batcon.org
BAT CONSERVATION INTERNATIONAL

USDA United States Department of Agriculture
Natural Resources Conservation Service

BCI: Conserving the world's bat and their ecosystems to ensure a healthy planet

"Working with BCI was a win win for our ranch and the livestock and wildlife that so heavily rely on a water supply in our area."

Daric Knight,
Moore Ranch
Arizona

BATS & AGRICULTURE:
CONNECTING FARMERS & RANCHERS TO INNOVATIVE TECHNOLOGIES IN BAT CONSERVATION

PROJECT SUMMARY

In 2013, Bat Conservation International received a Natural Resources Conservation Service (NRCS) Conservation Innovation Grant to support the use of innovative technology to promote bat conservation across our 8 target states of California, Nevada, Arizona, New Mexico, Colorado, Texas, Arkansas and Oklahoma.

We have been able to do that utilizing many techniques. BCI has served as an education and outreach provider and on-the-ground conservation partner for farmers and ranchers on a series of issues including wind energy development, mine/well closures, wildlife habitat monitoring, water for wildlife, and integrated pest management. In the last 4 years, we have shared information by:

- Creating a database of over 400 NRCS staff and producers;
- conducting a series of webinars 7/23/14 - 8/27/14 that reached hundreds of producers;
- developing an online resource page;
- attending and presenting at workshops in target states reaching over 50,000 individuals; and
- holding wetland restoration and stock pond workshops attended by producers that influenced 280,289 acres in four of the eight target states;

The mission of **Bat Conservation International** is to conserve the world's bats and their ecosystems to ensure a healthy planet. BCI is dedicated to the enduring protection of the world's 1300+ species of bats and their habitats and creating a world in which bats and humans successfully coexist. In pursuit of this vision, BCI will work worldwide at scale with local, regional, national and multinational public and private partners to respond rapidly and effectively to bat conservation crises, preventing the extinction of threatened bats and the extirpation of globally significant populations of bats.

This project was funded through **NRCS Conservation Innovation Grants (CIG)**. CIG is a competitive grant program that stimulates the development and adoption of innovative approaches and technologies for conservation on agricultural lands. Through CIG, NRCS partners with public and private entities to accelerate technology transfer and adopt promising technologies.

These methods have made it easier for farmers and ranchers to incorporate bat conservation into their land management practices. The workshops focused on improving land health through better grazing planning and other ranch management practices contributing to development of effective infrastructure to serve multiple needs. This includes reduction of pesticide use and development of wildlife habitat that provides important ecosystem services as well as serving as viable enterprises.

WHY CONSERVE BATS?

Farmers and agriculture can benefit tremendously from bats. Pests, such as the corn earthworm moth, infest commercial plants ranging from melons to corn, soybeans to cotton. Bats directly impact our own food by eating bollworms, mosquitoes, and larvae harmful to agriculture reducing the need for toxic pesticides.
From the 2011 report in *Science*, "The Economic Importance of Bats in Agriculture": "Estimating the economic importance of bats in agricultural systems is challenging, but published estimates of the value of pest suppression services provided by bats ranges from about $12 to $173/acre (with a most likely scenario of $74/acre) in a cotton-dominated agricultural landscape in south-central Texas." If we extrapolate the Texas figures across the United States, the estimated value of bats to agriculture may be "as low as $3.7 billion/year and as high as $53 billion/year. These estimates include the reduced costs of pesticide applications that are not needed to suppress the insects consumed by bats." The dollar value estimate doesn't include environmental or timber industry savings. In Texas, bats save farmers about $6.4 million per annual cotton harvest.

Farmers and ranchers who want to take advantage of the pest control benefits of bats can try the following to potentially attract bats:

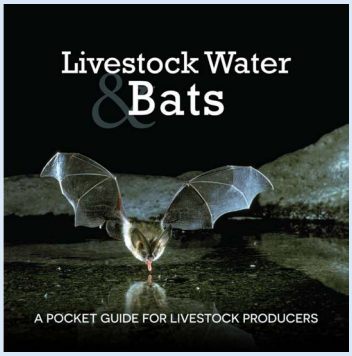
- Provide a water source
- Establish hedgerows of native vegetation to provide habitat
- Consider installing bat houses to provide shelter
- Use bat-friendly lighting
- Maintain potential roost trees (snags)
- Help protect local roosts
- Maintain/enhance habitat at local bridges

Products

What Bats Eat Database: Farmers and ranchers may use this document to search for crop pests eaten by bats in their area. Citations provided for reference.

Bats and Agriculture Resource Page: An online clearing house of manuals, articles and publications containing information on bat conservation management practices and the benefits to producers. *http://www.batcon.org/our-work/regions/usa-canada/bats-agriculture*

Water for Wildlife Pocket Guide: A condensed version of BCI's Water for Wildlife Handbook; it provides a quick reference to information and resources that help make water work for bats. *http://www.batcon.org/pdfs/BCI_Water-Pocket-Guide.pdf*



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"We are in high mesa country at 6200' and this set of double tanks at the head of a canyon was of strategic importance to us for both livestock and wildlife. The tanks had not successfully held water for a number of years; a week after the work was completed we had a big storm, both tanks filled, the spillways worked as planned and the tanks held water late into the winter. We were very pleased."

Nancy Ranney,
Ranney Ranch
New Mexico

Photo:: Goat tank on the Ranney Ranch in Corona, New Mexico., looking towards the tank from the livestock access point.

CASE STUDY:
COST-EFFECTIVE TECHNIQUES FOR INCREASING WATER QUALITY, STORAGE CAPACITY AND WILDLIFE HABITAT AT STOCK PONDS

INTRODUCTION

Stock ponds (aka "stock tanks" or "dirt tanks") that capture surface runoff and occasionally groundwater have been used to water livestock for more than a century. They've also become an important water source for many types of wildlife including large mammals, birds, bats, and amphibians. Because the vast majority of stock ponds rely on surface water runoff, the increased frequency and duration of drought and higher temperatures experienced over the last decade on western rangelands has resulted in many tanks drying prematurely. Many older tanks, especially those constructed in permeable soil types, also lose their water holding capacity over time, if not maintained. In addition, seasonal water quality often declines with water levels as minerals and bacteria are concentrated to harmful levels. This can reduce fitness for livestock watering at these tanks, reducing profits for livestock producers.

INCREASING STOCK POND EFFECTIVENESS FOR LIVESTOCK AND WILDLIFE

The USDA-Natural Resource Conservation Service has a Conservation Practice Standard for restoring and maintaining stock ponds and similar water storage facilities in clay soils (*Pond Sealing or Lining Compacted Clay Treatment 521D*). Here we outline additional cost-effective techniques developed for wetland restoration that complement the 521D Conservation Practice Standard to further enhance stock tank water storage capacity and quality while also increasing their value to wildlife.

TRADITIONAL STOCK POND CONSTRUCTION AND MAINTENANCE

Most stock ponds were constructed by using heavy equipment to excavate a depression in a low-gradient drainage with high clay-content (i.e. low permeability) soil. The excavated material was then used to form a dam or berm on the downhill side of the stock pond to help pool the water, and a spillway was created to allow for drainage during high flow events. In many cases, a solid foundation of compacted earth was not constructed as a foundation for the dam, permitting water loss through seepage, nor was the soil in the bottom of the stock pond adequately compacted to reduce water loss through soil infiltration. In addition, spillways were often made too narrow, resulting in the breaching of the dam during flood events due to the erosive force of the concentrated flow. Stock ponds often require periodic maintenance with a bulldozer or backhoe to remove sediment that has been trapped in the tank by the overland flow of water.

RECONSTRUCTING STOCK PONDS TO IMPROVE WATER STORAGE CAPACITY, QUALITY AND WILDLIFE HABITAT

The methods described here are like traditional methods for improving water storage capacity in that they involve (optional) additional excavation and soil compaction, without soil amendments, but differ in the compaction technique, the addition of habitat features for wildlife, dam and spillway design, and post-construction livestock management. These differences will be referenced in the corresponding construction steps. While these methods would also apply to the creation of a new stock pond or water source for wildlife (i.e. surface water wetland), the methods described below are intended for the reconstruction of existing stock ponds.

Step 1. Testing the soil for sufficiency of clay content

Contact your local NRCS office to see if they will assist with soil testing. You can also conduct a simple "ribbon test" in the field. To do this, use a soil augur, tube sampler, post-hole digger, or heavy equipment to take soil samples from below the top soil/organic ("A Horizon") layer. Enough samples must be taken from representative areas and depths of the tank to be reconstructed to determine if there is enough clay soil on site for this method to be successful. Sampling multiple sites and depths will help ensure that there is more than just a shallow clay lens that will not yield enough clay for compaction. Other visual indicators of clay content are well-formed and long-lasting hoof prints made by livestock and ruts in adjacent roads that hold water for an extended period.

To conduct the ribbon test, take a handful of the soil to be tested, and add a small amount of water from a water bottle while the soil is being worked (kneaded) in the hand, until it reaches the consistency of putty (too much water and the soil will become muddy and disintegrate, not enough water and it will crumble). Once the soil reaches the consistency that you would expect from modelling clay or heavy putty, use the thumb of your

hand that's holding the soil and press it against your curved forefinger to squeeze and push (extrude) out the thinnest ribbon you can from the soil. If you can make a thin ribbon that extends for at least an inch and a half before it breaks under its own weight, then there is sufficient clay content for compaction.

Also, soils with a high silt content will leave a slick, dark, mud on one's hand, while soils with high clay content will leave the hand relatively clean. Soils with high sand content will be grainy and will not form a ribbon. If the tank to be reconstructed does not have enough high clay content soil on site to use this method, bringing in clay soil from off-site may be an alternative if there is a source available at an economical haul distance. In general, we do not recommend buying commercial bentonite (a form of clay), as the product cost and haul distance for most projects will be prohibitive and the quality of commercially available bentonite varies widely. More information on high clay content soils and permeability is available in Appendix 10D of the **Agricultural Waste Management Field Handbook** (AWMFH, *https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17767.wba*)

Step 2. Designing the stock pond depth and configuration

Once it's been determined that the clay content is sufficient, you will need a laser level and surveyor's rod, field measuring tape, and wire flagging to lay-out and design any planned changes in the stock tank's depth and dimensions.

All NRCS projects should be undertaken in conjunction with staff engineers and meet or exceed all NRCS engineering and Conservation Practice Standards, and all other applicable rules and regulations. Using the field tape, surveyor's laser level and rod, and flagging, and taking into consideration local topography, soil profiles, and potential maximum volume of surface runoff, flag the new perimeter of the stock tank, and measure the existing elevations along the entire perimeter and at the dam or berm, and spillway. For wildlife purposes, design variability in the tanks shoreline such as small bays, coves, and peninsulas to provide a range of aquatic and terrestrial habitats. The construction or reconstruction of dams and spillways is beyond the scope of this document, but can be found in in Appendix 10D of the **AWMFH**, and in the **NRCS Engineering Manual** (*https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17900.wba*). However, one of the most important considerations is that spillways and or dams be designed to dissipate and not concentrate the force exerted by water during high-flow events. Therefore, the wider the spillway and more gradual the grade between impounded water and the point of egress the better. Vertical control structure such as large rock, boulders, and logs can be embedded in the spillway to armor or stabilize it so that it better withstands erosion during high flows.

Photos:: (L) Conducting a "ribbon test" to check for adequacy of soil clay content; (R) Using a laser level, surveyor's rod and wire flags to lay out the new tank dimensions and elevations at Goat Tank on the Ranney Ranch...

Step 3. Remove the top soil/sediment

After you have determined the depth and configuration of the reconstructed tank and marked the perimeter and other features with your wire flags, carefully remove the organic/A-horizon top soil layer (in many old tanks this may just be alluvial sediment) and stock pile it close to the tank, but out of the way of construction operations.

Some of this material will be returned to the tank as one of the last steps.

Step 4. Reconstructing/reconfiguring the stock pond

Use heavy equipment (a bulldozer, excavator, and or front-end loader are most efficient for this) and a laser level and rod to check elevations before, during, and after the process, and excavate the tank to the desired depth and configuration, carefully stockpiling the highest content clay soil (if you hit layers of sand or gravel, do not stockpile this with the clay soil).

Because the finished tank should have 18"-24" of compacted clay on the bottom, make sure this is accounted for when determining your final depths during excavation. Most NRCS and other engineering standards call for slopes of no greater than 3:1 for the sides, and the dam. Often this may be steeper than necessary. Re-grading slopes from 30 percent to the lowest slope that possible that still meets tank size and water holding objectives will reduce erosion and maintenance and provide a more natural appearance. Remember to add bays, coves, or peninsulas to the shoreline.

When the tank is finished, fencing will be configured to leave a section of the tank perimeter unfenced for livestock access to water. Determine in advance where you will want this livestock access to be and how large of an area of the perimeter will be needed based on herd size. If necessary, grade/configure this part of the tank perimeter to facilitate livestock access to water.

Because livestock will only be able to access the tank at this point/section, and water levels often fall over the course of a season, you will want this access point to be where water is most likely to remain as water levels fall (i.e. at a deeper portion of the tank).

Photos:: (Top L) Removing the top soil from Goat Tank on the Ranney Ranch, Some of the top soil will be stockpiled and returned to the tank when the reconstruction is complete; (Bottom L) Reconfiguring Goat Tank at the Ranney Ranch; (Right) Preparing the livestock access point at the 9 Cross Tank on the Moore Ranch..

"We have worked with BCI on the restoration of a dirt tank that would not hold water. With the help of BCI, that tank now holds water over 90 percent of the time and has helped supply water to wildlife and livestock much more reliably in our arid climate of east-central Arizona."

Daric Knight,
Moore Ranch
Arizona

Step 5. Constructing the clay liner.
Once the tank has been reconstructed to the desired depth and configuration, you will return the stockpiled clay from your excavation (or use clay soil you brought in from off-site) and compact it. The clay MUST have the correct moisture content and consistency to compact sufficiently. If the clay soil is too dry, it will not compact, and if it is too wet (i.e. mud-like), it will not compact. If too wet, the soil will need to be mixed with dryer clay soil (with the excavator or backhoe bucket) until it reaches the consistency of modelling clay (as with the ribbon test), or it should be allowed to dry with time. If the clay soil is not wet enough, water can be added to the stockpiled clay soil pile from a water truck, or piped from a nearby livestock water, and mixed using the heavy equipment.

When the clay is the correct consistency, put it back in the newly reconstructed tank in 6" layers ("flights") using the dozer, excavator, and or front-end loader, and then run over it completely, three times, with preferably a heavy rubber-tired piece of equipment (front-end loader or dump truck), to compact that layer.

Tracked equipment in general does not compact as well as rubber-tired equipment. Adding material to a dozer or excavator bucket or front-end loader or dump truck can add weight and provide better compaction. If the layer is much deeper than 6", it will not compact effectively, and if much less than 6" it will take much more time. Repeat this step until you have at least 18" (preferably 24") of compacted clay on the bottom and sides of the tank. For tanks with water depths greater than 24 feet, 24" of compacted clay is recommended. A soil compaction meter/tool should read at least 300 PSI for adequate compaction.

Step 5A (Optional) Creating a groundwater dam.
When there is reason to believe that there is water moving subsurface be-

Photos:: (Top L) Wetting clay soil and mixing it with a bulldozer bucket to obtain the right consistency that will allow compaction; (Bottom L) Compacting clay soil in the reconstructed Goat Tank on the Ranney Ranch; (Top R) Compacting clay soil in the reconstructed 9 Cross Tank on the Moore Ranch; (Bottom R) Ranch Manager Daric Knight tests clay soil compaction in the bottom of the newly reconstructed 9 Cross Tank on the Moore Ranch.

low the existing dam, a "groundwater" dam can be created. This technique was developed for creating surface water wetlands.

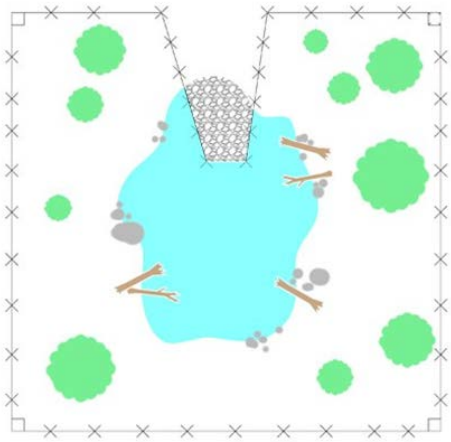
Using a bulldozer, or excavator, a one bucket or dozer blade-width trench, 4' deep or greater, is excavated along the inside base of the existing dam. This trench is then filled with clay soil, again in 6" layers, and compacted with the excavator bucket or bulldozer until there is at least 2' to 4' of compacted clay in the trench.

Where the top of the trench meets the bottom of the tank should also consist of at least 18" of compacted clay.

Step 6. Preparing for the livestock access

When the reconstruction is completed, fencing will be built or reconfigured to leave a portion of the tank's perimeter accessible to livestock. This will allow livestock watering, without allowing livestock to loaf in the tank and foul the water. If there is a chance that the livestock-accessible portion of the tank perimeter will become muddy, it can be "hardened" by excavating or grading a "ramp" (approach area), staking down geotextile fabric, and covering or armoring the fabric with 2"-4" of 1"-3" rock.

A more focused but elaborate access can be configured by creating a "boat ramp" type approach with geotextile and rock as described above, with the fencing configured to provide access only via the ramp.



Step 7 (Optional) Putting a layer of top soil back in the tank

Once the compacted clay lining is finished, spread 6"-12" of the stockpiled topsoil over the tank bottom, which will help protect the clay liner from desiccation and cracking if it is exposed for extended periods of time before

Photos:: (L) Constructing a "groundwater dam", a trench at the base of the existing dam filled with compacted clay; (Top R) Preparing the livestock access point, Moore Ranch; (Middle R) Staking down geotextile fabric as a base layer for rock to create the hardened access point for livestock at the Pitts Ranch ank on the Navajo Reservation in Crownpoint, NM; (Bottom R) The hardnened livestock access can be constructed like a boat ramp with fencing configured to manage livestock access.

the tank refills. This will also provide a substrate for aquatic insects, plants, and burrowing habitat/hiding cover for amphibians.

Step 8. Adding large woody debris and rock or boulders as habitat features for wildlife

The second to last step includes using your heavy equipment and or manual labor to move and place one or more logs or large limbs and or boulders into the reconstructed tank to function as hiding, perching, or basking habitat for birds, small mammals, or amphibians.

Logs can be placed so that they are partially submerged when the tank is full, and extend onto the shoreline. Placement should be done with consideration for future access for sediment removal and maintenance.

Step 9. Fencing to manage livestock and create wildlife habitat

The last step is to reconfigure the existing fencing or build new fencing that encompasses 70% or more of the tank and its perimeter, as well as adjacent shoreline and upland habitat for wildlife, leaving a section of (preferably hardened) tank perimeter where livestock can access the water (at a point where water will still be accessible when the tank water levels are low. Access can be incorporated to allow heavy equipment for tank clean-out and maintenance.

SUMMARY

The reconstructed stock tank will now hold more water for a longer time, provide higher quality water to livestock, and will create high-quality wildlife habitat.

Photos:: (L) Woody debris (a juniper snag) has been added to the reconstructed 9 Cross Tank, Moore Ranch; (Top R) Nine Cross Tank, Moore Ranch, AZ, Looking down the livestock access point, dry; (Bottom R) Nine Cross Tank, Moore Ranch, AZ, Looking down the livestock access point, full..