Bear Creek
Riparian Enhancement Project
Preliminary Technical Designs for:

- Fence
- Bridge
- Heavy Use Areas/Access Roads
- Livestock Watering Facilities
- Solar Pump System

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Pictorial Guide To Fence Installation


High Tensile Wire Fence


Woven & Barbed Wire Fence


H-brace at Gate Location

Introduction

Since fencing is such an important part of a livestock grazing system, the USDA-Natural Resources Conservation Service (NRCS) has developed specific designs and specifications for landowners to follow during installation. Landowners who are participating in USDA Farm Bill programs are required to follow these guidelines in order to have approved projects.

This document is designed specifically to assist landowners interested in self-installation of the following types of fencing: energized high-tensile, non-energized high tensile, barbed wire, and woven wire. It utilizes easy to follow photographs and diagrams to highlight common installation techniques as well as specific requirements for the different wire types. However, before starting the fencing project, be sure to review all fencing documents available through the NRCS (http://efotg.sc.egov.usda.gov/treemenuFS.aspx).

Planning

In order to save time and money, it is wise to properly plan your fencing project. NRCS is available to assist landowners in determining the best locations for fencing, highlighting selected segments on aerial maps to assist with field installation, and estimating segment and overall lengths to aid in purchasing materials. The landowner will still need to spend time in the field measuring and marking locations of key structures such as brace assemblies, gates, termination points, as well as identifying items that need to be removed.

It is generally recommended that brace assemblies be constructed first, followed by line posts, and completed with installation of wires. This guide follows this same order with instruction. By utilizing this document along with the NRCS guidelines, should provide all the information needed for a well-constructed fence installation.

Brace Assemblies (Corners, Ends, Gates and Pull Assemblies)

Brace assemblies are solid structures built at corners, ends, gates, and pull sites. Installation of these assemblies frequently takes up to half of the total fence construction time. Most fence failures are caused by improper construction of end and corner post assemblies. When assemblies are properly constructed, a few line posts can fail without affecting the entire fence. Breaks in wires can also be easily repaired. On the other hand, failure of a brace assembly will require additional time, effort, and money.

A brace assembly is made up of posts (see Table 1 for standards) and braces. The most common type of brace approved for NRCS projects is the H-brace. Figure 1 shows that the H-brace is made up of a brace post, an anchor post, a horizontal brace member (connected to posts with a galvanized pin; see adjacent pictures), a diagonal tension wire, and a wire tension rod. Proper installation of the assembly posts is critical considering the amount of tension that will be placed on each post (Table 1). If posts are dug instead of driven, dig your holes at least twice the width of the post and at least three feet deep. Leave enough post length above the ground to accommodate recommended wire spacing. Backfill with soil and tamp at four-inch intervals as you backfill.

Table 1. Assembly Post Material Standards

Wood Posts	• Acceptable species with bark removed include black locust, red cedar (1/2 of diameter must be heartwood), and Osage orange. • All other wood posts must be treated with a minimum of 0.4 lbs/ft^3 of chromate copper arsenate (CCA-Type A, B or C), or equivalent. No landscape Timbers allowed. • Corner, brace, end, and gate posts must be at least 8' X 5". • Horizontal brace members must be at least 8' X 4".
Steel Posts	• All steel brace pipes must be galvanized or coated with a rust-resistant metal paint. • Minimum 3-inch diameter high-carbon steel pipe weighing at least 7 lbs/foot. Pipe ends must have a water tight-cap. • Horizontal brace pipe can be 2-inch diameter high carbon steel that weighs at least 3.6 lbs/foot.

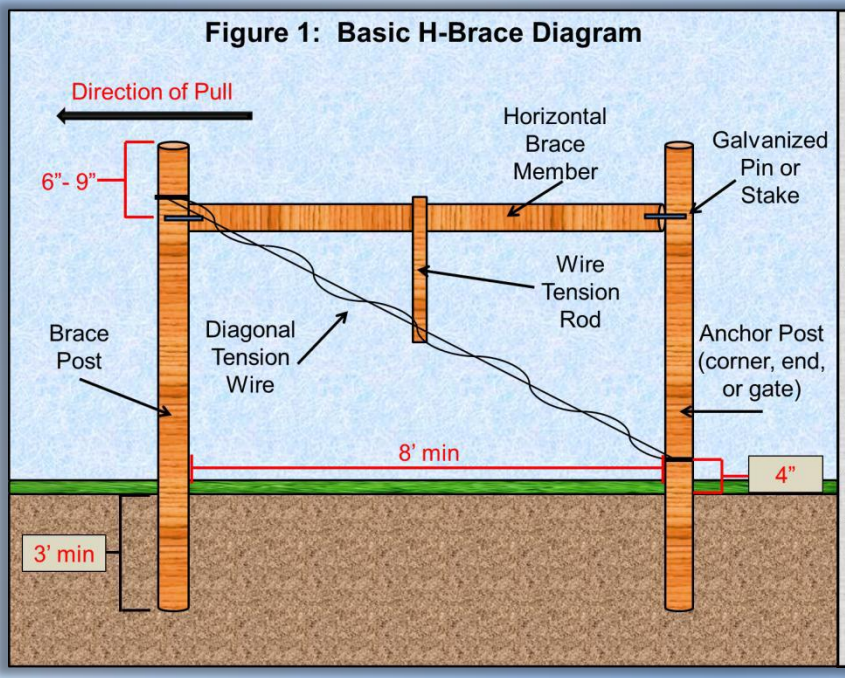


Figure 1: *H Brace Details*

The center line of horizontal brace members should be 6 – 9 inches below the top of the post and anchored with a 3/8" galvanized pin. Drive pin a minimum of 4" into post and horizontal brace member.

The tension member should consist of 2 complete loops of 9 gauge smooth single strand, 12 gauge double strand, or 12.5 gauge high-tensile wire. One end of the loops is attached to the anchor (corner, end, or gate) post 4-inches above the soil surface, and the other end is attached to the brace post at the same height as the top of the horizontal brace member. To provide stability to the assembly, twist the loops of wire.

When planning your assembly construction, the type of brace you should use depends on whether you are building an end or gate assembly, a corner assembly, or an in-line pull assembly. For end assemblies, a Single H-brace or Floating Angle Brace (Figure 2 and picture below) is recommended. A Double H-brace is preferred in areas of deep sands or soils with high water tables for more than half the year. The same rules apply for a gate assembly; however, it is recommended that an H-brace be constructed with two diagonal tension wires running in opposite directions (see picture below) to compensate for weight of gate. For corner assemblies and in-line pull assemblies, the design is a bit more complex. Refer to Figures 3 and 4 for assistance with constructing these assemblies.

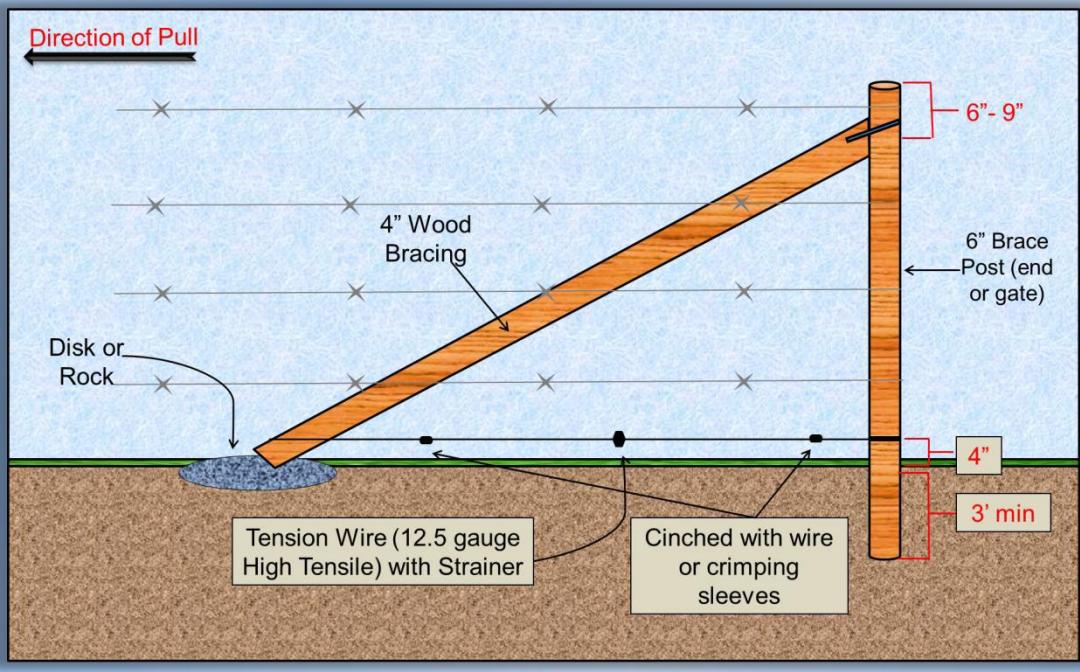


Figure 2:

Floating Brace

Floating braces are not as commonly used as H-braces, but are an option for ends and gates. The brace should be connected to the post using a 10" spike nail or brace pin.

At the ground end of the brace, a 15" minimum disc blade or flat rock is needed for stability. Notch the brace to accept a tension wire and secure wire by cinching in both directions.

H-Brace on Gate with two Diagonal Tension Wires

Floating Brace

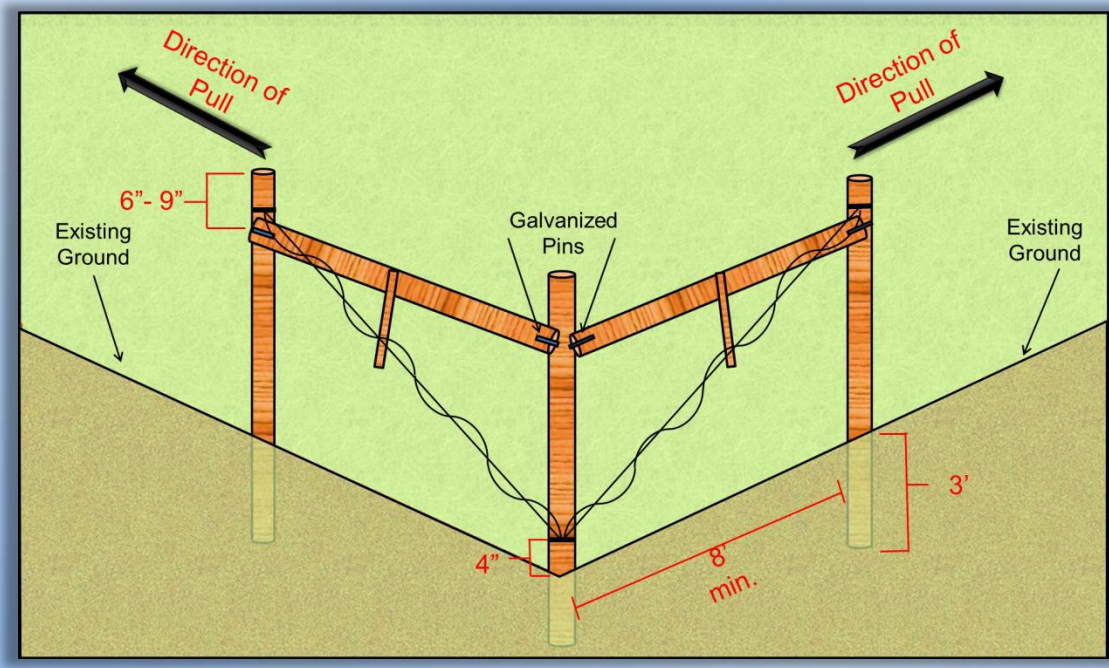


Figure 3:

Corner Assemblies

Where corners are sharper than 20°, an H-brace corner assembly must be used. These consist of a corner post with an H-brace on each side.

Corners with less than a 20° turn do not require this assembly, although a 5-inch diameter corner post must be installed 4 feet deep and must lean 2 – 4 inches towards the outside of the curve.

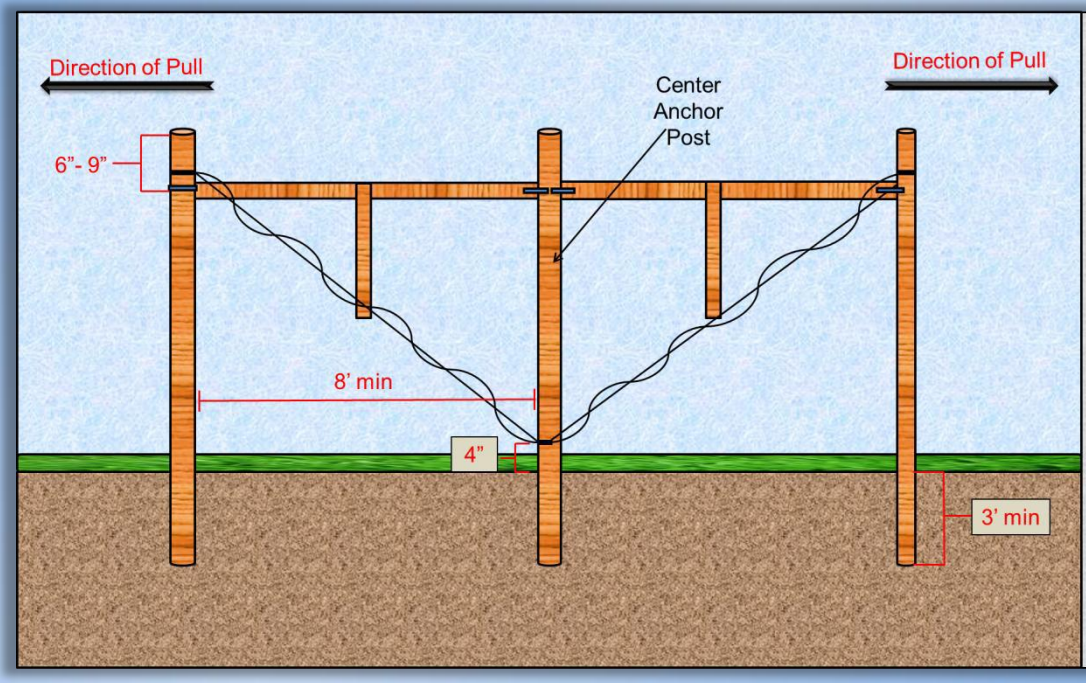


Figure 4:

In-line Pull Assemblies

Double H-braces must be used every 1,320 feet for barbed wire and high tensile wire and every 330 feet for woven.

Exception: No bracing is required for one and two strand interior electric high tensile fence.

In uneven terrain (>15% slope), more bracing may be needed.

Wires should terminate at center anchor post.

Line Posts

Although line posts are not as critical as assembly posts to overall fence construction, proper installation is necessary to prevent future problems. The recommended line post standards are displayed in Table 2 (below) while line post spacing and depth requirements are identified in Table 3 (below). If post holes are dug instead of driven, make sure you tamp the soil material as you backfill for stability. Diagrams displaying these details can be found in the following section on “Wires, Spacing, Tension, and Fastening”.

Wires, Spacing, Fastening & Tension

Installation of wires should be done after successfully constructing brace assemblies and setting line posts. The number of wires and spacing between wires will depend on several factors. Each type of fence has its own space requirements for perimeter (boundary) and interior (cross) fencing. Most perimeter fence wires are placed on the side of the post closest to the animal, except at corners.

The following figures and tables highlight NRCS's specification for different wire types. Specifications include the number of wires, wire spacing, and amount of tension required for bracing. For wood posts, staples are used as fasteners. Avoid driving staples in-line with the wood grain to prevent splitting. When using slash cut staples, place the staple parallel to the grain then rotate in the direction away from the cut face. The cut face will vary depending on if staples are left or right-handed. Space should be left between staple and post (see picture below) to allow free movement of wire. For steel posts, non-charged wires can be attached with clips recommended by manufacturer or by two turns of 14 gauge galvanized smooth wire (see picture below).

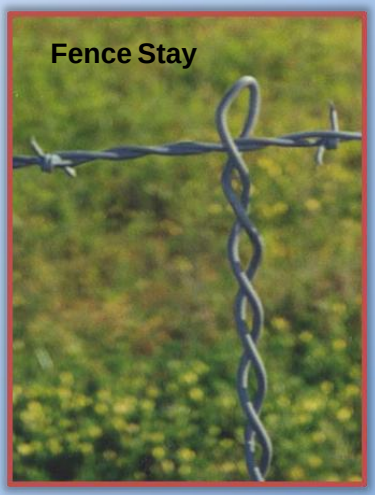
Fence "stays" (see picture below) can be used in between line posts to keep your lines evenly spaced. These can allow you to space your line posts farther apart, which can save time and effort. If you are using stays, they should be attached to wires in such a way to prevent stay slippage along the fence.

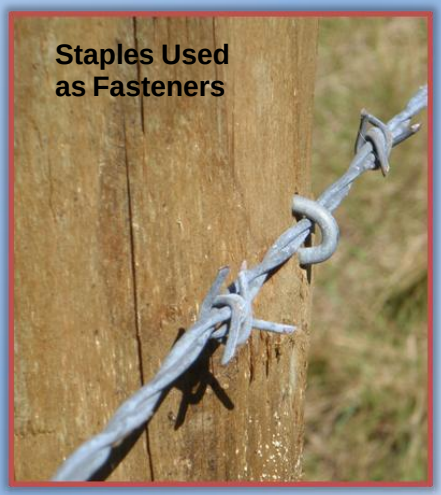
Table 2. Line Post Material Standards

Wood Posts	• Acceptable species with bark removed include black locust, red cedar (1/2 of diameter must be heartwood), Osage orange, and Australian ironwood (eucalyptus.). • All other wood posts must be treated with a minimum of 0.4 lbs/ft^3 of chromate copper arsenate (CCA-Type A, B or C), or equivalent. No landscape Timbers allowed. • Most posts must have a 3" minimum diameter. Exceptions are Osage orange (2.5") and eucalyptus (1.5").
Steel Posts	• Only new "T" or "U" posts, constructed of high carbon steel and weighing a minimum of 1.25 lbs/foot exclusive of anchor plate. • Studded, notched, or punched for wire attachment.
Trees as Posts	• Trees may be used as line posts in rocky or frequently flooded areas where holes cannot be dug or fences are difficult to maintain. Trees should be properly aligned, and have a diameter breast height of at least 4".
Others (Electric High Tensile Only)	• Fiberglass, rigid plastic, and polyvinylchloride solid round sucker rod of at least 5/8" in diameter. • Fiberglass T-posts of at least 1" cross section

Table 3. Line Post Spacing and Placement

Fence Type	Required Post Spacing	Required Post Depth
Electric High Tensile	• 75 feet maximum • 150 feet allowed if using stays every 50 feet.	• Wood = 24" • Steel = 20" • Fiberglass = 20"
Non-Electric High Tensile	• 16 feet maximum • 24 feet allowed if using stays	• Wood = 24" • Steel = 20
Barbed Wire	• 16 feet maximum • 24 feet allowed if using stays	• Wood = 24" • Steel = 20
Woven Wire	• 16 feet for standard wire fence material • 24 feet for high tensile wire fence material	• Wood = 24" • Steel = 20





Barbed Wire Fencing

New wire of two twisted strands that are either class 3 galvanized 12.5 gauge (min.) standard steel or class three galvanized 15.5 gauge (min.) high tensile steel is recommended for installation. Two-point barbs should be no farther than four-inches apart while 4 point barbs should be no farther than five-inches apart.

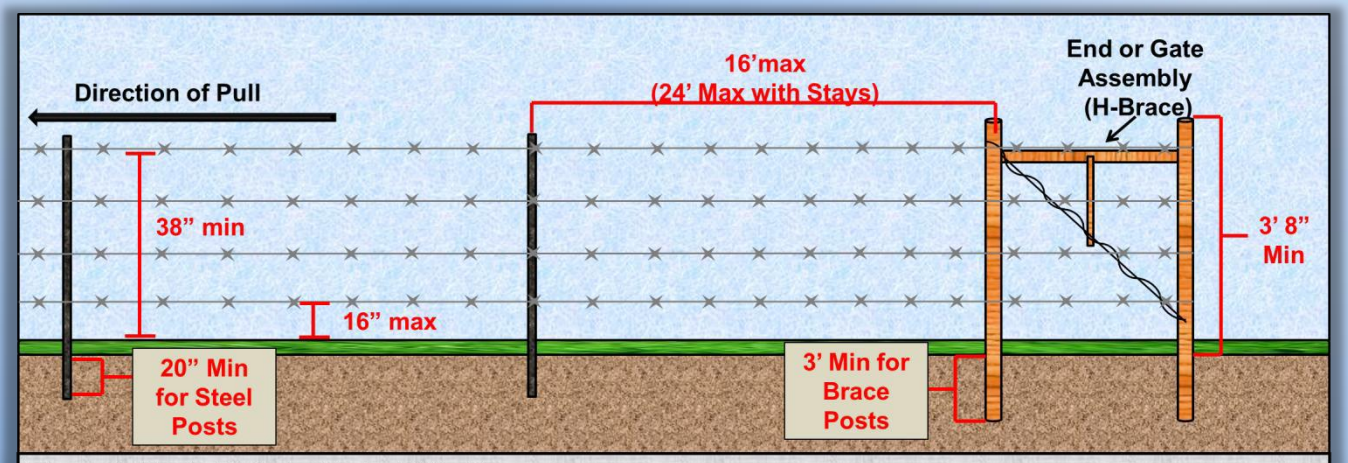


Figure 5: Typical Interior Barbed Wire Fence

This figure highlights important measurements for construction of a barbed wire fence. NRCS recommends three stands of barbed wire for interior fencing and four for perimeter (not available for NRCS cost-share) fencing. For small grazing animals, five wires or more are recommended. The minimum height for the top wire is 38"for interior fences and 42"for perimeter fences. For all fences, the top wire should be at least 2" below the top of wooden posts and 1" below top of steel posts. Bottom wires should be a maximum of 16" from the soil surface. All wires should be pulled for tension and attached firmly to brace posts.

High-Tensile Smooth Wire Fencing

Installation of new Class 3 galvanized, 12.5 gauge wire with 170,000 psi tensile strength is highly recommended. Use in-line strainers on each wire to maintain at least 150 lbs. of tension. A tension spring can be installed on the second wire from the top to monitor tension.

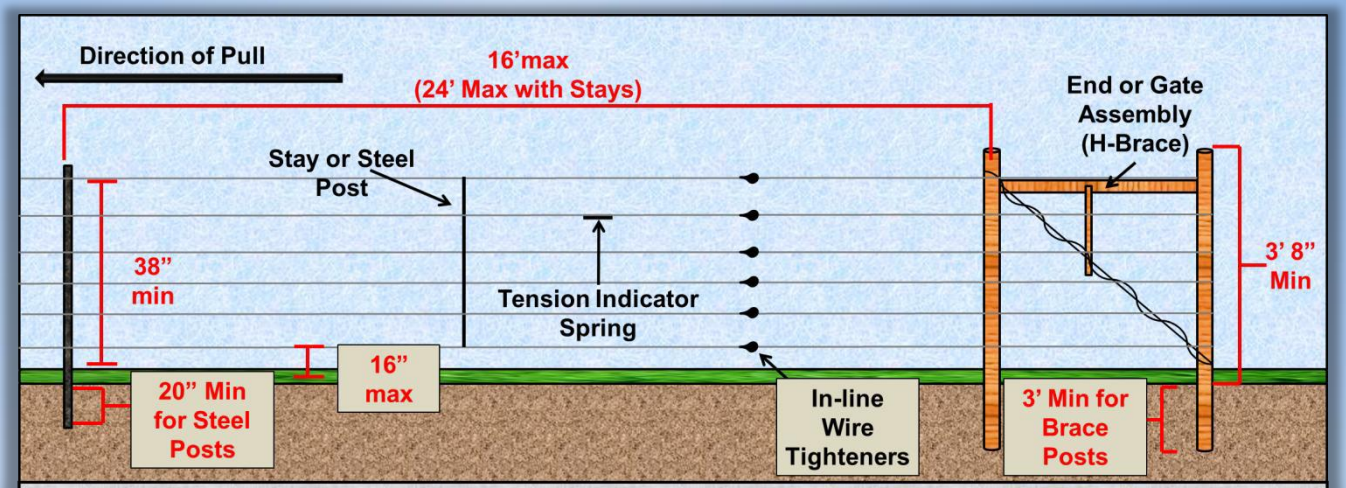


Figure 6: Typical Interior Non-Energized High Tensile Fence

This figure highlights important measurements for construction of a non-energized high tensile fence. NRCS recommends four strands of high tensile wire for interior fencing and six for perimeter fencing. The minimum height for the top wire is 38"for interior fencing and 42" for perimeter fences. For all fences, the top wire should be at least 2" below the top of wooden posts and 1" below top of steel posts. Bottom wires should be a maximum of 16" from the soil surface. The remaining wires are spaced closer toward the bottom of the fence than at the top. Wires must be tightened to 200 lbs. of tension using in-line strainers.

Woven Wire Fencing

For installation of standard low-carbon woven wire material, a minimum top and bottom edge wire gauge of 11 (12.5 for high-tensile material) and minimum intermediate wire and vertical stay gauge of 14.5 is preferred. The maximum distance between vertical stays should be 12-inches.

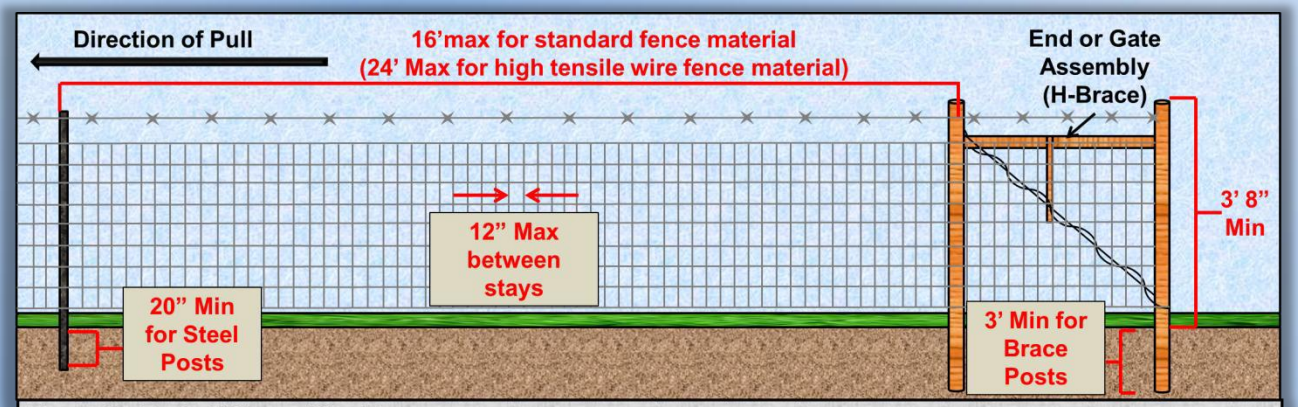


Figure 8: Typical Woven Wire Fence
This figure shows several measurements (for interior energized high tensile fences) that are required when placing and burying your line posts. The maximum spacing between posts depends on the quality of fence material that is used (16' vs. 24'). The top wire of the woven fence must be at least 38" high for interior fences. Although NRCS does not cost-share on perimeter fencing, they recommend that the top wire be a minimum of 42" high. Place at least one strand of barbed wire or one strand of high tensile smooth wire 4 to 10 inches above the top of the woven wire to reduce risk of deer becoming entangled in fence. Wires must be pulled for tension and attached to brace posts. Unlike other fence types, braces for woven wire fences must be at least every 330 feet in straight-line fence sections.

Electric Wire Fencing

Install new electric wire that meet the Class 3 galvanized, 12.5 gauge wire with 170,000 psi tensile specifications. The number of wires per fence will vary by animal type but normally ranges from one to three. Be sure to follow the wire spacing recommendations in Table 4. Use in-line strainers on each wire to maintain at least 150 lbs. of tension. A tension spring can be installed on the second wire from the top to monitor tension.

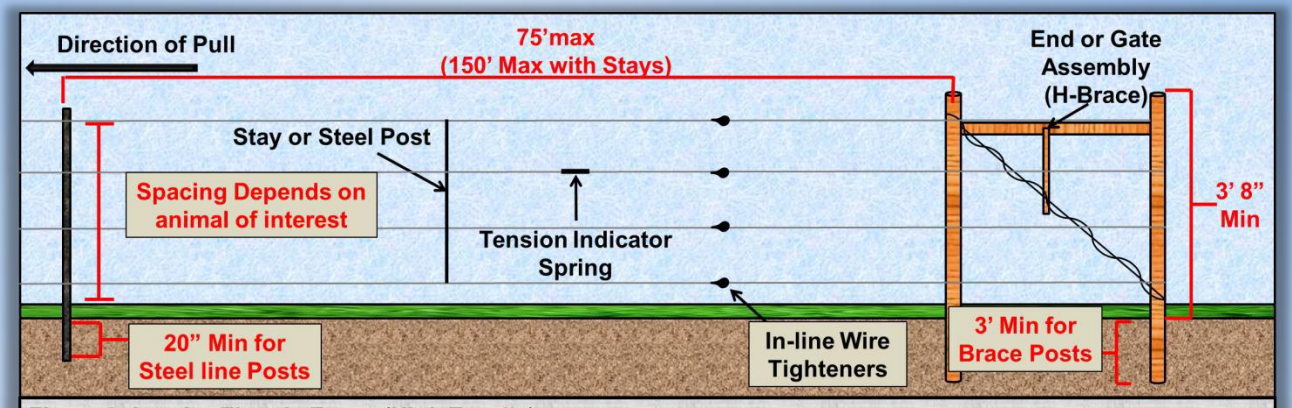


Figure 8: Interior Electric Fence (High Tensile)
This figure highlights important measurements for construction of an electric high tensile fence. NRCS recommends that interior electric fences consist of one or more wires placed at a height equivalent to two-thirds of the shoulder height or nose height of the grazing animal. For exterior electric fences, NRCS recommends four strands with the top wire being at a minimum height of 42 inches. Wires must be pulled for tension and attached to brace posts. Use in-line strainers to maintain at least 150 lbs. of wire tension. Install all electrical products (insulators, offset brackets, energizers, etc.) according to manufacturer's recommendation. Properly ground fence and utilize a surge protector to protect humans, livestock, and equipment from electrical charges, lightning strikes, and power surges.

Table 4: Recommended Electric Wire Spacing for Various Animals		
Animal Type	**# of Wires**	**Spacing from Ground (inches)**
Cattle	1	28, 34
Cattle	2	18, 28 to 34
Hogs	2	8, 16
Cattle	3	18, 30, 42
Hogs	3	8, 16, 24
Horses	3	20, 34, 46
Cattle, Horses	4	12, 22, 32, 42
Sheep, Goats	4	8, 16, 24, 36
Cattle, Horses	5	8, 16, 24, 34, 44
Sheep, Goats	5	6, 13, 21, 30, 40
Deer/Predator Control	6-8	6, 12, 18, 26, 36, 46, 56, 68

Project Information: Funds for this project were provided by the USDA Natural Resources Conservation Service and administered by the Two Rivers RC&D Council.

Rogue Valley Office
830 O'Hare Parkway, Suite 102
Medford, OR 97504
541-326-4828

Albany Office
200 Ferry Street SW
Albany, OR 97321
541-223-5130

Coos Bay Office
486 'E' Street
Coos Bay, OR 97420
541-266-8601

Newport Office
609 SW Hurbert Street
Newport, OR 97366
541-264-7040

SCOPE OF SERVICES

Date: September 13, 2021 Work Order Number:

To: Caley Sowers, District Manager, Coos Soil and Water Conservation District

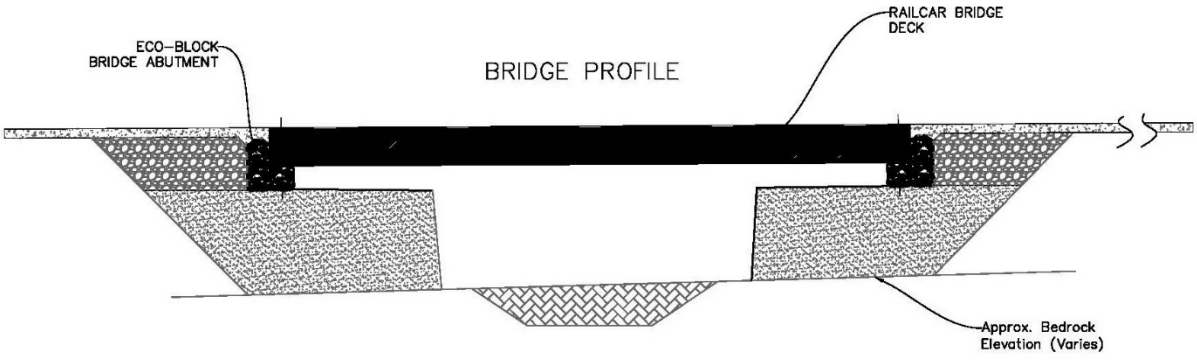
From: Will Dawson, South Coast Regional Manager, Civil West Engineering Services, Inc.

RE: **Johnston Ranch Bridge Crossing** Civil West Project Number: TBD

The purpose of this scope of services is to describe the services required for the engineering assistance and the preparation of preliminary design details for the installation of a bridge on the Johnston Ranch over Bear Creek in Bandon Oregon using Forestry best management practices.

Background Summary

On April 20, 2021 Civil West staff, and Coos Water and Soil Conservation District (Coos SWCD) met on the subject site and reviewed the existing stream condioitns where the landowners would like to install a bridge crossing, in Bandon Oregon. The project goals include the development of a cost effective sollution to span active stream channel width. The roadway will be used for forestry and agriculture activities. The goal is provide access to the westside of the Johnston property. The project may be funded with a grant through the Oregon Watershed Enhancement Board Small Grant Program.



I. Proposed Civil Engineering Scope of Services

Task 1 – Project Management and Administration – Under this task, we will provide the necessary project management and administrative services to conduct an orderly and well-managed project. This will include organizational issues, financial, and other administrative requirements. Coordination with ODFW and the Conservation District are included in this task.

Task 2 – Schematic Design Services: Under this task, we shall prepare a set of plans that will include details that outline general design considerations that should be addressed when constructing an eco-block abutment used to support a railcar bridge. Best forestry management practices along with manufacturer designed components will be utilized in this schematic, non-engineered, plan set. The plans and design tables provided are for reference only and Civil West will be held harmless against any liability.

Task 3 –Site Observation and Evaluation Support Services – Under this task we will make up to two (2) site visits to observe, evaluate, and provide recommendations on excavation. If needed a site visit can occur to verify improvements were constructed per recommendations provided in task 2.

Task 4 – Reimbursables – This task will include allowances for project costs related to reimbursable expense items.

- **Exclusions:**
  - Preparation and submittal of any required permits including any required fees.
  - Engineered Stamp Drawings
  - Any items not specifically mentioned in the above scope of services.
  - Hydraulic studies or flood plain certifications
  - Full Structural Calculations
  - Environment evaluations or permitting
  - Topographic Survey
  - Geotechnical Investigation

II. Project Fee Proposal

We have prepared a summary table that outlines the Additional Service Tasks that have been requested for this project below.

Task No.	Task Description	Proposed Total Fee
1	Project Management & Administration	$1,766.00
2	Preliminary Design Services	$6,262.00
3	Construction Phase	$1,890.00
4	Reimburables	$582.00
	Total Proposed Project Budget	**$10,500.00**

The above budget is considered “lump sum” and will be billed on a monthly basis to the limit of the total agreed upon budget. The budgeted task items above will not be exceeded unless approved by the client in writing. The time and materials (T&M) tasks shown above will be in addition to the proposed total

budget shown above and will be accumulated as they are engaged. If additional services are requested by the client, those additional services will be provided in accordance with our current hourly rate schedule attached as Exhibit “B”.

We are grateful for this opportunity to provide these services to the Coos Soil and Water Conservation District. We are prepared to begin work on this important project as soon as we are authorized to do so. Please let me know if you have any questions or if you wish to see any alterations to our proposed approach. If this proposed approach is acceptable, please sign below and return a copy to our office for our records.
Sincerely,

Civil West Engineering Services, Inc.

Will Dawson

South Coast Regional Manager

Authorized Representative Signature Accepting Scope of Services Date

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Pictorial Guide To Heavy Use Area Installation


HUA – Watering Facility


HUA – Construction


HUA – Feeding Area

Introduction

Areas on farms used frequently and intensively by livestock, farm equipment, and vehicles often benefit from the installation of a Heavy Use Area (HUA) best management practice. This conservation practice provides a stable, non-eroding surface that also protects and improves water quality and animal health. Examples where HUAs can be utilized on farms include winter-feeding areas, watering facilities, and travel lanes.

The USDA-Natural Resources Conservation Service (NRCS) has specific designs and guidelines for the installation and maintenance of heavy use areas. Landowners who participate in USDA Farm Bill programs are required to follow these designs and instructions in order to have successful projects. This document, however, is designed specifically to aid landowners interested in installing HUAs on their own, instead of using a contractor. It is not intended as a substitution for the more detailed NRCS construction specifications (http://efotg.sc.egov.usda.gov/treemenuFS.aspx), but as a supplement with easy-to-follow photographic images and diagrams.

Planning

NRCS is available to provide technical assistance to landowners in planning and installing heavy use areas. Assistance regularly includes site selection, design, specifications, recommended materials and quantities, pre-construction meetings, daily inspections, and final inspections. Financial assistance is also available through NRCS on a competitive basis. NRCS may also recommend or require other best management practices to accompany the HUA in order to protect other natural resources.

It is recommended that you construct your HUA on a relatively flat, dry, upland section of your property. All runoff from above slopes and building rooftops should be diverted away from the HUA. To protect water quality, the HUA should be located away from ponds, streams, and other water resources. To protect against possible complaints, it is recommended that you not place HUAs near utilities, cultural resources, environmentally sensitive areas, or property lines.

Concrete HUA Pad

Preparing HUA Site

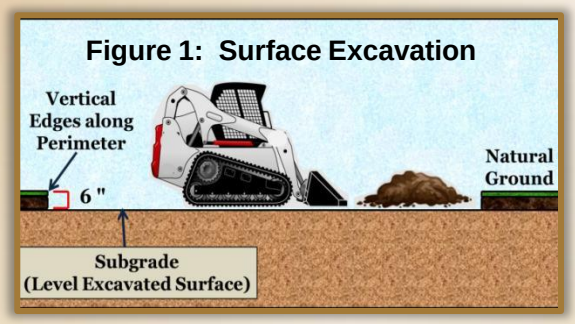


Figure 1: Surface Excavation

Table 1. Minimum Geotextile Requirements

Property	Test Method	Minimum
Tensile Strength	Grab Test STMD 4632	180 lb.
Mullen Bursting	Diaphragm Test ASTMD 3786	320 psi
Puncture Test	ASTMD 4833	80 lb.

Meeting these general site requirements may require changes in how you manage your property, but should also result in a long-lived heavy use area.

Plan your project so that the HUA pad meets the intended management use and anticipated load. The number of animals and the planned feeding facilities will dictate the size of the HUA. For example, if the intended purpose is to provide a stable winter-feeding area, you will need to consider the number of livestock utilizing the pad, the number of hay rings or feeding facilities needed for the livestock, and whether you can deliver feed to the location throughout the year. However, plan to make the HUA only as large as necessary due to additional costs and maintenance.

Most HUAs in Georgia are constructed using graded aggregate base (GAB), crusher run, or other suitable materials as a surface. In areas of intense use such as stock yards, holding pens, and dairies, it may be beneficial to use concrete for HUA construction. The concrete pad (photo above left) can reduce the need for maintenance (e.g., surface material replenishment, grading, etc.) and allow for relative ease when scraping and removing animal wastes.

Site Preparation and Excavation

Once you have decided on a location for your HUA, you can prepare the site. This includes the removal of all grasses, trees, stumps, roots, brush, weeds, and other materials.

After clearing the area, you can begin excavating the site. Excavation should be completed to a minimum depth of four to six inches beneath the natural surface while providing a vertical edge around the perimeter (Figure 1). A greater excavation depth may be required if unsuitable materials (loose, wet, organic, or other materials) are present. Some sites may even require soil reinforcement (geotextile and stone) and subsurface drainage to obtain a firm stable subgrade base. Final subgrade preparation should be such that when the surface layer materials (rock, concrete, etc.) are added, the pad surface will be flush with the natural ground.

Geotextile Installation

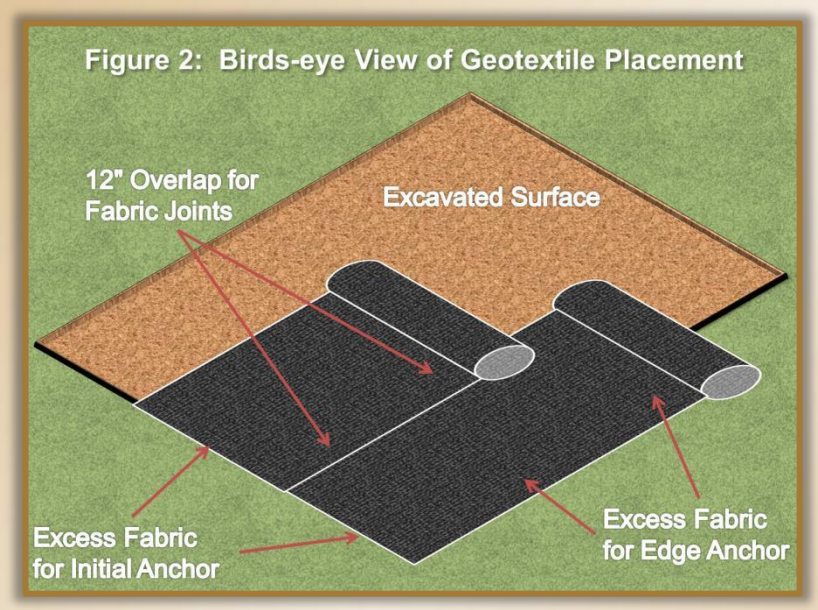
Geotextile fabric meeting NRCS specifications (see adjacent table) shall be installed according to manufacturer's recommendations prior to adding aggregate surface materials to prevent materials from sinking into subgrade over time. The fabric is placed in the same direction as the slope of the property with a 12-inch overlap at any joints (Figure 2). At evenly spaced increments along all overlapping areas, the fabric should be pinned to the subgrade to prevent fabric rollups.

For sites with porous subgrade and a need to protect groundwater from contamination, an impervious barrier should also be installed. For concrete HUA pads, geotextile is not required.

The geotextile fabric ends should be anchored along the perimeter using one of several approved methods to permanently maintain the fabric beneath the surface. Two of these methods are shown in Figures 3 and 4. Regardless of the method, the most important thing is that the fabric never comes to the surface where it will become damaged and/or eventually yanked out of the ground by livestock.

The simplest method, which requires the least material, is shown in Figure 3. However, some prefer utilizing anchor trenches (at least six inches wide and a minimum of six inches deep) to anchor the fabric along the perimeter. The width of the trench used for a site normally ends up being the size of the equipment bucket (6, 12, or 24 inches).

The simplest way to use anchor trenches is depicted in Figure 4. When using this method, in addition to planning for a 12-inch overlap at all fabric joints, you should also anticipate needing extra fabric in all directions from the excavated surface to anchor the fabric in the trenches along all sides. While this extra material will be slightly more expensive, it may save money in the long run by avoiding unexpected maintenance or replacement of materials.



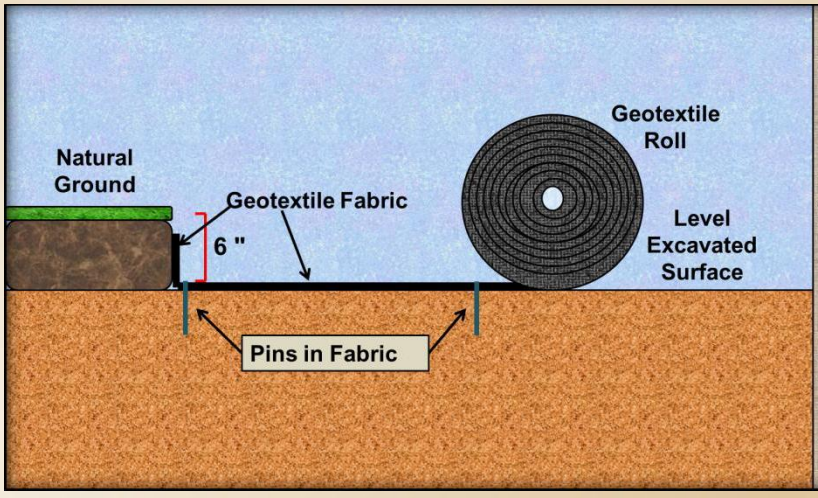


Figure 3. No-Trench Anchoring :

Lay the beginning end of the fabric four to five inches up the vertical edge at one side of the perimeter. Ensure the fabric ends are a few inches beneath the natural surface to protect it from being pulled out. At regular intervals, pin the fabric to the subgrade beneath the vertical edge. Place additional pins as needed through the fabric as it is laid across the HUA. Anchor all edges in a similar manner.

Repeat the process with additional lengths of fabric as needed to cover the HUA. Ensure that there is a one-foot overlap where any fabric sheets meet. Place pins regularly across the fabric, including the overlapped areas and next to all other vertical edges.

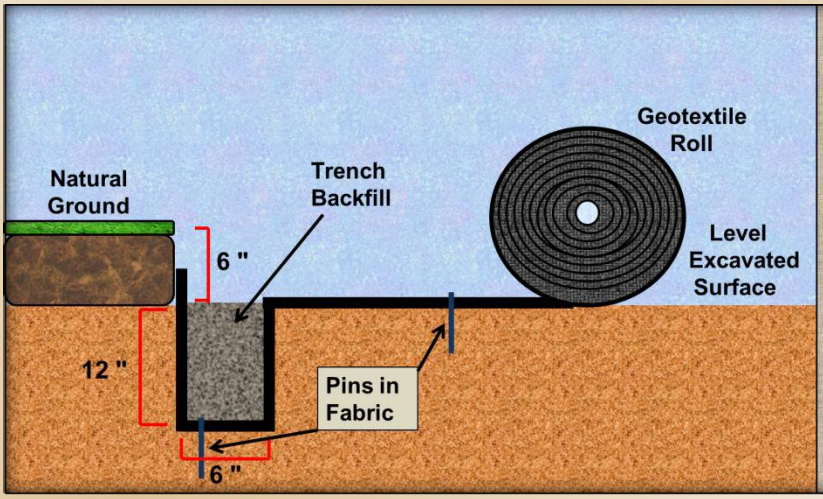


***Figure 4. Anchoring* with Trenches:**

Line the trench with the fabric so that the end is along the vertical edge a few inches below the natural ground. At regular intervals, pin the fabric to the bottom of the trench and continue placing additional pins as needed through the fabric as it is laid across the HUA. Anchor the far vertical edge in the same manner.

Repeat the process with additional lengths of fabric as needed to cover the HUA. Ensure that there is a one-foot overlap where any fabric sheets meet. Place pins regularly across the fabric, including the overlapped areas and in all other trenches. Fill the trenches with appropriate material and compact.

Surface Layer Completion

After the geotextile installation is completed, you are ready to apply the surface materials. These materials should be spread evenly over the geotextile covered area and compacted to a smooth, uniform grade. Keep in mind that heavy equipment is not recommended on fabric without a cushion of gravel or stone. Six inches of surface materials are required, so that the outside edge is the same elevation as the adjacent natural soil surface. Any soft spots discovered during compaction should be removed and replaced with suitable material. If the HUA pad is for a watering system, the surface should be graded to provide a slight mound around the watering system. This helps prevent future depressions and ponding.

Constructed HUA Before Vegetative Stabilization

If you are using concrete for your HUA, you will first need to construct the forms (four inches) for pouring. Concrete should be 3000 psi strength with fiber reinforcement at 1.5 lbs/cubic yard. A joint spacing of 15 feet on center or less should be maintained. Avoid extreme temperatures when pouring the concrete. If the concrete pad extends up above the adjacent ground level, use GAB or crusher run to provide a transition between the pad and the natural ground.

Vegetation and Runoff Control

Areas surrounding the completed HUAs need to be stabilized to prevent erosion. This can include seedbed preparation, liming, fertilizing, seeding, and mulching. Other practices such as filter strips and check dams may be necessary to help slow and filter runoff from areas above and around the HUA. See the construction specifications from NRCS for information on operation and maintenance, such as when to scrape waste and replenish surface materials during the life of the practice.

Project Information: Funds for this project were provided by the USDA Natural Resources Conservation Service and administered by the Two Rivers RC&D Council.

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Pictorial Guide To Watering Facility and Pipeline Installation

Freeze Proof Facility with Heavy Use Area

Pipeline with Trench

Concrete Facility along Cross Fence

Introduction

Installing a well-designed livestock watering system can improve the efficiency of a farm operation in multiple ways. Properly installed systems often improve the growth rates of livestock, reduce risk of disease, improve grazing efficiency, and protect water quality. The components of a watering system often include pipeline, heavy use area (HUA) protection, and the watering facility itself.

The USDA-Natural Resources Conservation Service (NRCS) has specific designs and guidelines for the installation and maintenance of each component of a watering system. Landowners who participate in USDA Farm Bill programs are required to follow these designs and instructions (http://efotg.sc.egov.usda.gov/treemenuFS.aspx). These details are included in NRCS Conservation Plans that are distributed to every landowner that is participating in the programs. This document is intended to be supplemental to those plans with easy-to-follow photographic images and diagrams.

Planning

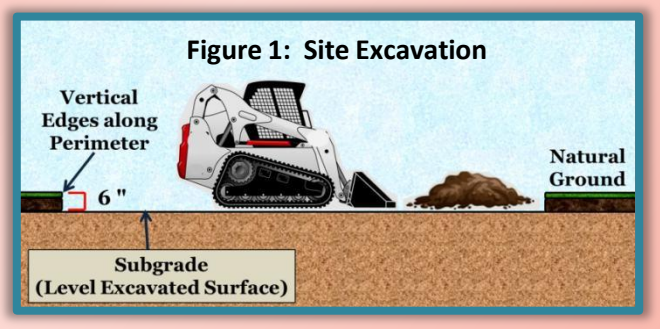
NRCS is available to provide technical assistance to landowners in planning and installing watering systems. Assistance regularly includes, site selection, design, specifications, recommended materials and quantities, pre-construction meetings, daily inspections and final inspections. Financial assistance is also available through NRCS on a competitive basis. NRCS may also recommend or require other best management practices to accompany watering systems in order to protect other natural resources.

Your facility should be constructed on a nearly level area where there is good natural drainage and a firm foundation. Pick a site that discourages loafing around the facility (away from shade trees, mineral feeding sites, etc.). Also, when selecting a site, ensure that enough room is available for the heavy use area pad that must be constructed around the facility. To promote uniform grazing of pastures and distribution of animal wastes, locate the facility so that animals don't travel more than 800 feet for water.

The type of watering facility selected will be based on the needs of the operation. Facilities can be open top or closed (floating-ball type). They can consist of

Table 1. Trough Specifications	
Concrete	• Use concrete with a compressive strength of 3,000 psi at 28 days • Minimum base and wall thickness of 4 and 3 inches, respectively • Steel reinforcement either: 3/8" bars spaced on 8-inch centers in both directions, or 8 gauge welded wire mesh
Galvanized Steel Tanks	• Wall thickness must be at least 20 gauge
Fiberglass and Plastic	• Must be made from, or coated with, ultraviolet resistant material

Table 2. Livestock Water Needs	
Beef Cattle and Horses	• 20 gallons per head per day
Dairy Cattle	• 25 gallons per head per day
Sheep and Goats	• 2 gallons per head per day



commercially available galvanized metal, reinforced concrete, freeze-proof plastic, fiberglass, or other approved materials (see Table 1). Facilities can be designed to be filled manually or automatically with a water level control valve. The most important consideration when choosing a manually-filled facility is size. Select one that, when combined with your specific water source, helps you meet the water requirements of the livestock on the property (see Table 2) with minimal labor. Your local NRCS representative can help you with selection.

The best water source varies by site. Consistent supply is ideal, but cost, maintenance, and labor are also factors. Common sources include wells, public water supply, ponds, creeks, and springs.

Several choices of pipe materials are approved by NRCS. Your local NRCS representative can help present your options, such as type and size of pipes needed for the situation, and guide the decision-making process. You can also refer to the NRCS Construction Specifications for Pipeline to review allowable materials on your own.

After selecting facility locations, water source(s), and materials, construction can begin. In general, watering facility site preparation should come first, followed by pipeline construction, then heavy use area pad construction, and finally watering facility installation. Although the HUA construction will be largely completed after pipeline installation, it is often ideal to complete the first few steps during facility site preparation.

Watering Facility Site Preparation

Site preparation includes the removal of all grasses, trees, stumps, roots, brush, weeds, and other objectionable materials. The cleared area should extend at least 15 feet (eight feet for small ruminants) outside the perimeter of the facility to allow for the HUA. This guide briefly describes construction for a gravel HUA pad. Refer to the *HUA Construction Specifications* for more details or for guidance with concrete HUA pads.

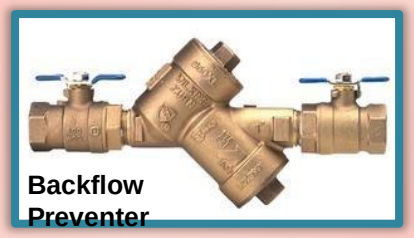
To prepare for the gravel HUA pad, excavation should be a minimum depth of four to six inches while providing a vertical edge around the perimeter (adjacent Figure 1). If desired, a deeper trench can be dug around the perimeter of the area to allow for eventual anchoring of the geotextile fabric edges to help keep it in place. Ensure that no loose, wet, or organic, materials are present. The remaining steps should be completed after the pipeline is installed.

Pipeline Installation

Although the “plow-in” method of pipeline placement is approved by NRCS in suitable soils, most landowners begin their pipeline construction by digging a trench. As a precaution, it is recommended to call 811 to have all utility lines marked (free of charge) to avoid accidents. After locating utility lines and other potential hazards, trenches should be dug so that pipe can be buried a minimum of **two feet deep**. Deeper trenches may be needed to protect against traffic, farm operations, freezing temperatures, or soil cracking. There should be no large rocks or other sharp materials in the trenches that might damage pipe. Drastic changes in grade along the pipelines path should be avoided.


Pipeline Trench

The pipe should be assembled beginning at the water source and pieced together using appropriate unions, gaskets, couplings, and/or solvent cements. Backflow preventers (see pictures above) or check valves are required to be installed at a well or public water source to protect water quality.


Backflow Preventer


Check Valve

The pipeline should terminate at your watering facility site, with a vertical section of pipe exposed above the level of the natural ground. Be sure to flush and disinfect pipeline before connecting to watering facility and water supply valves to prevent contamination. After flushing, the pipeline should be tested for leaks, repaired if necessary, and re-tested before backfilling begins. Use mineral soils or other selected material that is free of rocks or sharp material for the initial backfill, and be careful not to disturb the placement of the pipe when backfilling. To avoid settling, crown the backfill material, but make sure to quickly stabilize the site with vegetation to prevent erosion.


Vertical Pipe ready for Watering Facility

HUA Completion

To complete the gravel HUA pad, geotextile material (refer to NRCS Standards for specific materials) must be laid down on the excavated surface that extends 15 feet from the perimeter of your planned watering facility. It may take several lengths of fabric to cover the area properly, and separate lengths of fabric should overlap at least 12 inches. If anchoring the edges of fabric for extra protection using the trenching method (see Figure 2 on next page), excess fabric will be needed along the perimeter. When anchoring, pin the material to the ground throughout the trench and then backfill with gravel or other suitable material. Even if trenching is not desired, the fabric should still be properly pinned to the ground around the entire


Trench Backfilled and Mounded Before Stabilization

pad to prevent the fabric from being yanked out by livestock. Heavy equipment should never drive over fabric before backfill is applied.

The HUA pad should be backfilled with appropriate material (crusher run, graded aggregate base, etc.) until the surface of the pad is even with (or slightly higher to allow for settling) the natural soil surface. Areas around the completed HUA pad should be stabilized with vegetation to prevent erosion. See the *NRCS Construction Specifications for Heavy Use Areas*, or talk with your local NRCS representative, for more detailed information on the construction of this conservation practice.

Watering Facility Installation

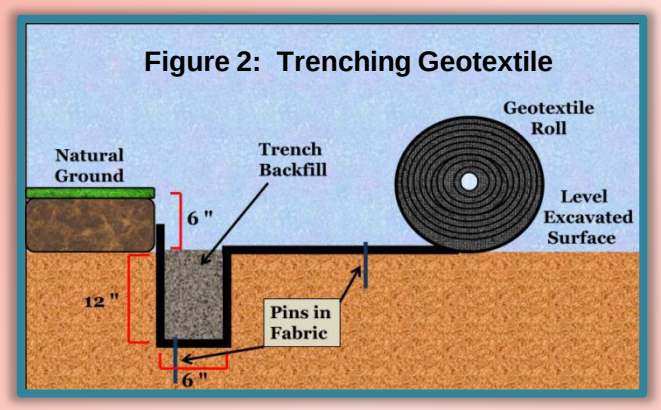
Due to the variety of facilities available, installation of a watering facility should be guided by manufacturer's recommendations. Many closed-top (floating ball) facilities require bolting to a concrete foundation. Others may be much simpler, especially if it is a facility that will be manually filled.

There are, however, some recommendations that apply to most facilities in use. The height of livestock should be considered, and for horses or cattle the facility height can vary from 22 to 36 inches. Water levels should ideally be kept a few inches below the top of the facility by using water control valve and/or overflow pipe. Drainage outlets can provide a method for emptying the facility for maintenance. Any exposed valves or pipes should be protected with shields or covers to prevent damage by livestock.

Operation and Maintenance

Pipelines and all components (pumps, valves, pressure regulators, etc.) should be regularly inspected and tested. Periodically, pipelines should be checked for materials that restrict system flow such as debris, minerals, and algae.

Watering facilities should be periodically cleaned and kept free of materials, and inspected for leaks and faulty equipment (water control valves, etc.).

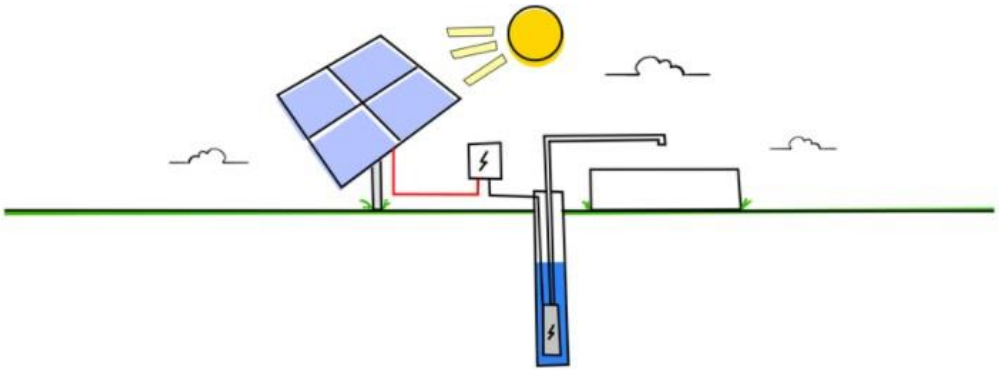



Geotextile Placement and Trench Anchoring of HUA Pad


Closed-Top Tank on Concrete Foundation with Completed HUA Pad

Project Information: Funds for this project were provided by the USDA Natural Resources Conservation Service and administered by the Two Rivers RC&D Council.

How Solar Pumps Work



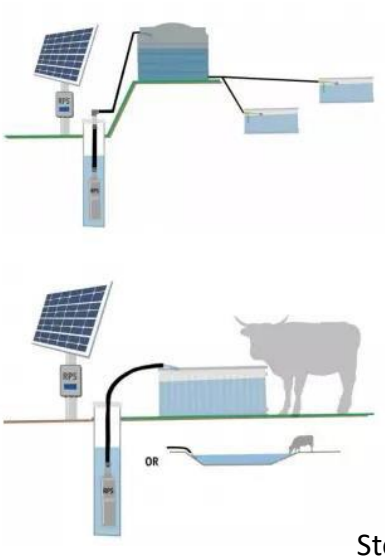
When the sun shines on the surface of your solar panels, the movement of electrons generates DC power which is transferred through attached wires to the pump controller.

The pump controller is the brains of the system and with sophisticated technology and sensor inputs, it turns the submersible motor and drives the pump to push water against gravity to the surface.

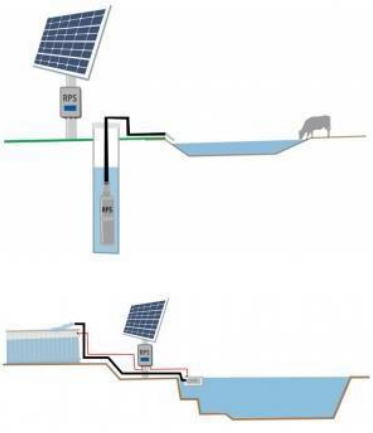
Solar pumps are sized by calculating the total vertical feet they'll need to push water, the pressure they need to generate, and the total water required each day.
Start sizing your pump now

Diagrams of Popular Installs

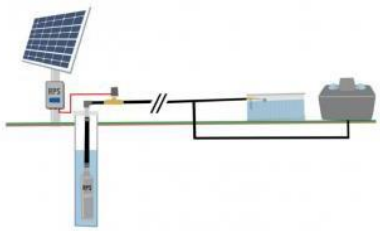
Pumping into tanks



Pond installs

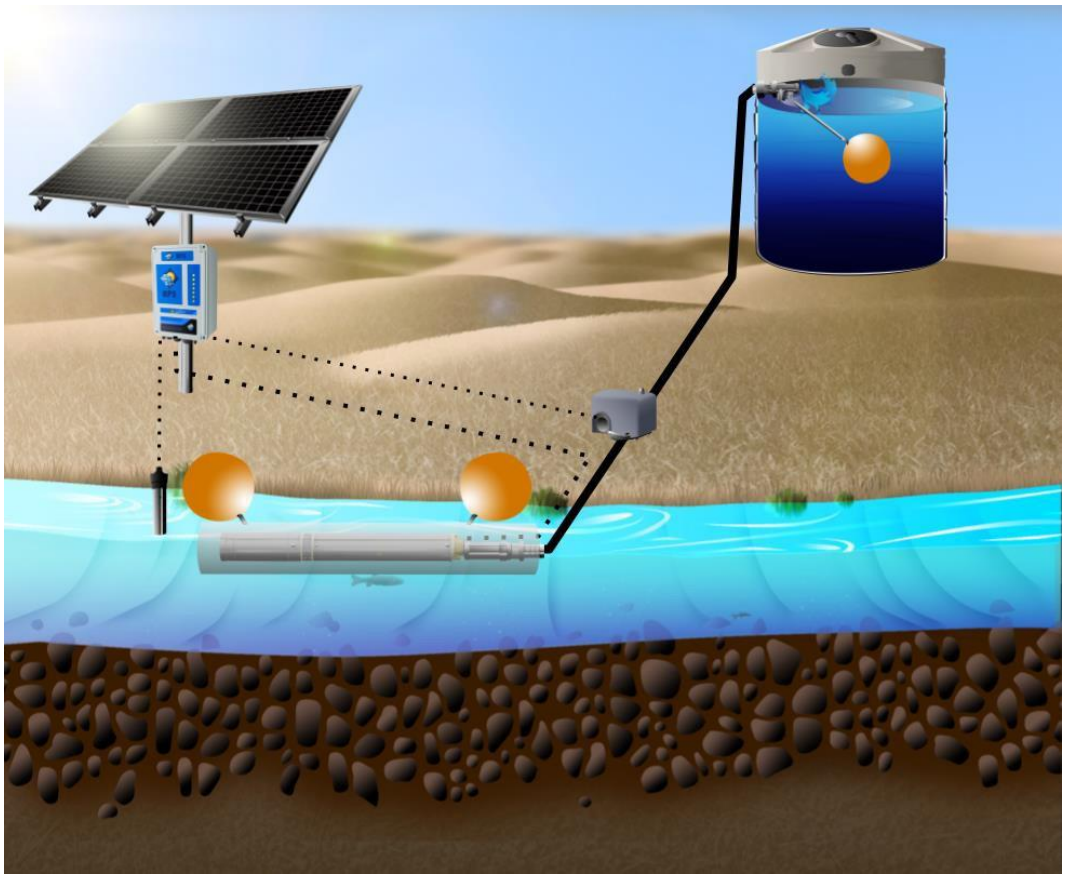


Pumping into waterers



Works with all float valves and waterers: Ritchie, Miraco, Tarter, Behlen Country, Mira-fount, SPI etc.

Step-By-Step Installation Videos can b viewed here:
https://www.youtube.com/channel/UCx18O-6Dhv8seaELuAA_Y5Q



RPS Kits Include:

RPS Controllers
Multiple Sensor Inputs
Tank & Well Low sensors
Variable Frequency Control
Cycling Protection Timer
Exterior Shut-off Switch

RPS Solar Panels
UL1703 Certified
Per Intertek ETL
Nationally Recognized to Hail, Wind Requirements
IEC 612512 / IEC 61646
*Comply fully with NRCS

2 Year Comprehensive Warranty
30 Day Money-Back Guarantee
Engineering Phone/Text Support

Includes the BEST step-by-step installation manual you're ever used. Seriously. You'll want to frame it. 22+ pages of full color to arm you with knowledge and give you a reference on the basic wiring, plumbing and mounting required.

RPS Motors
Slow Start/Stop
Brushless Motor Tech.
Permanent Magnet Efficiency
Rated for Continuous Operation

RPS Pump Ends
Serviceable in the Field
Helical & Centrifugal Technology
Lifetime Rotor Warranty
Stainless Steel Body

Plumbing connectors
Controller mounting hardware
Low-water & tank shut-off sensors
Waterproof splice/heatshrink kit

Figure 1. Example of Solar Panel Installation with Protective Fencing

Figure 2. Example of Solar Panel Installation with Watering Trough on a Heavy Use Area Protection