the sustainability of reintroducing these species into their historic habitat in the Sierra Nevada Mountain Range for the first time in 75 years. If the initiative is successful, it would help

contribute to the recovery of these species with benefits for California's Bay/Delta, and possibly serve as a model for fisheries reintroduction elsewhere. A foundation of this effort will be the use of Section 10(j) under the Endangered Species Act – a concept previously successfully employed in the Deschutes River Basin (above) - to ensure that the parties throughout this region do not incur any harm from the ESA.

Long-term Environmental Enhancement and Water Supply Reliability: *Klamath Settlement Agreements (California / Oregon)*

The three Klamath Agreements - the Klamath Basin Restoration Agreement, the Klamath Hydro-Electric Settlement Agreement and the Upper Klamath Basin Comprehensive Agreement - reflect an intensive, collaborative effort that has consumed much of the last decade. The Klamath irrigation community wants to move on to stability and has spent thousands of hours over the last decade at the negotiating table to reach this outcome. The Klamath settlement agreements are a critical means of keeping Basin family farmers and ranchers in the business of producing food and fiber for our country and the world. The settlement agreements are a unique solution that advances this critical need. What happens or does not happen for Klamath Basin irrigators could set an example, not only for all Western family farms and ranches, but other areas of the country where agricultural production is beset with environmental challenges.

Understandably, the idea of removing dams is a sticking point for some in the agricultural community, and the Alliance does not universally endorse the removal of dams. In fact, the Alliance is a leading proponent of creating more surface water storage in the West. We are advocates for enhancing the benefits of existing water-supply dam-reservoir projects and for building new ones to meet the needs Western irrigated agriculture. The potential impacts and precedents of removing any dam are concerns to us as advocates for irrigated agriculture.

The Klamath Settlement Agreements are unique to the Klamath Basin and its issues and their dam-removal components have no bearing on other agricultural region's decision-making. Moreover, no irrigation dams or flood control dams are removed as part of these settlements. Dams slated for removal are owned by a private company, PacifiCorp, which believes it is in the best interest of their Western states customers to remove them. Importantly, this is a private property rights issue. We believe that holders of private property rights in this country should have a say about what they do with their assets, and that is what PacifiCorp has exercised. In this instance, agricultural producers stand to gain increased water supply reliability in exchange for the expected fish passage benefits associated with removal of these dams.

To date, the local irrigators who have actually experienced a threat to their livelihood and way of life with water shut-offs, paying for litigation, and ESA pressures want these agreements in place. Proponents of these agreements believe they provide the most cost-effective, timely and politically viable solution.

Conservation and Drought Resilience: *Colorado River Basin*

In Wyoming, ranchers Pat and Sharon O'Toole have always managed their land with conservation in mind. Along the way, they've built strong partnerships with Trout Unlimited, Audubon Wyoming and The Nature Conservancy; organizations some ranchers once viewed as adversaries. Further south, in the fertile North Fork Valley outside of Paonia, Colorado, Harrison Topp took the leap from annual vegetable production to perennial fruit, growing food in a region with just 15 inches of annual average precipitation.

The newest Family Farm Alliance report, "*Innovations in Agricultural Stewardship: Stories of Conservation & Drought Resilience in the Arid West*," focuses on these two case studies and three others that profile producers across the Colorado River Basin and beyond who -- with curiosity, creativity and seasons of trial and error -- are conserving resources while enhancing productivity. The Alliance teamed up with the National Young Farmers Coalition on this report with the aim of elevating the voices of farmers and ranchers who are employing smart solutions to build drought resilience, steward water and grow good food.

Some of the farmers highlighted in the Alliance report are integrating efficient irrigation technology with soil health to increase both productivity and water savings. Others are navigating conservation within constraints outside of their control, such as the operations of the ditches which deliver water to farms. To paint a fuller picture of the complexities and nuances of agricultural water conservation in the West, the Alliance worked with the engineering firm Applegate Group to create a water balance for three of the case studies. These water balances utilize a technical, objective approach to assess the producers' water rights, current conservation efforts, and barriers or opportunities for future conservation. They underscore the reality that conservation practices are different on every operation and unique from farm to farm.

As the pressures of climate variability and drought increase, farmers and ranchers are at the forefront of our national adaptation strategy. Producers are coming together to help one another, but they also need support from consumers, policy makers, scientists, and service providers. The Alliance hopes that these case studies will provide policy makers and other stakeholders with a more nuanced understanding of the diversity and complexity of western agricultural water conservation and an appreciation of what continuing to take agricultural lands out of production might mean. A copy of the Alliance report is included as an attachment to this written testimony.

How the Federal Government Can Help

The Congress and the federal government certainly cannot change the hydrology of the West, but there is a role it can play to support family farmers and ranchers. Policy makers should understand the following observations and principles as they develop new solutions to the Western drought:

- State water laws, compacts and decrees must be the foundation for dealing with shortages.
- Water use and related beneficial use data must be accurately measured and portrayed.
- Benefits of water use must reflect all economic / societal / environmental impacts.
- Water conservation can help stretch water supplies, but has its limits in certain situations.
- Public sentiment supports water remaining with irrigated agriculture, and developing strategic water storage as insurance against shortages.
- Technologies for water reuse and recycling are proven effective in stretching existing supplies for urban, environmental and other uses.
- Urban growth expansion should be contingent upon sustainable water supplies; using irrigated agriculture as the "reservoir" of water for municipal growth is not sustainable in the long run.
- Planning for water shortage in the West must look to the long-term in meeting the goals of agriculture, energy, cities, and the environment.
- A successful water shortage strategy must include a "portfolio" of water supply enhancements and improvements, such as water reuse, recycling, conservation, water-sensitive land use planning, and water system improvements. New infrastructure and technologies can help stretch water for all uses.
- Temporary fallowing proposals should be approached in a thoughtful, thorough manner only after urban, energy and environmental users of water demonstrate a better management of their share of the finite supply.
- Unintended consequences associated with reducing productive agricultural land/groundwater recharge/riparian habitat benefits should be avoided and, if unavoidable, minimized and fully mitigated.

We offer the following specific actions that federal policy makers can address in new drought legislation:

Encourage accurate measurement and portrayal of water use and related beneficial use data.

As is often the case, what happens in California often has a ripple effect that extends to other Western states. For example, the common acceptance that "farmers use 80% of the water" is a mythical argument that is applied by critics of irrigation in areas throughout the West. We need to find clear and comparable ways to present these types of water use numbers as we struggle with finding the appropriate way to prioritize our water uses among competing demands. And, we need a solid understanding of how water used for environmental purposes is really benefitting the species or habitat it is intended to protect, and how to more efficiently manage such uses for maximum benefit using less water, the same standard to which irrigated agriculture is currently being held.

Find ways to streamlines regulatory hurdles assist in developing new environmentally-sensitive storage projects and other necessary infrastructure improvements.

There are several bills under consideration in the House of Representatives intended to facilitate the construction of new surface storage facilities. Congress should work to quickly pass all of these bills, given the brief window of opportunity the drought-related political attention has provided this year.

The President and Congress will prioritize whatever federal funds are available to meet existing and future needs. As for the rest of the capital, it must come either from state and local governments or from the private sector. If the federal government cannot fund the required investments, it should take meaningful steps to provide incentives for non-federal entities to fill the void, and remove barriers to the new ways of doing business that will be required.

The Alliance believes that the federal government needs to seriously consider adopting a policy of supporting new projects to enhance water supplies while encouraging state and local interests to take the lead in the planning and implementation of those projects. Local and state interests (see Sites JPA example, above) have shown enormous creativity in designing creative water development projects. Water agencies have at times obtained additional federal funding through the appropriations process; however, Reclamation could also supplement this effort by providing funding for local partnership agreements, especially where Reclamation and its water contractors are identified as potential beneficiaries.

Provide additional funding to support WaterSMART and/or other programs that provide incentive-driven cost share money for new water conservation projects.

Small federal investments in cost-shared, competitive grants help irrigation districts make larger investments in water conservation and management technologies that can help stretch water supplies to meet unmet needs. The Secure Water Act should be reauthorized to extend these grant programs into the future.

Sufficient funding should be provided to implement and expand the *"More Water, More Energy, Less Waste Act of 2007."*

This could lead to the treatment and beneficial use of excess produced water from oil and gas drilling and coal bed methane extraction. This law directs the Department of the Interior to evaluate the feasibility of recovering and cleaning produced water for further use in irrigation and for other purposes. The bill would also authorize a grant program to test produced water recovery technologies in Western states.

Improve ESA transparency and species recovery.

We know the ESA can play an important role in species protection, but it can only successfully do so with increased public input, stakeholder cooperation and new "outside-the-box" thinking on transparency and accountability. Unfortunately, the manner in which the ESA is being implemented in its current form discourages this sort of an approach. Private landowners should be viewed as potential partners in species recovery, not enemies. Incorporating the following four simple concepts into legislation or administrative directives would improve implementation of the ESA to recover and seek to remove species from the endangered list, and encourage public engagement and federal agency transparency and accountability:

- Require data used by federal agencies for ESA listing decisions to be made publicly available and accessible through the Internet. This would allow the American people to actually see what science and data are being used to make key listing decisions.
- Require the U.S. Fish and Wildlife Service and National Marine Fisheries Service to track, report to Congress, and make available online: 1) funds expended to respond to ESA lawsuits; 2) the number of employees dedicated to litigation; and 3) attorney's fees awarded in the course of ESA litigation and settlement agreements.
- Require the federal government to disclose to affected states all data used prior to any ESA listing decisions and require that the "best available scientific and commercial data" used by the federal government include data provided by affected states, tribes, and local governments.
- Prioritize resources toward species protection by placing reasonable caps on attorney's fees.

Surely constructive and thoughtful parties can all agree that a law addressing the needs of species in trouble is important. There is no reason why we should not be able to have an open and candid discussion about fixing the law to make it work as intended.

Require fish and wildlife agencies to inject some reality, set priorities and be accountable in their effort to manage the environmental share of the water pie.

In the Western U.S., environmental enhancement and mitigation programs are increasingly competing for existing sources of water. In some these instances, these actions have caused major conflicts, costly lawsuits and delayed benefits for endangered species and the environment. It's time that environmental interests, fish and wildlife agencies and water managers begin to inject some reality, set priorities and be accountable in their effort to manage the environmental share of this water pie. Legislative language that puts the burden of proof on the fisheries agency to conclusively demonstrate benefits to targeted imperiled fish species would be helpful. An institutional structure that ensures true peer review and impartial decision-making relative to this objective would also be useful.

Conclusion

Some California producers are starting to feel that their way of life is being written off by a segment of the public that appears to believe that the tragedy occurring in the Central Valley is a comeuppance that farmers somehow deserve. We still hold a sliver of hope that critical thinkers and leaders will easily distinguish this nonsense from reality.

California and the West need to manage water as if every year is a drought year. We need to invest in storage facilities to capture water in wet years, we need to look to innovative technology to enhance supplies and delivery and we need to get the very most benefit from the water we have available. The ability to measure, assess and show value for how that water is used is incumbent on every water manager -- environmental, urban and agricultural.

It will be hard work to reach an agreement and enact a legislation to wisely manage the West's water now and in the future, but that's the kind of work we elected you to do. Farmers work hard, and we expect Congress to do the same. We need you – all of you, urban and rural, Republican and Democrat – to come together and find a way to fix this broken system, now, before it breaks us all.

Only together can we in California and the West plan and prepare for our collective future. If we don't, we ensure only that the next drought will be worse than this one.

Thank you.

INNOVATIONS in AGRICULTURAL STEWARDSHIP

Stories of Conservation and Drought Resilience in the Arid West

A compilation of case studies from

NATIONAL YOUNG FARMERS COALITION

Family Farm ALLIANCE

The **National Young Farmers Coalition (NYFC)** represents, mobilizes, and engages young farmers to ensure their success. We are a national network of farmers, ranchers, and consumers who support practices and policies that will sustain young, independent, and prosperous farmers now and in the future. Visit youngfarmers.org or contact kate@youngfarmers.org for more information.

The **Family Farm Alliance (FFA)** is a powerful advocate for family farmers, ranchers, irrigation districts, and allied industries in seventeen Western states. The Alliance is focused on one mission: to ensure the availability of reliable, affordable irrigation water supplies to Western farmers and ranchers. Visit familyfarmalliance.org or contact dankeppen@charter.net for more information.

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Photo courtesy Singing Frogs Farm

LETTER TO THE READER

In the arid West we are entering a new normal. Drought and climate variability are colliding with population growth, spiking the demand for food and fresh water. Across the Colorado River Basin, a geography that supplies water to over 35 million people in seven U.S. states from Wyoming to California, and two states in Mexico, new efforts are underway to close the gap between supply and demand. While everyone is feeling the sting, farmers and ranchers are all too often caught in the middle.

The last 14 years have seen prolonged drought in the western U.S., but 2015 has set new historical records. California offers a prime example. Like most western states, California relies primarily on snowmelt for its drinking water, irrigation, and water for the environment. On April 1st of this year, the state's snowpack was a mere 5% of normal.[1]

The southern portion of the state relies on melt from the Colorado River system, which is experiencing far below average snowpack, as well. In an urgent response, Governor Jerry Brown ordered mandatory water cutbacks in towns and cities statewide. Meanwhile, many farmers are already receiving little to no surface water allocation due to the miniscule supply and regulatory constraints, even after many regions have invested billions of dollars in efficiency improvements.

This sense of urgency has spurred renewed efforts to find solutions across western states. However, too often agriculture is viewed as the default "reservoir" that other sectors can access to satisfy growing demands for water. A report released by the Bureau of Reclamation in 2012 identifies a 3.2 million acre-foot gap between water supply and demand in the Colorado River Basin by 2060.[2]

Suggestions to meet this gap indicate taking 6-15% of existing irrigated agriculture out of production. Such efforts are already underway: Thirsty cities continue to buy water from farmers at tough-to-beat prices while the almond unfairly bears the brunt of the latest round of negative PR targeting water-demanding crops. If we continue down this path we risk serious implications for our farmers, ranchers, and food supply.

Without a doubt, agriculture has a significant role to play in water conservation. But all too often discussions of what to do about water scarcity take place off the farm, without input from those who have a direct connection to our food supply and far away from the landscapes that will be most affected. In order to develop **smart policy, it is critical to understand the solutions farmers and ranchers—young and seasoned alike—are utilizing to build drought resilience, steward water, and grow good food for all of us.**

The National Young Farmers Coalition and the Family Farm Alliance have teamed up to elevate the voices of farmers and ranchers doing just this. Following are five case studies profiling producers across the Colorado River Basin and beyond who—with curiosity, creativity, and seasons of trial and error—are conserving resources while enhancing productivity. Some are integrating efficient irrigation technology with soil health to increase both productivity and water savings. Others are navigating conservation within constraints outside of their control, such as the operations of the ditches which deliver water to farms.

To paint a deeper picture of the complexities and nuances of agricultural water conservation in the West, we worked with the engineering firm Applegate Group to create a water balance for three of the case studies. These water balances utilize a technical, objective approach to assess the producers' water rights, current conservation efforts, and barriers or opportunities for future conservation. They underscore the reality that conservation practices are different on every operation and unique from farm to farm.

Of all the producers whose stories are told here, what binds them together is their ability to manage for the economic, ecological, and social health of their operations, communities, and environments. They represent a growing movement of agriculturalists who are stepping up to the plate—and have been for years, despite the lack of attention—to farm with "whole systems" in mind. These farmers see that healthy soil is integral to healthy crops; that efficiency is an investment in future food and water security; that ecological services contribute to the bottom line; and that farmers sharing knowledge with one another is critical to innovation and adaptation.

As the pressures of climate variability and drought increase, farmers and ranchers are at the forefront of our national adaptation strategy. Producers are coming together to help one another, but they also need support from consumers, policy makers, scientists, and service providers. Our hope is these case studies will provide policy makers and other stakeholders with a more nuanced understanding of the diversity and complexity of western agricultural water conservation and an appreciation of what continuing to take agricultural lands out of production might mean.

Now is the time to engage farmers and ranchers as allies in finding innovative solutions that support the health of our land, water, and Western communities.

Sincerely,

Kate Greenberg
National Young Farmers Coalition

Dan Keppen
Family Farm Alliance

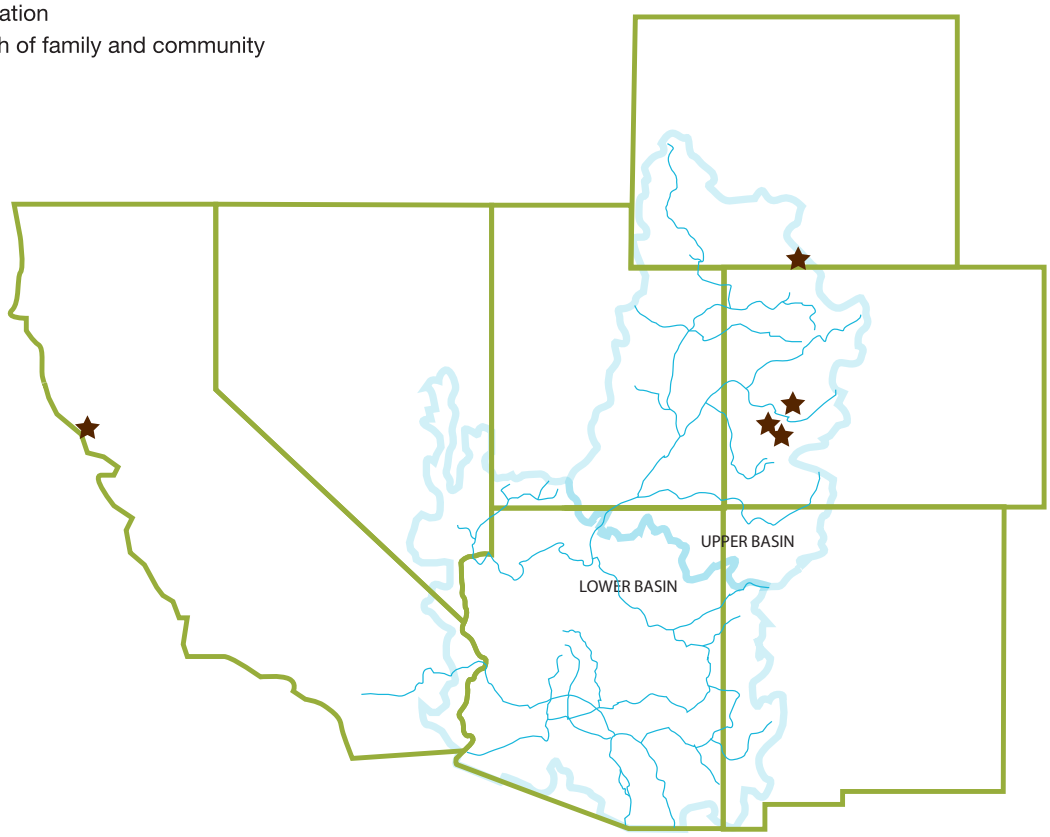
1 http://www.water.ca.gov/news/newsreleases/2015/040115snowsurvey.pdf

2 http://www.usbr.gov/lc/region/programs/crbstudy/FactSheet_June2013.pdf

EXECUTIVE SUMMARY

Through the process of researching and compiling the following stories, a number of common themes emerged. These themes point toward more conservation-oriented, resilient agriculture evolving in the arid West. These ideas are not new but have not yet been implemented at a scale equivalent to their potential. The solutions illuminated here must be amplified across all sectors invested in western water.

- **Farmers are investing in irrigation efficiency and conservation**
- **Efficiency improvements may be cost-prohibitive for some producers**
- **Many farmers and ranchers manage their water for multiple values including:**
  - food production
  - ecosystem services
  - biodiversity and wildlife habitat
  - recreation
  - health of family and community
- **Soil health is critical to drought resilience, productivity, and water conservation. This includes such methods as:**
  - cover cropping
  - rotational grazing
  - no-till
  - mulching
- **Soil health is an investment with long-term benefits; it connects producers across operation types, regions, and philosophy; it enhances other forms of water-use efficiency**
- **Farmers and ranchers are our first line of innovation for climate change adaptation and drought resilience**



The Colorado River Basin is a seven-state geography governed by complex interstate and international water law. The river travels some 1,450 miles from the Rocky Mountains to the Gulf of California. It supports over 35 million people; 15% of U.S. produce; and recreation, industry, wildlife, and the environment.

Pat & Sharon O'Toole

LADDER RANCH

A 135-year-old ranch built through holistic management

CONSERVATION AS FOUNDING PRINCIPLE

The Little Snake River Valley runs along the border between Colorado and Wyoming and helps form the headwaters of the Colorado River. This is a portion of the same water that eventually fills millions of taps in cities like Los Angeles and Phoenix. But first, it is stewarded on the Ladder Ranch, home to Pat and Sharon O'Toole, their children, and grandchildren.

The O'Tooles husband the same landscape that Sharon's great-grandparents settled on in 1881. Today, Ladder Ranch raises cattle, commercial sheep, horses, and working dogs. The O'Tooles have also created a ranch recreation business, which caters to fishermen, birders, hunters, and cyclers, as well as visitors interested in ranch life.

Sharon's family has long practiced what is known as holistic management—a way of integrating the whole farm or ranch, not just for economic health but for environmental and social benefits as well.[3] While Sharon grew up on the ranch, Pat is a first-generation rancher. From day one, he adopted the holistic management practices that for so long have been part of Sharon's family legacy. With their children taking on other elements of the business, the ethos of stewardship lives on.

To the O'Tooles, there is no inherent conflict between production and conservation. As Pat puts it, "We were always taught to keep one eye on the livestock and one eye on the landscape. One does not do well without the responsible management of the other. This is the resource ethic that we try to pass down through the generations."

WATER MANAGEMENT

Ladder Ranch, like many ranches in the interior West, relies on irrigation water derived from melting mountain snowpack. That water feeds a myriad of purposes. It grows hay and grass pasture, which supports the financial bottom line. It buffers soil against drought and fills creeks and streams. It supports trout fisheries and the anglers who seek them. It enhances biodiversity and provides water to wildlife that use Ladder Ranch as a migratory corridor. It draws in beneficial insects and pollinators and helps build a beautiful landscape. The O'Toole's holistic approach manages for all of these values simultaneously.

On 600 acres of irrigated land for hay and tens of thousands of additional acres of non-irrigated grazing land, the O'Tooles carefully monitor soil health. They plant

ABOVE: The O'Tooles have received many awards for conservation
TOP of PAGE: Ladder Ranch
Ladder Ranch photos courtesy Pat and Sharon O'Toole

Baling hay for the herd

cover crops on the farmland and utilize rotational grazing, which Sharon's father, George Salisbury, pioneered in the fifties. Rotational grazing imitates the movement of wild animals by rotating large herds of grazers—in this case sheep and cattle—on a carefully planned schedule. This allows the grasses ample time to regenerate while adding organic matter to the soil.

The irrigation practices the O'Tooles use vary depending on the nuances of the specific tract of land they are irrigating. Side-roll sprinklers irrigate about one-third of their pastures and flood irrigation waters the other two-thirds. While flood irrigation is considered less efficient, at the Ladder Ranch the "excess" water is essential to supporting waterfowl habitat. The water moves slowly across the land and eventually seeps back into rivers and streams to feed nine miles of trout fisheries and to provide irrigation for downstream users. In this specific case, increased irrigation efficiency could hinder other conservation values, a key example of the need for nuanced approaches to water management.

LEVERAGING PARTNERSHIPS

Another way the O'Tooles have conserved their lands' agricultural heritage is by partnering with land trusts to place a significant amount of acreage under conservation easement. Conservation easements are critical legal tools used to protect open space and working agricultural lands from development. The O'Toole's easement requires future owners to uphold the conservation values the family has agreed to, long into the future.

These decisions have made the O'Tooles leaders in collaborative conservation. Their partnerships include Trout Unlimited, Audubon Wyoming, and The Nature Conservancy—organizations some ranchers once viewed as adversaries. The O'Toole's recognize they share a common goal with many in the conservation community and have collaborated to protect threatened species, restore native habitat, and promote biodiversity.

A FAMILY ADAPTING TO A CHANGING CLIMATE

For the family, conservation is a pragmatic business choice that enhances their operation and ensures a productive landscape for future generations. With careful and specific management, the O'Tooles have watched their business and the landscape thrive together. In a changing climate—with a less reliable snowpack and thus a potentially less consistent water supply than in earlier years—they remain highly adaptable and responsive. Nothing is ever set in stone. As Pat puts it, "Our ranch is 135 years old, and we are still learning."

SNAPSHOT

Years owned by the same family: 135

Irrigated acres: 600

Commercial land use: cattle, sheep, working dogs, agritourism

Water management: Cover crops, rotational grazing, integrating ecosystem services

3 http://holisticmanagement.org/wp-content/uploads/2011/12/HolisticManagement-1-22.pdf

HOTCHKISS, CO

Cynthia and Ira Houseweart

PRINCESS BEEF

Raising grass-fed beef on the triple bottom line

RECORD OF RESILIENCE

Along the North Fork of the Gunnison River, a tributary of the Colorado River, orchards, ranches, and farm stands dot the landscape. This valley is home to rancher Cynthia Houseweart, who owns and operates Princess Beef, a grassfed beef operation she founded over 15 years ago with her husband, Ira. Like all farmers and ranchers in this arid region, Houseweart is constantly pushed to adapt her operation to an increasingly unpredictable water supply.

A historic drought in 2012 led many ranchers to cull their herds as they watched their pastures—and thus their winter feed—dry up. Yet Houseweart's pastures stayed alive, even after irrigation was turned off in August. Houseweart attributes this to how she manages her soil. As she recalls, "Down here on our place […] it stayed green. You couldn't really tell it was a drought. [The soil] holds the moisture so much better when the ground can soak it up." The unique way Houseweart manages her herd, her soil, and her water kept her afloat through one of the worst drought years on record. She is an example of how many innovative ranchers today think about their operations.

ROTATE RATHER THAN TILL

Houseweart's first tool for resilience is to keep the soil covered. She does this through rotational grazing and no-till pasture management. Traditional ranching involves moving cattle infrequently, leaving them out in open pastures to graze for extended periods of time. This often leads to over-grazing, which, in turn, compacts soil or makes it prone to erosion, heightens rates of evaporation, and prevents the soil from soaking up precious moisture.

Rotational grazing, on the other hand, is the practice of moving the herd frequently to allow previously grazed pastures to regenerate. Houseweart rotates her cattle every two to three days. This brings some short-term disturbance to the soil, but by resting each pasture for much longer than it was grazed, Houseweart builds up organic matter and naturally fertilizes her land through the cattle's urine and manure. This also helps restore the carbon and water cycles on her ranch.

In addition, Houseweart has not tilled her pastures in the nearly two decades she has managed them. Underneath the soil surface a complex ecosystem of life delivers water and nutrients to the plants. Tillage would disrupt and damage that ecosystem and the soil structure.

ABOVE: Cynthia Houseweart and her herding companion
TOP of PAGE: Cattle graze on healthy forage
Princess Beef photos courtesy Cynthia Houseweart

The Houseweart family on their centennial ranch

Houseweart has found that by not tilling her pastures, her forage grows more vigorously throughout the year and is supported by this subsurface ecosystem. She has also reduced fuel costs by not running a tractor over her pasture. These practices build soil structure and sequester carbon, which allows the soil to work as a sponge to hold water in place for when it's most needed. This means that even in extremely dry years, or when surface water is tenuous, Houseweart has a buffer against drought.

Houseweart's ranch is also unique in the efficiency of its irrigation technology. Instead of flood irrigating her pastures, as is common, Houseweart has invested in a center pivot sprinkler, which is typically around 80% efficient versus 65% efficiency for flood.
But Houseweart has taken her efficiency to the next level by integrating this technology with stewardship practices. She rotates her cattle behind the sprinkler, which both increases the fertility of her pasture and reduces the amount of cutting and baling hay she needs to do.

THE TRIPLE BOTTOM LINE

From the get-go, Houseweart has managed for the whole health of her ranch and family. The decisions she makes for economic reasons must also be ecologically viable while supporting the well-being of each individual on the ranch, her family, and the community. This way of managing is possible on any operation at any scale.

But it is not Houseweart alone who drives this. She collaborates with a broad host of partners, from her local Natural Resources Conservation Service (NRCS) agent to a strong local growers' network. The Housewearts rely not only on a supportive community but on their willingness to adapt and try new things to meet modern challenges. As snowpack and irrigation supplies become more variable, and aridity continues to be a growing pressure, producers like the Housewearts point to a viable way ahead.

SNAPSHOT

Years owned by the same family: 100

Irrigated acres: 100

Commercial land use: Grass-fed beef

Water management: Rotational grazing, no-till, center pivot irrigation

4 http://www.cprl.ars.usda.gov/pdfs/Howell-Irrig%20Efficiency-Ency%20Water%20Sci.pdf P. 468

HOTCHKISS, CO

Steve Ela

ELA FAMILY FARM

A highly efficient, 80-acre, organic orchard building soil for the future

WATER ONLY WHERE IT'S NEEDED

High up on a south-facing hillside overlooking the North Fork Valley in north-central Colorado, orchardist Steve Ela grows 80 acres of organic tree fruits. In the peak of summer, Ela Family Farm is a locus of bounty: apples, peaches, pears, plums, and cherries hang heavy from the trees, tempting passersby with their undeniable sweetness. But the bounty doesn't grow itself: In as hot and dry a region as this, averaging less than 15 inches of precipitation a year, water is a top limiting factor to success. In his decades of farming, Ela has learned a thing or two about water.

When Ela's family bought the orchard in 1987 it was furrow irrigated. This form of irrigation, which remains a standard practice for many orchards to this day, lets water flow by gravity from a ditch or stream through furrows running through the crop. Based on the specific needs of his orchard, Ela felt he could improve the growing environment for his trees—and thus his productivity—by becoming more efficient.

Upgrading the orchards' irrigation system was Ela's first priority. He worked with his local Natural Resource Conservation Service (NRCS) agent to design and install a permanent drip irrigation system, an array of flexible plastic tubing with small emitters that release water directly where and when it's needed. The cost of this upgrade was significant, running nearly $2,500 per acre. The upgrade required care during installation to avoid damaging the tree roots as well as additional maintenance. But the increased efficiency has allowed for more effective watering, so the trees are irrigated consistently and with only the amount of water they need.

MANY SOURCES OF IRRIGATION

One of the primary challenges when it comes to irrigation water for farmers in the valley is late-season irrigation water. Surface water there is stored in a series of reservoirs and released into a network of ditches throughout the growing season. When the reservoirs are empty, the ditches are shut off. The amount of water in the reservoirs is primarily determined by that years' snowpack and subsequent spring melt.

Snowpack in recent years has been well below average. To mitigate this, Ela uses a few techniques. First, the farm owns and utilizes a broad array of water rights from multiple sources. These include Leroux Creek, the Highline Ditch, and numerous small reservoirs. Not only does this offer Ela options throughout the growing season, many of these rights are senior rights. That means that in the event of a "call," or when water supplies are too low for every user to get their full share, senior rights take priority. These rules are based on western water law that is over a century old. When Ela is unable to pull from the ditches, he can then tap the reservoir supply.

ABOVE: Ela admires his orchard
TOP of PAGE: Spring blossoms mark the start of the growing season
Ela Family Farm photos courtesy Steve Ela

A view of the North Fork Valley from Ela Family Farm

But relying on this system of water allocation isn't Ela's only approach. Nor is being as efficient as possible with his irrigation technology. Ela takes it yet a step further: into the soil.

HEALTHY SOIL GROWS HEALTHY FRUIT

Step into Ela's office and you will find binders full of farm records tracking the soil fertility of his orchard. Before becoming a full-time farmer, Ela received his Masters degree in soil science from the University of Minnesota. With the desire to someday return to his family's land, he knew that growing healthy soil would be essential to fostering a thriving business.

On his orchard, Ela curates what he calls a "soil smorgasbord," meaning he manages for overall soil health so the ecology of his orchard can provide the crops with what they need at a given time. A key part of this "smorgasbord" is a permanent cover crop mix, which holds water in the soil, provides nutrients, and produces a healthier fruit crop. The mix, which includes species such as alfalfa and white clover, provides the orchard with 50% of its nitrogen needs and the majority of its mineral needs. This greatly reduces the need to apply organic fertilizers and also reduces the associated cost. Ela mows the cover crop three to four times a year, which has built his soil organic matter (SOM) to 3-4%, an impressive percentage for a region where average SOM is 2% or less. These healthier soils wick up moisture and maintain cooler temperatures in the orchard throughout the hot summer months. The less water the trees expend under heat stress, the less water needs to be applied to keep them thriving. And the more water they can keep in the soil to grow larger, sweeter fruit.

DOLLARS AND "SENSE" OF CONSERVATION

Economics may best explain the value for these improvements. When the orchard was purchased in 1988, gross revenue was about $200,000. Now, 27 years later, the orchard's gross revenue is $1.1 million, a 450% increase using the same amount of water and acreage. By integrating modern irrigation technology, soil health practices and a tenacious marketing sense, Ela has watched his productivity climb and his operation withstand the tests of time. Water efficiency and conservation have proven smart business risks that turned into real returns. For Ela, managing his orchard for long-term ecological health and economic viability just makes sense.

SNAPSHOT

Years owned by the same family: 27

Irrigated acres: 80

Commercial land use: Organic apples, peaches, pears, plums, and cherries

Water management: Drip irrigation, microsprinklers, cover crops

PAONIA, CO

Harrison Topp

TOPP FRUIT

Beginning farmer brings an octogenarian orchard back to life

LEARNING TO FARM

In the fertile North Fork Valley outside of Paonia, Colorado, Harrison Topp prepares for his second season growing organic cherries and plums. The orchard, which Topp's parents purchased in 2007, has been in production for over eighty years. His family previously leased the orchard to a larger farm in the valley, but due to the age and condition of the trees, the operators decided to end the lease. In 2014, the responsibility of bringing the orchard back into working order fell to Topp.

At a spry 28 years old, Topp first began farming six years ago on small-scale vegetable operations, first as an apprentice and then as manager. It wasn't until last year that Topp took the leap from annual vegetable production to perennial fruit and became the primary operator of his new business, Topp Fruit. When asked what drew him to farming, Topp notes a desire for the lifestyle and a good dose of stubbornness. Now he is figuring out the day-to-day work of growing food in a region with just 15 inches of average annual precipitation.

WATER MANAGEMENT

As Topp experiments with the arts of pruning, cover cropping, harvesting, and caring for the daily needs of his orchard, he is also learning the intricacies of irrigation. Topp has a single source of irrigation water: surface water from the Fire Mountain Canal. The canal runs just upslope of the orchard and carries water to many producers throughout the valley. In Colorado, as in many western states, this is the original irrigation structure: Canals, also known as "ditches," supply users water that has often been captured and stored in reservoirs. Many ditches in Colorado are earthen—the same canals hand-carved through the landscape by homesteaders or, in some places, by native farmers millennia ago. The Fire Mountain canal is concrete lined, while others in the area have been piped to save water.

The way the Fire Mountain Canal is operated determines to a great extent the choices Topp can make with his irrigation practices. Some ditch systems deliver water to users throughout the season according to their rights and needs. The Fire Mountain Canal, however, runs on what is called a constant flow: when water flows through the canal, Topp and the other water users must use it before it flows downstream. However, neither Topp nor any individual producer alone can determine canal or ditch operations as the ditch is operated by the Fire Mountain Canal and Reservoir Company whose members include shareholders along the ditch. When water is released from Fire Mountain Canal, Topp receives the entire amount diverted at this point for four-and-a-half days straight on an ongoing cycle until the water is turned off. There

ABOVE: Topp takes a break for a photo shoot
TOP of PAGE: Gated pipe irrigates Topp's orchard
Topp Fruit photos by Kate Greenberg

Topp and fellow farmer Elizabeth Woods Darby mark irrigation furrows

is no benefit to him as a producer—and in fact some disincentives—to use less than his full allocation.

RESILIENCE IN HEALTHY SOIL

Topp uses furrow irrigation, or shallow channels that run alongside the trees. This type of flood irrigation is often considered less efficient than such technologies as sprinklers or drip irrigation. But for Topp, installing more efficient irrigation comes with a steep price tag, one he might be willing to consider if it did not also pose a risk to the health of his orchard.

Some years, particularly in drought years, the Fire Mountain Canal can be turned off as early as July. This is often due to scant snowpack producing below-average runoff. Summer rains can help but are not reliable. This means Topp risks losing late-season irrigation, which is critical to fruit ripening. Topp relies on furrow irrigation to store water in the soil. As water flows through the furrows, some of it is used by the trees, some returns to the river, and some is stored in the soil. Topp is essentially using his irrigation technology to do what the larger irrigation infrastructure prohibits him from doing: storing water on-farm for late-season irrigation. His management also supports multiple values, including building healthy soil, enhancing river flows, and growing delicious fruit. While water conservation and efficiency are critical to the future of the West, Topp offers an example of why their nuances must be sufficiently understood.

The limits on Topp's irrigation infrastructure have urged him to build the health of his soil. This year he is planting multiple mixes of cover crops—an amalgamation of crop types that bring nutrients and organic matter to the orchard. The healthier the soil, the more water it can store. And the more water Topp can store in his soil, the less he risks losing his crop in a drought year due to lack of surface water. (See the Appendix for an in-depth discussion on options for supplementing irrigation supplies).

YOUNG FARMERS OF THE FUTURE

Conservation means many things to farmers and ranchers. Soil conservation is critical to Topp's ability to conserve water, while his operation is also driven by the constraints of his irrigation infrastructure, the cost of efficiency improvements, and the particular operations of his ditch. Yet Topp is perpetually questioning how to do things better. He looks to his neighbors who, as one-time beginning farmers, have navigated decades of their own challenges. Topp says there have been few things more valuable than the mentorship of fellow farmers.

When asked where he sees himself in forty years, Topp replies, "I'd like to say I'm still farming [….] If I do continue, I'd like to expand to a scale that gives me more flexibility so I can grow fruit for a greater portion of the population." It will take a reliable water supply for Topp to realize that future. There is no easy answer. But one thing is clear: We need more young farmers like Topp on the land, learning from their predecessors, forging innovative routes to conservation, and adapting to the variables of a changing climate.

SNAPSHOT

Years owned by the same family: 8

Years operated by Topp: 2

Irrigated acres: 4.4

Commercial land use: Organic cherries and plums

Water management: Cover cropping, soil moisture management, furrow irrigation

Paul and Elizabeth Kaiser

SINGING FROGS FARM

A small-scale, organic, no-till vegetable operation

GROWTH IN DROUGHT

Take a tour of Singing Frogs Farm and you will see crop rows packed with purple kale, butterhead lettuce, and heirloom tomatoes—over one hundred vegetable varieties in total. In this cool, low valley just outside of Sebastopol, California, farmers Paul and Elizabeth Kaiser are surprising their neighbors. In the midst of California's driest year on record, the Kaisers are increasing revenue on their two-and-a-half acres of cultivated bottomland while drastically reducing water consumption, an unlikely combination when the drought is driving farms elsewhere out of business.

Even in a historically unprecedented dry year, and in a region with an average of 30 inches of annual precipitation, the Kaisers are not daunted by the drought. Instead, they take it as a challenge to build drought resilience on their farm, where the precious groundwater they use to irrigate is just as tenuous as surface flows elsewhere. Whether through no-till, composting, or an intensive greenhouse schedule, the Kaiser's resilience always comes back to the health of their soil.

THE PATH TO NO-TILL

Like many young farmers today, the Kaisers did not grow up on a farm. In 2004, ready to raise a family and try out the ideas they experimented with while working on land restoration in The Gambia, West Africa, they purchased eight acres in Sonoma County. This land was not exceptional. The light, tan soil had only 2.4% soil organic matter (SOM) when the Kaisers bought the property, relatively low for the area. Only a couple of the acres were arable. Cold air funnels in from the surrounding vineyards, driving temperatures below freezing in the winter and bringing frost dates as early as September and as late as May.

The Kaisers started out tilling the soil, as is still the norm on most operations big and small. Soon they realized tillage, the process of breaking up the soil for cultivation, was disturbing critical life processes taking place underground. Now with no-till, Paul and Elizabeth are building their soil structure. This means they are able to capture more water—not to mention beneficial carbon and nitrogen—and store it in the soil where it supports the soil biome and the next crop.

The Kaisers also use an intensive greenhouse schedule to rotate crop successions and keep the soil covered at all times. The beds are not bare for more than a few

ABOVE: Farm employee Marty harvests a head of lettuce
TOP of PAGE: Singing Frogs Farm produces over 100 varieties of vegetables
Singing Frogs Farm photos courtesy Paul Kaiser

Most of the Singing Frogs Farm Crew: L to R (back row) Miguel, Elizabeth, Paul, John, Marty & Kim. L to R (front row) Anna, Lucas, Nina and Bryanna

hours at a time, which greatly reduces water loss to evaporation. Paul and Elizabeth are able to achieve this with transplants grown in their greenhouse and ready to plant-out immediately following harvest. They also apply a massive amount of compost, which they top-dress to the beds rather than tilling in. They plant directly into the compost, which retains moisture, builds organic matter, and delivers nutrients to the crop.

MORE ORGANIC MATTER, LESS IRRIGATION

Now, after eight years of no-till production, composting, and keeping the ground covered, the Kaisers have measured their soil organic matter at a twelve-inch depth at 6.5% and at a six-inch depth an astounding 9.5%. That's an increase of over four-fold from when the couple turned over their first row on this land. With every percent increase in SOM, the soil can hold upwards of twenty thousand gallons of water per acre, with some sources citing that number up to twenty seven thousand gallons[5] So when the rains come, as they have been and are predicted to continue in more intense events, Kaiser's soil not only captures and retains that moisture, but also evades damaging erosion. After a recent eleven-inch downpour, the Kaiser's fields remained intact.

The Kaisers's soil water savings is showing up as savings in their irrigation, too. The Kaisers use precision drip irrigation across the farm. Two slender tubes run the length of each thirty-inch wide bed, dripping water precisely where it's needed. This system irrigates at around 90% efficiency, meaning that 90% of the water diverted to the farm is used by the crop, rather than lost to evaporation, runoff, or deep percolation, an extremely high level of efficiency for any farm.

The Kaiser's attribute the efficiency of their farm to a combination of healthy soil, efficient irrigation technology, and refined management practices. Paul explains, "When we started farming here […] I was typically running the irrigation system two to three hours every-other day. And that was pretty standard. Now I am down to 45 minutes to an hour every five to seven days." The Kaisers grow the same crops now as they did then.

Not only are the Kaisers saving water, they're making more money doing it. Their high-intensity production pumps out over seven times the average volume of similar farms in California, pulling in around $100,000 an acre in sales and supporting four full-time staff.

A COMMITMENT TO INNOVATION

The improvements at Singing Frogs Farm didn't happen overnight. The Kaisers have put in seasons of trial and error integrating biology, ecology, and human stewardship to realize a profitable, productive, and conservation-oriented operation. They have invested in efficient irrigation and continue to refine their water management. Rather than finding productivity and drought resilience at the expense of healthy soil and an intact ecosystem, the farm is thriving precisely because they foster both.

SNAPSHOT

Years owned by the same family: 11

Acres owned/managed: 8

Irrigated acres: 2.5

Commercial land use: Diversified vegetable operation

Water management: No-till, composting, constant soil cover, drip irrigation

5 http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1082147.pdf

6 https://scripps.ucsd.edu/news/8155

GLOSSARY

WATER MANAGEMENT

Acre-foot: Amount of water that will cover an acre of land at a depth of one foot, or 325,851 gallons of water[1]

Center pivot: A type of automated sprinkler irrigation that rotates around a fixed point

Ditch: A channel constructed to deliver water for irrigation (see also "canal")[2]

Efficiency: Quantity of water consumed by crops versus the amount of water delivered[3]

Flood irrigation: Water diverted from ditches and spread across the field or pasture[4]

Furrow irrigation: A type of flood irrigation that applies water into shallow, evenly spaced channels that convey water through a field to the crops[5]

Irrigation canal: A channel constructed to deliver water for irrigation (see also "ditch")[6]

Micro sprinklers: Small sprinklers that deliver water just above the soil surface[7]

Reservoir: An artificial lake built to store water

Side roll: A type of automated sprinkler irrigation that moves in a line across a field

Sprinkler Irrigation: A form of irrigation typically higher in efficiency than flood; includes such technology as side rolls and center pivots[8]

Surface drip irrigation: Pipes or hoses that deliver water directly to the soil surface through small emitters[9]

Subsurface drip irrigation: Pipes or hoses that deliver water below the soil surface through small emitters[10]

SOIL HEALTH

Conservation tillage: Any tillage system in which at least 30% of the previous crops' residue is left in the field to protect the soil

Cover crops: Non-cash crops that can provide multiple benefits including erosion prevention, nutrient availability, weed suppression, and water availability[11]

Holistic management: A whole farm planning system that helps farmers, ranchers and other land stewards better manage resources for environmental, economic, and social benefits[12]

No-till: Process of crop production that does not disturb the soil through tillage

Rotational grazing: Rotating livestock frequently throughout many small pastures to allow for pastures to regenerate[13]

Soil food web: Diverse soil community that includes bacteria, fungi, protozoa, nematodes, worms, insects, and more that work in tandem to create healthy soil

Soil health: The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals and humans[14]

Soil organic matter (SOM): The part of the soil that contains anything that once lived. It aids in crop growth, reduces erosion, retains nutrients, stores water, and sequesters carbon, among other benefits[15]

SOM: Short for "soil organic matter"

Tillage: Preparation of the soil for cultivation

WATER LAW

Beneficial use: The lawful use of water for a beneficial purpose which includes agricultural, industrial, and household use and may include environmental use

Call: In times of shortage senior water rights holders may "call" for water, thus curtailing deliveries to undecreed or junior water users in order to fulfill the beneficial use need of the decreed senior use right[16]

Consumptive use: Water use that permanently withdraws water from its source; water that is no longer available because it has evaporated, been transpired by plants, incorporated into products or crops, consumed by people or livestock, or otherwise removed from the immediate water environment[17]

Diversion: Removing water from its natural course or location, or controlling water in its natural course or location, by means of a water structure such as a ditch, pipeline, pump, reservoir, or well[18]

Return flow: Water that returns to streams, rivers or aquifers after it has been applied to a beneficial use[19]

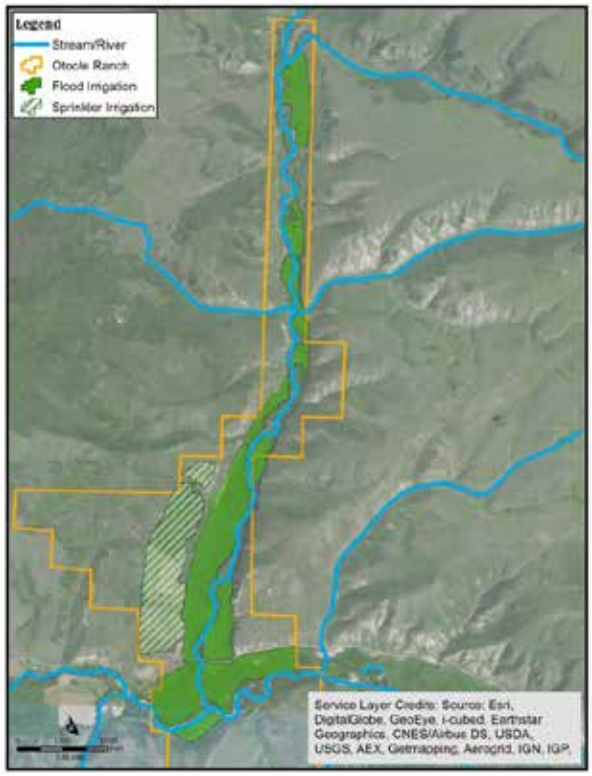
Water right: Considered a property right; the right to use a portion of the public's surface or groundwater resource under applicable legal procedures[20]

Definitions #1, 3, 4, 7-10, 16-20 courtesy of Colorado Foundation for Water Education (CFWE) from their publications *Citizen's Guide to Colorado Water Conservation* and *Citizen's Guide to Colorado Water Law*. Visit yourwatercolorado.org
Definitions #5, 11, 13-15 courtesy of the Natural Resources Conservation Service (NRCS), visit nrcs.usda.gov; #2 and #6 courtesy of the Bureau of Reclamation (BOR), visit usbr.gov; #12 courtesy of Holistic Management International, visit holisticmanagement.org

APPENDIX I: LADDER RANCH WATER BALANCE

Background

Ladder Ranch is located at the confluence of Battle Creek and the Little Snake River and straddles the Colorado-Wyoming border. The ranch draws water from Battle Creek and the Little Snake at multiple points for the irrigation of over 600 acres of hay pasture. Approximately 400 acres of flood irrigated pastures lie within a quarter mile of the two streams. Pressurized side roll sprinklers are used to irrigate approximately 175 acres on higher ground on the west side of Battle Creek.

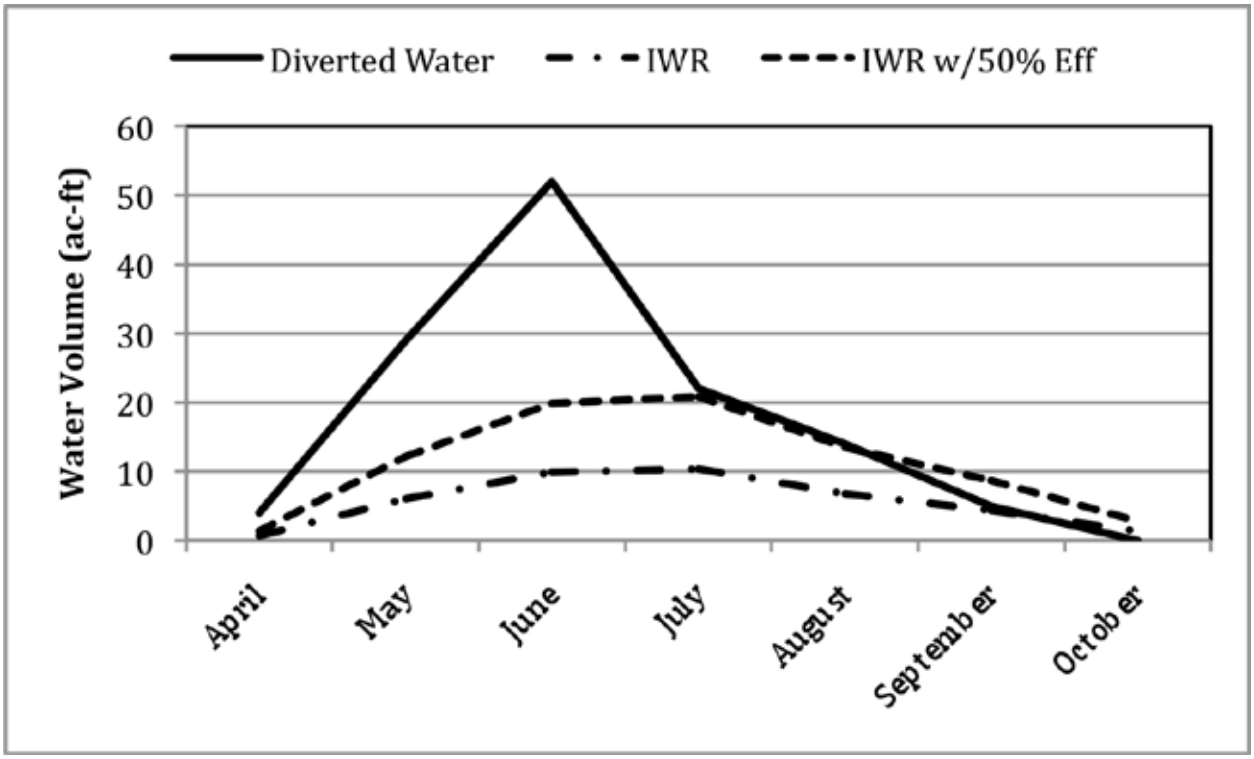


Water Rights

There is no irrigation and very little water use located above the ranch on Battle Creek, while there are approximately 2,200 acres of irrigated land above the ranch on the Little Snake. There is very little reservoir storage in the basin, which results in high peak flows that quickly taper off once the snowmelt is over. The ranch holds very senior water rights in Wyoming and Colorado, and these rights have never been called out or subject to administration during historical calls on the Little Snake in 2002 and 2004. Pat O'Toole stated that the ranch does reduce their irrigation diversions during low flow periods in order to leave sufficient water in both streams to maintain the fisheries there.

According to a recent study by CDM entitled "Agricultural Water Needs Study," hay pasture in this area requires approximately 2.28 acre-feet of supplemental irrigation water per acre to adequately meet the annual crop water demand. This means that crops on the ranch consume approximately 1,350 acre-feet of water annually (one acre-foot can cover a football field with one foot of water). Supplying a maximum crop demand of approximately 0.30 inches per day would require a total peak diversion flowrate of 15 cubic feet per second (cfs) assuming a system efficiency of 50 percent. Some diversion records are available from the Colorado Water Conservation Board for water rights filed with the state. One water right with fairly complete records is the Porter Salisbury Pump 1 & 2. The diversion records are compared to the irrigation water requirement (IWR) for this right in the figure on the next page.

LADDER RANCH WATER BALANCE, CONTINUED



This figure confirms comments by Pat O'Toole that when excess water is available, it is diverted, but once runoff tapers off, diversions are reduced to better match needs.

Irrigation Practices

The potential conversion of additional lands to sprinkler irrigation has helped many farmers and ranchers better manage their limited water supply. The impacts, however, of making such a change has both pros and cons that must be evaluated on a case by case basis. As mentioned previously, most of the irrigated lands on this ranch are located close to the creek. When excess water is applied in the spring, some of it would quickly return to the stream via surface return flows and be available by the next diverter downstream. In many cases, on this ranch the water is diverted from the stream and return flows accrue to the stream all within the ranch property, which implies that the only potential beneficiary of reduced diversions would be the stream in between. Some water would also penetrate below the root zone of the crops and travel through the soil back to the creek. This practice would tend to build up the amount of water stored in the soil and delay its release back to the stream system, thereby acting as an uncontrolled reservoir.

Future Water Conservation Measures

The "Agricultural Water Needs Study" mentioned earlier estimated that 72 percent of return flows in this area return to the stream within the same month that they are diverted, while most of the remainder returns over the following 4 months. This implies that most of the excess water diverted in May and June would return during those months; however, stream flows would continue to benefit from this return water through October. Based on our analysis of available data it appears that the current practices on the ranch are reasonable. While converting more areas to sprinklers would reduce the amount of flow diverted during the runoff season, it could negatively impact stream flows during the late summer and fall periods. Additional data would need to be collected to better predict the potential impacts of any large scale irrigation changes on the ranch.

Water balance researched and written by Applegate Group

APPENDIX II: ELA FAMILY FARM WATER BALANCE

Background

The Ela Family Farm is located on the upper portion of Rogers Mesa at an elevation of 5,850 feet near Hotchkiss, Colorado. The farm primarily grows a variety of fruits including apples, pears, cherries, peaches, and plums. The growing season extends from a blooming of the trees in mid-April to mid-May and concludes with harvest primarily in late August and September. The climate in this area is semi-arid with rainfall only contributing a small percentage of the annual crop water requirements. Crop production is heavily reliant on irrigation water. The soils consist of up to 20-24 inches of stony clay loam with an organic content of 3-4 percent.

Water Rights

The farm owns a wide variety of water rights that are used on the property, all of which are delivered through a combined ditch system off of Leroux Creek. Direct flow decrees include shares in the Allen Mesa, Highline, and Ellington Ditches, which have been physically combined into one ditch system. Their most senior decree includes 0.5 cubic feet per second out of Leroux Creek, which is typically in priority until August. After all the direct flow decrees are out of priority, the farm utilizes 250 shares it owns in the Leroux Creek Water Users Association, which operates numerous small reservoirs in the Leroux Creek Drainage.

The amount of water available from these shares varies depending on the snowpack. On average years, these shares will net about 190 acre-feet of water, but the volume can range from 100 acre-feet in dry years up to 225 acre-feet in wet years (one acre-foot can cover a football field in one foot of water). In order to have a firm water supply during dry years, Ela leases an adjoining parcel of land to the south and fallows the majority of that land in order to focus the water supply on the orchards. Ela also owns 200 shares in the Fire Mountain Canal, which equates to approximately 0.13 cubic feet per second (cfs). However, that water is leased to other users and is not used on Ela's property.

Irrigation Practices

Information regarding the property and associated irrigation practices were obtained from a meeting with Steve Ela on January 8, 2015. The property was originally purchased by the Ela family in 1987. At that time the entire orchard was irrigated with flood irrigation in furrows between the rows of trees. The family immediately started installing the backbone of infrastructure that would be required to convert over to micro-sprinklers in 1989. This included an NRCS Yak screen, main pipeline, and filtration system. Water would pass through the yak screen at the pipeline entrance and pressurize using the gravity fall from that point to the filter location. Pressures in the northeast corner of the property were not sufficient, so a 2 horsepower pump was added to increase the pressure there. Overflow from the Yak screen is conveyed to the alfalfa pastures for irrigation there. No flow measurement device is in place to determine the amount of overflow water, but according to Ela, during dry years there is very little overflow once spring runoff is over.

The first micro sprinklers were installed in 1990 and all orchards on the property were converted by 2000. Around 2002, the Ela family started to install buried drip lines in some orchards. After experimenting with multiple arrangements they determined that three drip lines per tree row is most effective. The drip lines contain pressure compensating drippers spaced 2 feet apart with flowrates of 0.25 gallons per hour. Once buried, the drip lines have assisted with controlling the ground cover near the tree trunks since that area is drier than between the rows where the cover crop can be managed easier. The drip system currently covers approximately 30 acres of the farm in 1-acre zones with the rest remaining on micro sprinklers. One distinct advantage to the drip system is that it is set up so that the user can adjust the application rate by simply entering the percentage of a full irrigation that is required. This makes seasonal adjustments much simpler than the micro sprinklers.

Installing the drip system necessitated increased water filtration in order to avoid plugging the drippers. After experimenting with numerous filtration options, the farm determined that sand media filters were the most effective. There are currently six of these filters in the system, and they are automatically backwashed as necessary. The frequency of backwash cycles depends greatly on the time of year.

Irrigation Demand vs. Supply

Aerial photography obtained from the National Aerial Imagery Program (NAIP) was used to determine the number of irrigated acres. The farm has 83.3 acres of orchards on the sprinkler and drip system and 6.4 acres of alfalfa/hay that are currently irrigated. Another 5.4 acres of potential orchard exists between older remaining rows of some crops. Evapotranspiration (ET) data was obtained from Colorado Agricultural Meteorological Network (CoAgMet) from their nearby station on Rogers Mesa. The

ELA FAMILY FARM WATER BALANCE, CONTINUED

station is located about 1 mile to the south and about 200 feet lower in elevation. The ET data is for a reference crop of alfalfa, which can be converted to other crops such as orchards by applying a crop coefficient to the data.

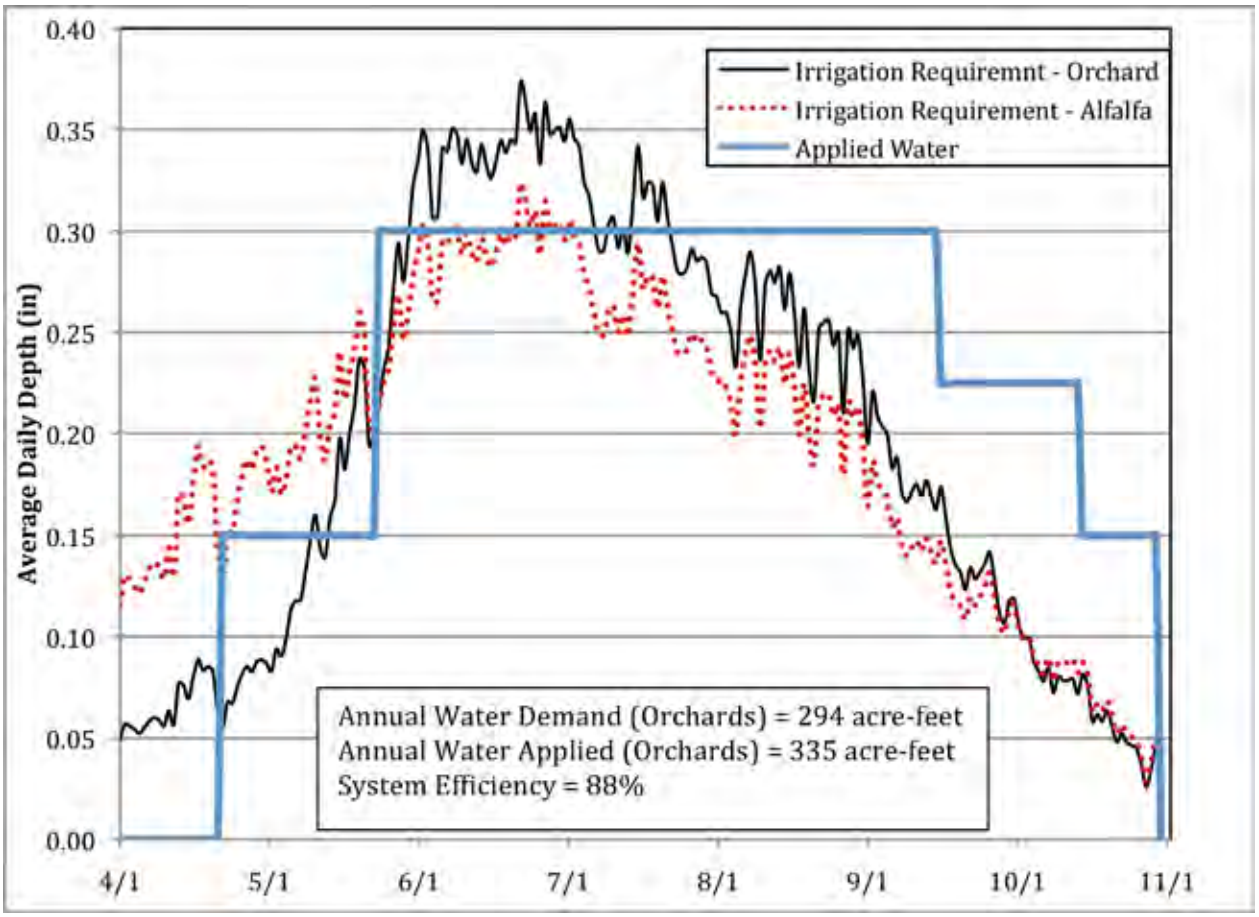
The Food and Agricultural Organization (FAO) published crop coefficients for a wide range of crops including orchards. These values were used to estimate the ET demand for the crops. Average precipitation data was also obtained from CoAgMet and to the ET demand at an 80% efficiency rate in order to calculate the Irrigation Requirement (IR) for the orchards. The amount of irrigation water supplied to the orchards was calculated by applying the dripper/micro sprinkler spacing and flowrate to the average irrigation schedule described by Ela. The figure below depicts a comparison between the irrigation supply and demand for an average year.

This analysis shows that the orchard irrigation system is achieving an efficiency of approximately 88%, which is very close to accepted values of 90% for drip systems and 80-90% for micro sprinklers.

Future Water Conservation Measures

There does not appear to be a significant amount of additional water that could be saved by increasing water conservation practices on the orchard portion of the farm. Converting more land to drip would allow the system to be managed so that the supply can even more closely follow the demand, but this will not likely result in a significant amount of conserved water. Rather it would allow the user to easily adjust the system to better match daily demand and maintain more consistent soil moisture. Backwash water could be used if a larger settling pond was provided to store backwash sediment and water, but another pump would be required to inject this water back into the system. This would also increase the complexity of operations while not resulting in a significant amount of water savings. Ela's willingness to experiment with various technologies and his efforts to continuously improve the system have resulted in a very efficient system overall.

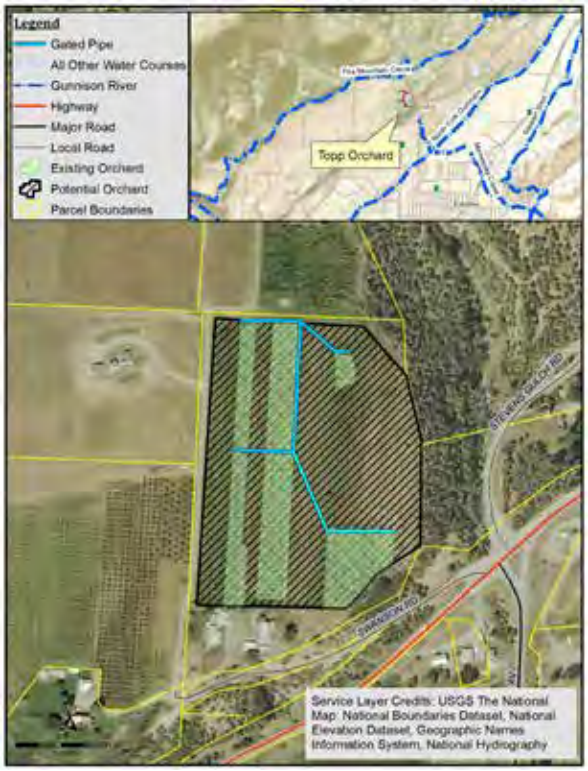
Water balance researched and written by Applegate Group



APPENDIX III: TOPP FRUIT WATER BALANCE

Background

The orchard owned by Harrison Topp is located on the upper portion of Rogers Mesa at an elevation of 5,850 feet near Paonia Colorado. The orchard has not been intensively managed in the past and only 14 acres of the site remains planted. The growing season extends from a blooming of the trees in mid-April to mid-May and concludes with harvest, primarily in late August and September. The climate in this area is semi-arid with rainfall only contributing a small percentage of the annual crop water requirements. Thus crop production is heavily reliant on irrigation water. The soils consist of up to 20-24 inches of stony clay loam.



Water Rights

The orchard owns 480 shares of water in the Fire Mountain canal, which is the only irrigation water supply on the property. These shares equate to 0.33 cubic feet per second (cfs) of water according to the Fire Mountain Ditch Company. Water is diverted from the Fire Mountain Canal in conjunction with the neighbors' shares on the north side of the property. The entire amount diverted at this point is routed to the Topp Orchard 4.5 days per week, while the northern neighbor takes the water the remaining 2.5 days a week.

The Fire Mountain Canal has a relatively junior water right on the North Fork of the Gunnison River, and it is called out every summer. When direct flows are not available, water is released from Paonia Reservoir in order to achieve a full decreed flow of approximately 175 cubic feet per second (cfs). The canal typically turns on around mid to late April and runs at a full canal flow until the reservoir is drained. After the reservoir is drained the canal typically has to shut down for the season. The average shutdown date is September 24th; however it varies greatly from late July to late October. The figure on the next page shows the frequency of start and stop dates for the canal.

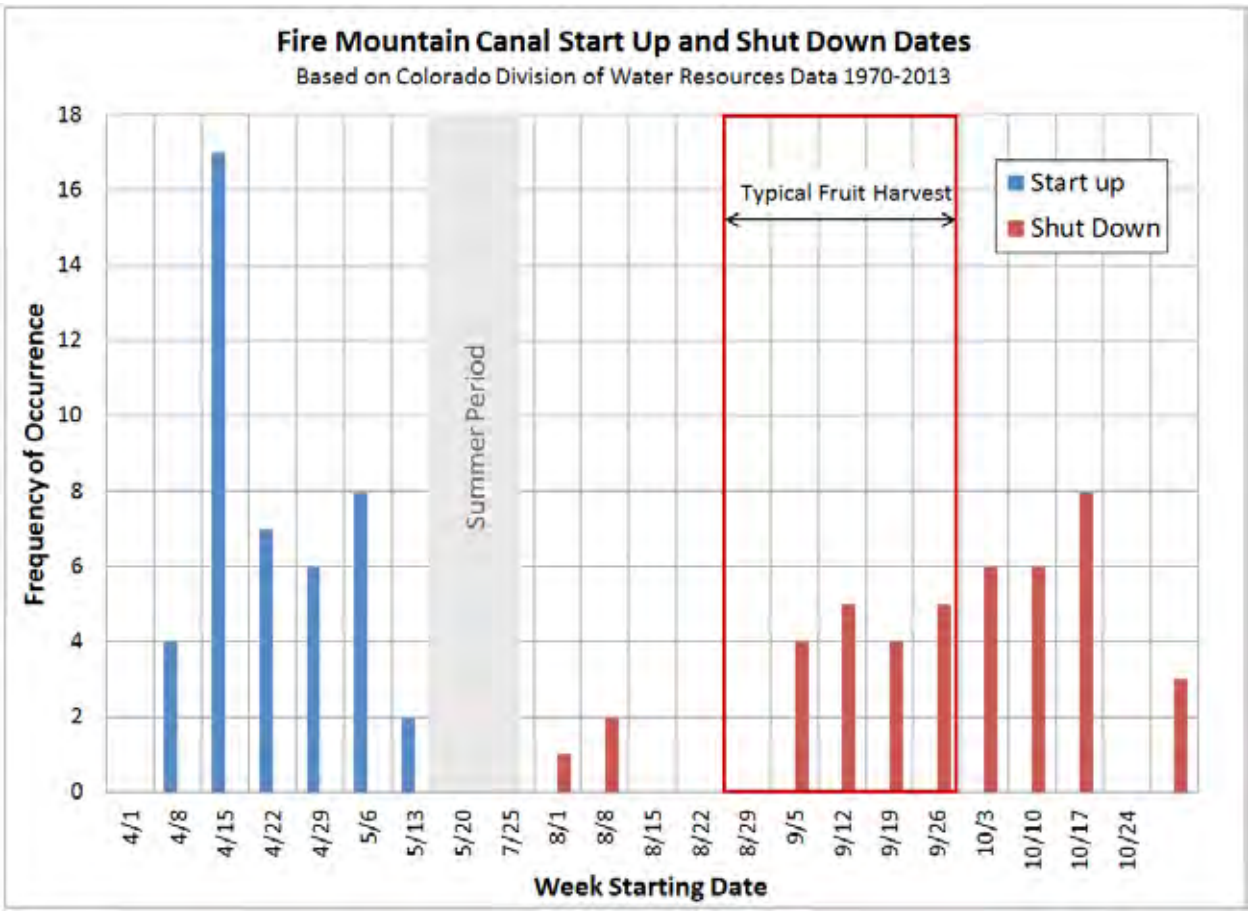
Irrigation Practices

Information regarding the property and associated irrigation practices were obtained from a meeting with Harrison Topp on January 8, 2015. The property was originally irrigated with flood irrigation in furrows between the rows of trees. The farm has 14.4 acres of potential orchard; however, many of the trees were recently removed and there is currently only 4.4 acres of orchard under irrigation. Gated pipe has been installed along the top and middle of the remaining orchard blocks as shown in the attached map. The remaining land is irrigated on a very limited basis.

Irrigation Demand vs Supply

Aerial photography obtained from the National Aerial Imagery Program (NAIP) was used to determine the number of irrigated acres. Evapotranspiration (ET) data was obtained from Colorado Agricultural Meteorological Network (CoAgMet) for their nearby station on Rogers Mesa. The station is located about 12 miles to the southwest and about 200 feet lower than the orchard. The ET data is for a reference crop of alfalfa, which can be converted to other crops such as orchards by applying a crop coefficient to the data. The Food and Agricultural Organization (FAO) published crop coefficients for a wide range of crops including orchards and these values were used to estimate the ET demand for the crops. Average precipitation data was also obtained from CoAgMet and to the ET demand at an 80% efficiency rate in order to calculate the Irrigation Requirement (IR) for the orchards. The amount of irrigation water available for the orchards was assumed to be constant since flows in the Fire Mountain Canal are typically constant when the canal is in operation. The figure on the next page depicts a comparison between the average demand, the average supply, and the supply in 1977.

TOPP FRUIT WATER BALANCE, CONTINUED



This analysis shows that on an average year the orchard irrigation system has surplus water when water is available. The largest potential hindrance to a productive orchard at this location is the uncertainty of late season water, which is critical as the fruit is ripening. Data from the Colorado Division of Water Resources shows that the canal is typically turned on in mid to late April but turns off as early as late July in extreme drought years. The driest year on record was 1977. During that season, approximately 47.7 acre-feet of water was available, which is nearly enough to meet the annual demand of the orchard. The timing of the water, however, would not have been sufficient to produce a crop and may have even resulted in tree mortality.

Harrison Topp indicated that he estimates he applied 18 acre-feet to the remaining orchards in 2014. Based on the irrigation requirement estimated from CoAgMet, the 4.4 acres would have required 15.5 acre-feet. This results in an estimated efficiency of 86 percent. This would be very high for gated pipe, which is typically around 60-70 percent efficient.

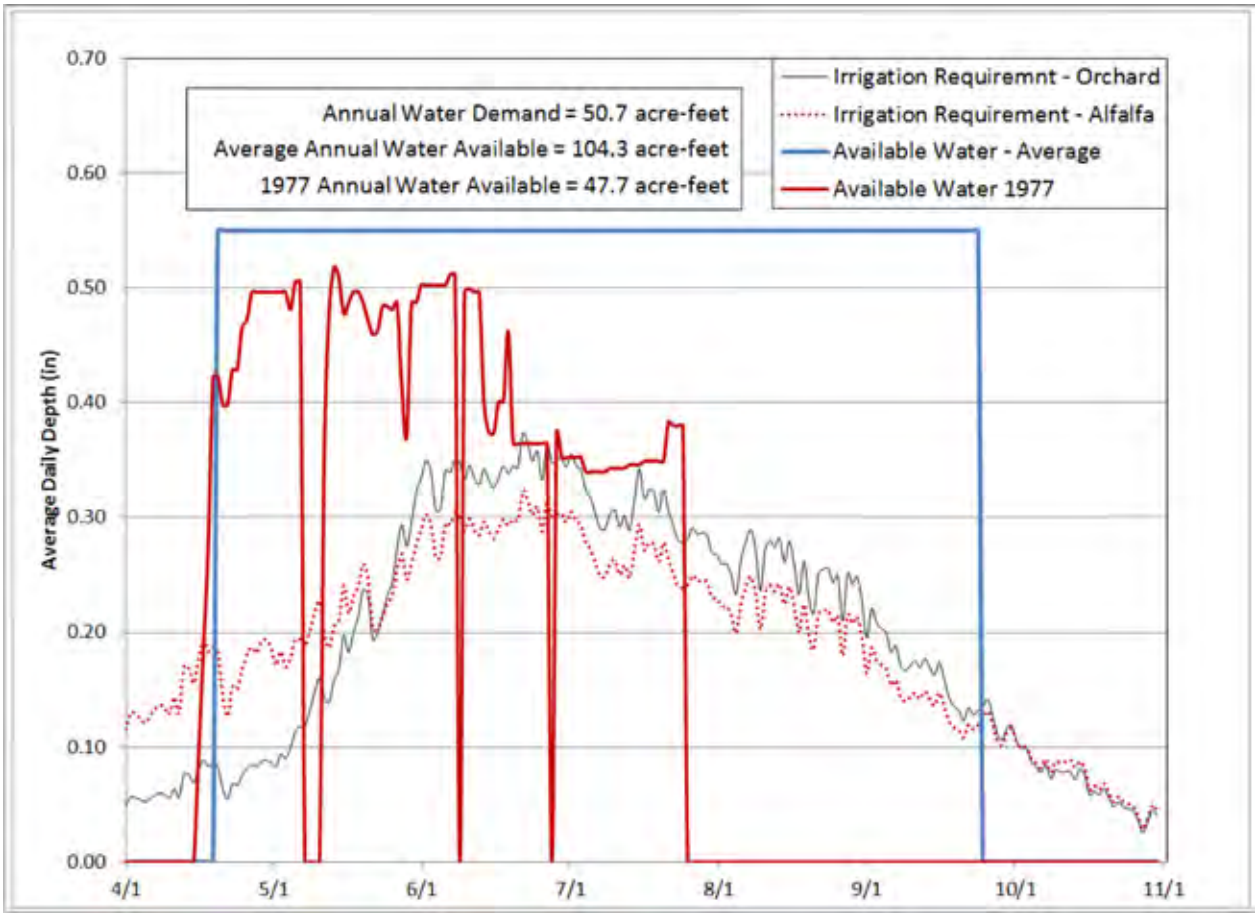
Future Water Conservation Measures

In order for this property to reach its full potential as an orchard, late season water would be required. In extreme drought years it would take approximately 18 acre-feet of storage to bank extra water in the spring for use in the fall. Constructing a reservoir of this size on the property would significantly reduce the amount of orchard acreage. Another option would be to seek out a supplemental water supply.

If a new supply was obtained through a well such diversions would require augmentation water to offset stream depletions when it was used. It is our understanding that augmentation water is difficult to find in the North Fork of the Gunnison due to the lack of storage available. A final option to address this shortage would involve operating the Fire Mountain canal at lower flowrates in late summer and fall when the canal is relying on storage water. This would require a major organizational change for the Ditch Company but the benefits to the users could be substantial.

Under the current method of canal operation, converting to micro sprinklers or a drip system would not help solve

TOPP FRUIT WATER BALANCE, CONTINUED



the potential water shortage late in the season and it could, in fact, negatively impact the orchard. Under flood irrigation, while the canal is on the entire soil profile could be irrigated to the field capacity. Then when the canal is shut down, there will be a sufficient amount of water stored in the soil column for use by the trees. If micro sprinkler or drip irrigation was installed it could limit the amount of soil moisture that could be built up and stored in the soil for later use. These systems would conserve water while the canal is on, but without the benefit of a local storage vessel the water supply for the property would remain unchanged.

If the orchard was completely replanted and irrigated with all 480 shares of water, on an average year about 53.6 acre-feet of water would return to the stream system through seepage or surface runoff. Some of this water might be intercepted by the North Fork Farmers Ditch and incorporated into their system for use by downstream users. The remaining water would enter the North Fork of the Gunnison upstream of a couple of very senior ditch diversions. This water would help fulfill their water decrees and be diverted into their system.

Another option would involve buying additional land that does not have a sufficient water supply and using some of the excess shares from this property to bolster irrigation there. Assuming the Fire Mountain Canal continues to operate the canal at a constant flow, we estimate that the 480 shares would be sufficient to irrigate approximately 6 additional acres. This estimate also assumes that drip or micro sprinkler irrigation systems were installed and managed to achieve 90% efficiency, similar to other local orchards. This option would actually increase the consumption of water since only 10% of diverted flows would then be returning to the stream system.

In summary, the best alternative for this property would involve changing the diversion patterns of the Fire Mountain Canal. However, that is beyond the control of a single shareholder. The lack of late season water likely explains why there are not as many orchards on in the North Fork Valley that rely strictly on Fire Mountain Canal water.

Water balance researched and written by Applegate Group

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