SDSU Extension

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Chapter 56

Pasture Water: Innovations

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Disclaimer: This chapter focuses on innovative application of new or emerging technologies for water systems and may include information on certain products or companies that manufacture or distribute products or technologies that are not widely available. SDSU Extension does not endorse any of the products or companies mentioned here. Any inclusion by name is provided solely as a resource for the reader to research the unique technology, method, or innovation.

As mentioned in the fence chapters, South Dakota producers have a propensity for innovation that carries over to water systems as well. The objective of this chapter is to highlight variations in water systems and to challenge the reader to explore non-traditional options for water management that are economically and environmentally efficient, effective, and adjustable. This chapter includes information on:

- Innovations in Water Delivery Systems
  - Improving water delivery from wetlands, ponds, dams, and dugouts
  - Solar powered water systems
  - Wells
  - Nose pumps
  - Rural water systems
  - Overland high density polyethylene (HDPE) pipe
- Fence and Water Assistance Programs

The References section at the end of this chapter provides sources of additional information, and the reader is encouraged to explore options provided in some very informative documents, including extensive reviews of water delivery provided by:

Kansas State University Extension (Blocksome, and Powell 2006): http://www.ksre.ksu.edu/bookstore/pubs/S147.pdf

Virginia Cooperative Extension: http://pubs.ext.vt.edu/442/442-755/442-755.html#L6

Key Points

- Many innovative water delivery systems that improve water quality, quantity, and efficiency of delivery are available to livestock producers.
- Solar, solar-electric, animal powered, and overland water distribution systems can be cost effective.
- Water delivery systems can be designed in concert with fencing systems to create efficient pasture infrastructure.
- Many resources exist to assist livestock producers with water system design and cost.

USDA NRCS – Missouri (2006): http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mo/technical/engineering/?cid=nrcs144p2_013021

Innovations in Water Delivery Systems

Pasture water system technology is continuously evolving. As technology improves, so does the efficiency of antiquated power and delivery systems. Along with basic electricity, rural water, wind, solar, animal, gravity, and even water powered water delivery systems exist and can be utilized under various conditions. A few simple examples that are being successfully utilized in South Dakota are highlighted here.

Improving water delivery from wetlands, ponds, dams and dugouts: Natural wetlands, spring, or watershed fed dams and dugouts remain the most common sources of water on many South Dakota pastures. Several options are available to producers to improve the water delivery and overall water quality of those systems. Simply removing cattle from the water source via fencing to reduce erosion and nutrient loading from feces and urine is the first step to water improvement (Figure 1).

Figure 1: Dugout located near a wetland with a spring or fen water source flowing into the lower right hand corner of the dugout. This dugout is typical of most in that livestock have unrestricted access. Borrow piles have eroded due to livestock impacts, and water quality is compromised. Whether a dugout or a dam, modern management calls for the exclusion of livestock from a stagnant water source. *Photo by Pete Bauman.*

Delivering adequate water volume to the livestock excluded from a water source can be a challenge, but gravity, solar, wind, and electric pumps can be employed to accomplish water delivery goals. Figure 2 describes a unique option for delivering water via

Figure 2: Installation of a simple system to divert spring water from the wetland shown in Figure 1. A perforated barrel was plumbed (top). The barrel was buried near the outflow of the spring. A filter of rock surrounds the barrel and a plastic catch apron was installed on the downslope side (middle). Overland pipe was then run to two stock tanks (bottom). *Photos by Pete Bauman.*

Figure 3: Dugout pictured in Figure 1 above two years after the exclusion of livestock and the installation of the perforated barrel and tanks. Borrow piles were allowed to re-vegetate naturally. *Photo by Pete Bauman.*

gravity from a spring or seep in order to improve the overall quality of water provided to livestock and to decrease negative impacts to the resource.

Figure 3 demonstrates the overall improvements to the resource simply by eliminating the cattle from the water source. Elimination of livestock allows for improvement of overall water quality by eliminating feces, urine, and erosion of the banks. Improved livestock health and wildlife habitat are the results.

Where available, natural springs and artesian wells can be utilized for improved water delivery to livestock. Springs, seeps, and artesian flows can harbor unique and/or rare plants and animals, so development of these sites should be done in consultation with a professional who can assist the producer in minimizing impacts to the resource while accomplishing water delivery goals. Figure 4 shows an artesian well that was tapped for water delivery with an electric pump option.

Figure 4: Although uncommon, artesian springs do occur in South Dakota. In this case, the spring provides enough natural pressure to lift the water several feet above the surface of the ground through a shallow PVC pipe. Water is then gravity-fed through flexible black 1 ¼" PVC to a small pump house equipped with an electric pump and pressure tank. Livestock are excluded from access to the spring. *Photo by Pete Bauman.*

Solar powered water systems: As solar power technology improves and becomes more affordable, the options for improved water management in remote locations are increasing. With the awareness and desire to protect ponds, dams, and dugouts from contamination and erosion caused by livestock, many producers and conservation organizations are employing solar power in isolated pastures where electricity is unavailable. Solar powered water delivery systems are becoming very advanced, with many options and modifications for customization now available. However, the basic premise of a solar system is to simply allow a solar panel to gather light energy from the sun, convert that energy into usable electricity that drives a pump, and pump the water to a storage tank for consumption by livestock (Figure 5).

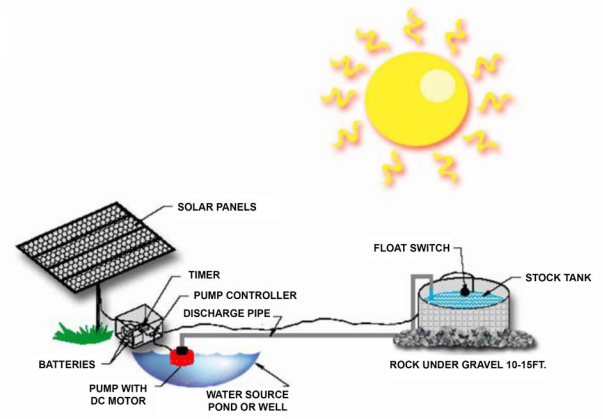


Figure 5: Basic layout of a solar water tank system. *Diagram taken from Blocksome and Powell, 2006.*

Although basic solar water delivery system designs are relatively constant, components continue to advance the ease of use for producers. Improvements in solar cell technology have resulted in reliable, efficient, and durable solar panels capable of producing adequate power and yielding sufficient water flow, rendering solar systems as a trusted option for remote livestock watering.

Solar pumps: Historically, most solar water systems relied on traditional cylindrical well casing pumps (Figure 6) suspended from some type of float system to pump water from a pond. A casing pump is roughly 36 inches long when suspended vertically from a float mechanism, and the pumps require about 48 inches of water to ensure adequate pump

Figure 6: Example of casing pump (left) and float pump (right). *Photos by Pete Bauman.*

clearance from the bottom of the pond. In some instances, pumps can be installed horizontally to allow for use in shallower waters (even creeks). Because they are relatively long, casing pumps generally draw from deeper areas of the pond, which can be beneficial as the water provided may be cooler and cleaner (Figure 7).

Aside from the traditional casing pump, perhaps the most user friendly improvement has been the development of floating pumps (Figure 6). These compact units float on top of the water and draw from the upper portions of the water body (Figure 7). Because they draw from the top of the water column, these pumps tend to deliver warmer water that may contain algae in late summer. However, this water is still markedly cleaner and of much better quality when compared to water sources where cattle are allowed to mire in the pond, dam, or dugout. Manufactures often rate their panel and pump combinations in gallons per minute and/or number of head (livestock). Generally, casing pumps with larger solar panels tend to deliver a greater volume of water than do float pumps. Most suppliers will assess needs and make recommendations on the appropriate panel and pump setup.

Solar Panels: Solar panel management is perhaps the most challenging part of designing a permanent or portable system.

While most manufacturers recommend mounting larger panels on permanent posts for stationary systems, producers have designed options for portability, convenience, and weather resistance (Figure 8).

As solar panel efficiency improves and the desire for more options for compact systems and portable systems increases, some manufacturers have begun building systems that are simple and efficient to service and transport (Figure 9).

Figure 7: Example of a typical float pump installed in a dugout where cattle are excluded (top). Photo on the bottom shows a float pump (blue pump) compared to a casing pump connected to a floating tire and rim. In shallow water sources, vertical casing pumps can contact the bottom if not installed properly. *Photos by Pete Bauman.*

Figure 8: Photo on the top shows a permanently mounted panel system wired to a submerged casing pump. Photo on the bottom illustrates producer innovation, mounting a large panel on a homemade trailer allowing the panel to be used in several locations throughout the pasture. *Photos by Pete Bauman.*

Wells: Wells can still be a viable option for water delivery to livestock where available. Well use and management is regulated under various groundwater regulations, and producers should review rules specific to their situation prior to installing or utilizing wells for livestock. The information contained here assumes that the user has determined that the use of the well for these purposes is permitted. See http://denr.sd.gov/des/wr/summary.aspx for information on well use in South Dakota. Figures 10 and 11 demonstrate a variety of innovative well options producers may consider if refurbishing or installing new wells.

Nose pumps: Nose pumps refer to pump systems that are operated by the action of the animal actively pushing a plunger or piston with their nose, commonly activating a diaphragm system to lift water to a trough. These systems deliver roughly ½ to 1 pint of water per stroke. Although they have been in use for many years, nose pumps are not traditionally a popular option in South Dakota. The Vermont Natural Resources Conservation Service lists the following information as pros/cons for traditional diaphragm nose pumps:

- Nose pump advantages:
  - easily moved, set up, and maintained
  - no energy source is needed
  - can be used to access sources of surface water
  - can be set back from the water source, reducing contamination concerns

Figure 9: Photo at left shows a compact solar panel and weather resistant component system (black box) permanently mounted on a small utility trailer. The box houses a backup battery, electrical system, and supplies. Trailer space allows for transportation of tank, pump, and hose. The system at right is a commercial system with a similar solar panel and weather resistant component box mounted above a steel water tank. This system utilized a tank transport skid that is easily removed. In both cases, managers are afforded convenience and flexibility when moving livestock between pastures and water sources. *Photos by Pete Bauman*

Figure 10: Isolated or abandoned pasture wells or old windmill pits can be refurbished for use under certain conditions, either with solar powered or 110V pump systems. Solar systems on wells where significant lift (>15 ft.) is necessary may require higher capacity solar panels and casing pumps to generate enough electricity to deliver adequate water volume for livestock (*photos by Pete Bauman*).

Figure 11: When practical, a dilapidated, abandoned well (upper left) can be renovated and fitted with modern pumps, controls (upper right), and pump house (lower left). In this instance, 110V power is available via overhead lines, and the pump house doubles as a source of power for the electric fence. Shown here is a 110V fence energizer wired to switches capable of turning power on and off to various pastures as necessary (lower right). *Photos by Pete Bauman.*

- Nose pump disadvantages:
  - generally for larger sized livestock
  - limited to approximately 20 feet of lift and 200 feet distance (or combination thereof)
  - a single pump serves a relatively small number of livestock
  - the water delivery is very slow since each stroke provides only approximately ½ pint to 1 pint of water, depending upon the manufacturer
  - cannot be used in freezing conditions; nose pumps are designed to provide water for spring through fall pasture situations.

- Successful nose pump installation:
  - Approximately one nose pump/20 head, depending upon the manufacturer (check individual manufacturer specifications)
  - securely mount each nose pump to a raised base
  - if raised base is made of lumber, it should be pressure treated
  - use a foot valve pipe to maintain water in the line
  - train livestock to use the nose pump prior to putting them out on pasture, training should be before the weather gets extremely warm and no other water sources should be available to the livestock

See: http://efotg.sc.egov.usda.gov/references/public/VT/JS614VT_NosePump_FillableForm.pdf for more information.

Fossum and Strasky (2001) performed a limited independent review of various diaphragm nose pump manufacturers http://www.peaceforage.bc.ca/forage_facts_pdfs/FF_4_nose_pump.pdf. Aside from traditional diaphragm nose pumps, a single Canadian company is manufacturing a 'frost free' nose pump system. These systems hold much promise for isolated areas in South Dakota where freezing limits the ability to utilize the water source in the winter, such as livestock grazing crop residue (Figure 12) (see references for more information).

Figure 12: The Frostfree nose pump system operates on a simplistic mechanism of water lift and delivery. Its lack of moving parts, higher water delivery rate, and operation in freezing temperatures may be a practical option for South Dakota producers. More information can be found at http://www.frostfreenosepumps.com/. *Photo provided by Frostfree Nosepumps, LTD*

Rural Water Systems: Rural water systems in South Dakota have expanded their services in recent decades to include livestock watering systems in pastures. South Dakota has several rural water districts, each having unique circumstances and rules governing pasture water services. Where available, rural water services to pastures may include the following general expenses:

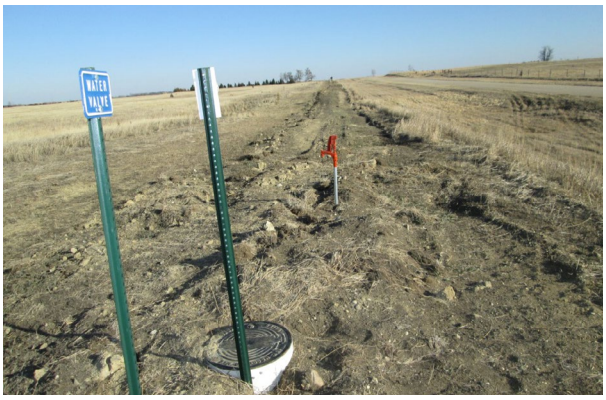
- ~ $2,000 - $3,000 installation fee
- ~ $1,500 hookup fee
- ~$3/ft. installation of water line across pasture (buried)
- ~$1/ft. installation of water line across pasture (over ground)
- ~$500 - $1,000/tank site, depending on various factors (concrete tank pads can add substantial costs)
- $7 - $11/cow for a 150 day grazing season (based on ~ 20 gallons/day/cow)

Fourteen rural water systems currently operate in South Dakota. The South Dakota Association of Rural Water Systems maintains a website with information on location of rural water systems and contacts at http://www.sdarws.com/default.aspx, or call 605-556-7219 for information on services in your area.

Although rural water systems are arguably the surest way to deliver fresh, clean water to livestock, expense can be a hindrance to some producers. In certain instances, short-term surface disturbance from installation of curb stops and pipelines can be unsightly and can lead to issues with invasive species. In addition, large herds can require several million gallons annually. Figure 13 shows land scarring of new water lines and eventual land healing that begins to take place following rural water installation and use. Producers have the opportunity to install multiple water access sites and improved watering sites along with the installation of new water lines (Figure 14).

Overland high-density polyethylene (HDPE) pipe: One of the most versatile tools in water delivery on the market today is HDPE pipe designed and utilized for overland livestock watering systems. The use of this flexible pipe allows producers to design

Figure 13: Installation of rural water lines can cause significant land disturbance in some locations (left). If done well, scars from buried line eventually heal and re-vegetate. The photo at right shows buried line two years post installation. Invasive species can be a concern in disturbed areas and managers must monitor buried line sites to control invasive or noxious plants. *Photos by Pete Bauman.*



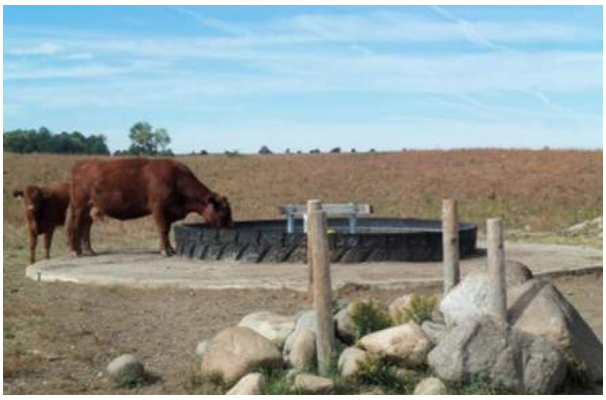
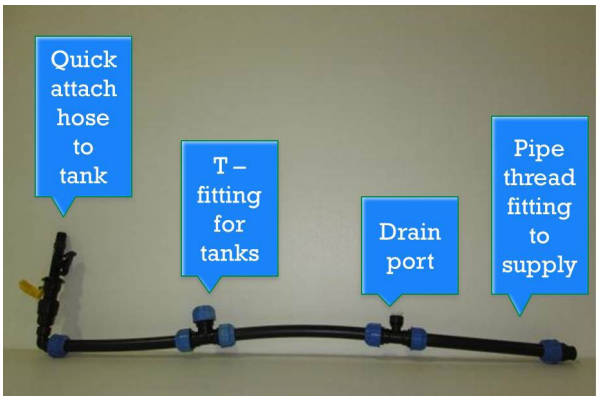


Figure 14: Where available, some producers opt for installation of water hydrants when installing rural water (left). Installation of durable rubber tire tanks and concrete pads ensure longevity in remote pasture situations (right). *Photos by Pete Bauman.*

and modify both permanent and temporary/movable water systems quickly and efficiently. Improvements to the pipe and components have resulted in durable systems that are not damaged by livestock, can be driven over with vehicles, are able to be pulled, and can even be allowed to freeze (although not recommended). Components allow for quick attach/detach operations, quick coupling to tanks, drainage ports, and pressure monitoring where necessary (Figure 15).



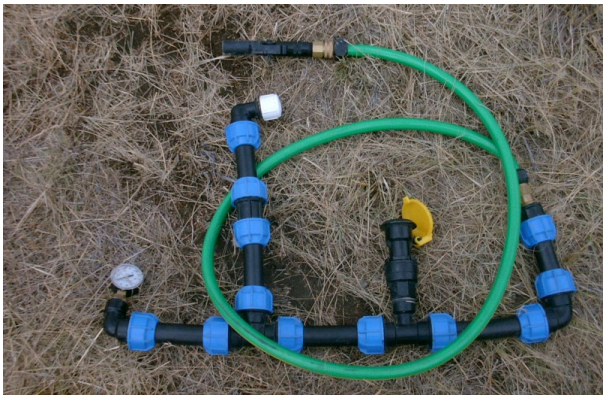


Figure 15: (Below) Typical components of PVC pipe system (photo by Pete Bauman). (Below Left) Options include quick attach for garden hose to tanks, pressure valves, T's, elbows, and end plug. *Photos by Rick Smith.*

Statistics on 1" diameter 160 psi HDPE pipe:*

- Piping distance depends on topography and available pressure. One mile is a practical limit, but some systems have gone much further.
- Delivery distance depends on the source. Generally, rural water will provide the longest delivery pressure, with 220V or 110V electrical systems providing adequate water pressure in many cases. Solar power or other systems may be limited, depending on the rise and run of system.
- In some cases rural water systems have the ability to raise water pressure at the delivery point.
- With 160 psi pipe and 200 psi compression fittings, achieving a delivery pressure of 80 psi or more is feasible.
- Bigger tanks can compensate for low water flow because they offer more storage capacity.
- Rocky ground is ideal for above ground pipe choice.
- With hills or rolling ground, it is easy to place drain plugs and drain the system when desired.
- Overland pipe offers exceptional flexibility.
- Zero disturbance to land and resources when laid on top of ground.
- Exposed black pipe can heat up quickly, but vegetation soon covers the pipe, keeping water relatively cool.

- Where pipe is exposed to sunlight, water can become very hot. However, water delivered to large storage tanks cools quickly and achieves ambient air temperature rapidly.
- Line can always be buried if desired, but most buried systems only use 100 psi pipe.
- Current (2014) prices run under $0.52/ft. to set up a system if the landowner rolls out the pipe.
- Buried line via a contractor will cost ~ $3/ft.

** Much of the information above provided by Pasture Works, Hayti, SD.*

Suppliers of overland water systems and components: In SD, only a few retail outlets carry high density polyethylene pipe and the specialized connecting components necessary to build a functional and efficient water system. These include:

Pasture Works
45062 180th St.
Hayti, SD 57241
Phone: 605-886-6513
rhsmith@datatruck.com

Cammack Ranch Supply
P.O. Box 100
Union Center, SD 57787
crsuc@yahoo.com
Phone: 605-985-5591
Fax: 605-985-5593
http://www.cammackranchsupply.com/

Kennebec Telephone Company
PO Box 158
220 S Main St.
Kennebec SD 57544
Phone: 605-869-2220
Toll Free: 888-868-3390
Fax: 605-869-2221
http://kennebectelephone.com/

Fence and Water Assistance Programs

Several options exist for livestock managers to obtain support for fence and water system upgrades designed for improved pasture management and wildlife benefit. The Natural Resources Conservation Service (NRCS) works with producers to design and implement grazing systems with fence and water improvements that consider the health of rangelands and subsequently wildlife habitat. NRCS programs, such as the Environmental Quality Incentives Program (EQIP) and others, can be utilized to establish and maintain grasslands for grazing. The US Fish and Wildlife Service offers fence and water systems support to landowners willing to incorporate conservation programs, such as grassland and wetland easements or Wildlife Extension Agreements (WEAs) on their property. The SD Department of Game, Fish, and Parks offers programs and incentives to livestock managers seeking options to incorporate or retain grasslands into their operations, provided that those projects incorporate benefits to wildlife and habitat. Other private conservation groups, such as Northern Prairies Land Trust, Ducks Unlimited, Pheasants Forever, and Habitat Forever, offer both individual and cooperative programs to encourage producers to improve grazing habits on sensitive areas, and often those programs include some level of cost share for fence and water improvements.

All agency and conservation organization programs are subject to available funding. Therefore, South Dakota producers should inquire locally if these or other organizations offer programs in their home area. Whenever one can approach systems management through integration of the parts, it is likely that the efficiency of the entire system will improve. Such is the case with integrating fence and water systems. Figures 16 – 22 are some examples where fence and water are truly 'integrated' for efficiency, livestock health, and wildlife benefits.

Figure 16: Map of a Grant County, SD ranch that utilizes an array of methods for fence and water development under assistance of the NRCS EQIP program (top). Black lines on map are permanent 4-strand barbed wire perimeter fences. Yellow lines are single-strand, semi-permanent high tensile cross fences. Water is provided via natural ponds, dams, and dugouts. Blue symbols represent watering stations where livestock access to the water source has been restricted via temporary electric fence, and water is supplied via manufactured solar float pumps and delivered to manufactured movable solar tanks (bottom). Cattle are fenced out of all dams and dugouts with a single strand of smooth electric wire. *Map and Photos by Mike McKernan.*

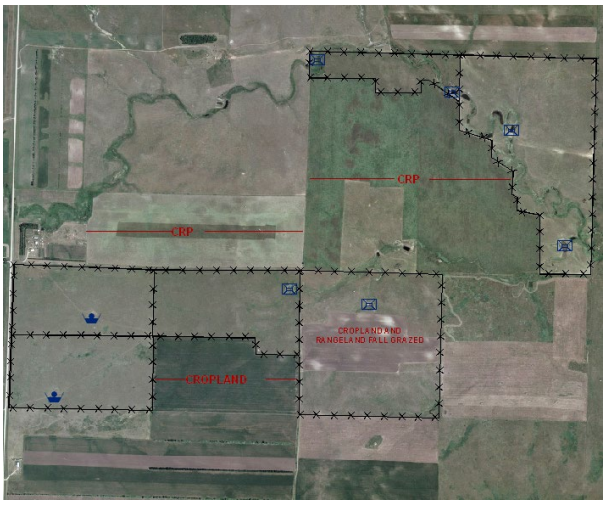


Figure 17: 'Before' map of a ND ranch utilizing expired Conservation Reserve Program (CRP) fields. Permanent fences (black lines) are placed as typical rectangular pastures with water sources located within large paddocks. *Map courtesy of Burleigh County ND Soil Conservation District.*

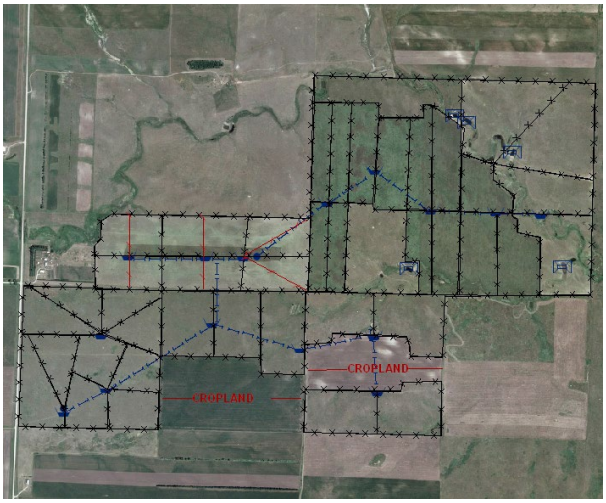


Figure 18: 'After' map of the ranch shown in Figure 17 (left). Larger CRP pastures were subdivided into smaller paddocks with permanent fencing and water sources designed to service several paddocks. The producer stated that permanent fences are not ideal and would prefer temporary fences in most areas. *Map courtesy of Burleigh County ND Soil Conservation District.*

Figure 19: 'Before' map of a ND ranch. Permanent fences (black lines) are arranged in typical rectangular paddock design. *Map courtesy of Burleigh County ND Soil Conservation District.*

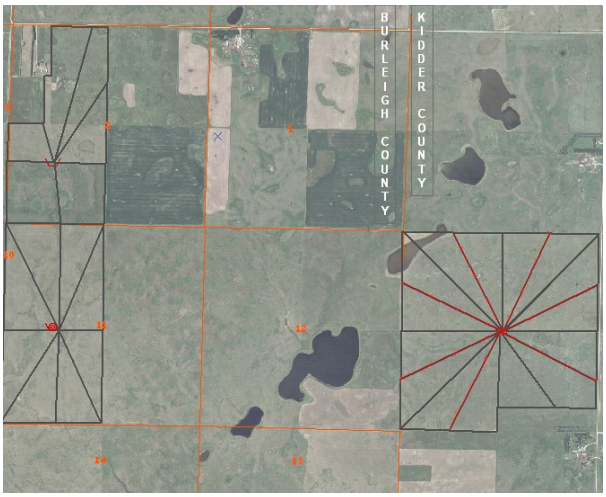


Figure 20: 'After' map of ranch shown in Figure 19 (left). Larger pastures are subdivided into smaller paddocks with temporary fencing and centralized water sources. *Map courtesy of Burleigh County ND Soil Conservation District.*

Figure 21: Map of a Deuel County, SD ranch fence and water plan resulting from an NRCS EQIP contract. Fences are permanent 4-strand barbed wire. The water system consists of underground rural water lines piped to permanent tire tanks set in concrete (upper right). Pipe trench scars are prevalent for several years after installation and may require special consideration for invasive species management (lower right). *Map courtesy of Deuel County, SD Natural Resources Conservation Service, photos by Pete Bauman.*

Figure 22: Producers interested in using livestock to manage remote or 'new' grazing areas where infrastructure may be limiting can utilize temporary fencing. In the photo at left, managers arrange a stock tank and moveable poly wire in a fashion that allows simply raising the wire to allow cattle to access the other side. At left, simple expanded steel escape ladders allow an opportunity for birds and small mammals to exit the water should they fall in the tank. *Photos by Rick Smith.*

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