NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WATERING FACILITY

(No.)

CODE 614

DEFINITION

A permanent or portable device to provide an adequate amount and quality of drinking water for livestock and or wildlife.

PURPOSE

To provide access to drinking water for livestock and/or wildlife in order to:

- Meet daily water requirements
- Improve animal distribution

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where there is a need for new or improved watering facilities for livestock and/or wildlife.

CRITERIA

General Criteria Applicable To All Purposes

Design watering facilities with adequate capacity and supply to meet the daily water requirements of the livestock and/or wildlife planned to use the facility. Include the storage volume necessary to provide water between periods of replenishment. Refer to the National Range and Pasture Handbook for guidance on livestock water quantity and quality requirements.

For wildlife, base water quantity and quality requirements on targeted species needs. See Biology Technical note 54 for additional guidance. http://www.nm.nrcs.usda.gov/technical/tech-notes/bio/bio54.pdf

Wildlife escape features shall be incorporated into the watering facility design. Biology technical note 55 provides guidance for the design of escape ladders. http://www.nm.nrcs.usda.gov/technical/tech-notes/bio/bio55.pdf

Locate facilities to promote even grazing distribution and reduce grazing pressure on sensitive areas.

Design the watering facility to provide adequate access to the animals planned to use the facility.

Include design elements to meet the specific needs of the animals that are planned to use the watering facility, both livestock and wildlife. To protect bats and other species that access water by skimming across the surface, fencing material should not extend across the water surface

Protect areas around watering facilities where animal concentrations or overflow from the watering facility will cause resource concerns. Use criteria in NRCS Conservation Practice Standard 561, Heavy Use Area Protection to design the protection.

Install permanent watering facilities on a firm, level, foundation that will not settle differentially. Examples of suitable foundation materials are bedrock, compacted gravel and stable, well compacted soils.

Design and install watering facilities to prevent overturning by wind and animals.

Design watering facilities and all valves and controls to withstand or be protected from damage by livestock, wildlife, freezing and ice damage.

Construct watering facilities from durable materials that have a life expectancy that meets or exceeds the planned useful life of the installation. Follow appropriate NRCS design

procedures for the material being used or industry standards where NRCS standards do not exist.

Use the criteria in NRCS Conservation Practice Standard 516, Pipeline to design piping associated with the watering facility. Include backflow prevention devices on facilities connected to wells, domestic or municipal water systems.

Where heavy equipment tires are used as troughs, clean and rinse thoroughly before using them as they may have been filled with chemicals such as ethylene glycol or calcium chloride.

For expanded definitions of the criteria and considerations contained in this standard please review the NRCS publication "Watering Systems for Serious Graziers" at the following web address: http://www.mo.nrcs.usda.gov/news/images/Watering%20Systemslow.pdf

Water Quality. The quality of the water must be sufficient for use by the intended animal. **Table 1** lists the State of New Mexico livestock water standard, as of February 2000. If it is suspected that any of the levels in **Table 1** are exceeded, the cooperator shall test the proposed water source for those contaminants.

The maximum recommended level of nitrate (NO3) is 45 mg/l. The following maximum recommended level for total dissolved solids (TDS) applies:

- Small animals - 3,000 Mg/L,
- Poultry - 5,000 Mg/L,
- Other livestock - 7,000 Mg/L.

SOURCE: U.S. Environmental Agency, 1973b.

Table I
State of New Mexico Livestock Water Standard

Contaminant	Quantity	Unit
Dissolved Aluminum	5.0	mg/l
Dissolved Arsenic	0.2	mg/l
Dissolved Boron	5.0	mg/l
Dissolved Cadmium	0.05	mg/l
Dissolved Chromium	1.0	mg/l
Dissolved Cobalt	1.0	mg/l
Dissolved Copper	0.5	mg/l
Dissolved Lead	0.1	mg/l
Total Mercury	0.01	mg/l
Dissolved Selenium	0.05	mg/l
Dissolved Vanadium	0.1	mg/l
Dissolved Zinc	25.0	mg/l
Radium-226+ Radium-228	30	pCi/l
Tritium 20,000 PCi/L	20,000	pCi/l
Total gross alpha (including radium-226, but excluding radon and uranium	15	pCi/l

Windmill supplied facilities shall have at least a 10-day total storage capacity. Motor and engine powered facilities shall have at least a 5-day total storage capacity. The minimum capacity for a trough shall be a 1-day supply. Recharge time for troughs shall be within one day.

Capacity for water requirements shall be computed at the design water elevation. Capacity for payment shall be computed to include the 2 inches of minimum freeboard.

The installation shall have a capacity to provide seasonal high daily water requirements for the number and species of animals to be supplied as shown in **Table 2.**

Table 2
Livestock Daily Water Consumption

Type of Livestock	Gallons per Day per Head
Beef Cattle Horses	10 to 15
Dairy Cows (Drinking only)	15
Dairy Cows (Drinking and barn needs)	35
Hogs	4
Sheep and Goats	1 to 2

Layout. The site shall be well drained. Areas adjacent to the watering facility that will be trampled by livestock shall be graded, graveled, paved, or otherwise treated to provide firm footing, eliminate water puddles, and reduce erosion. Design of the protective surface around the watering facility shall be in accordance with NRCS Conservation Practice Standard 561, Heavy Use Area Protection.

The watering facility shall be protected from freezing and ice damage. Freeze-proof troughs, float boxes, or electric heaters may be used.

When a roof is placed over the watering facility to provide shade, the roof shall be designed for appropriate snow and wind loads. The roof supports (posts or columns) shall be durable enough to withstand anticipated livestock and wildlife activities.

MATERIALS AND CONSTRUCTION

All materials shall have a life expectancy that meets or exceeds the planned useful life of the installation. A watering facility may be designed and constructed from any of the following materials:

- Reinforced concrete,
- Reinforced concrete floor with steel walls,
- Rubble masonry,
- Fiberglass,
- Galvanized corrugated steel or steel plate with welded, bolted, or riveted joints,
- Appropriate rubberized materials such as tires,
- Special designs or materials as approved by the State Conservation Engineer.

Used Material. All used material, including refurbished tanks, must comply with NEM Part 512.

Reinforced Concrete. All concrete shall be proportioned, mixed, placed and cured as required to produce a 28-day strength of at least 3,000 pounds per square inch.

Reinforcing steel shall be covered by at least 2 inches of concrete. See **Table 3** for size and spacing of steel. All splices shall be lapped a length at least 30 times the diameter of the reinforcing steel and be tied in place with iron tie wire. Reinforcing mesh shall be lapped at least 6 inches.

Table 3
STEEL REINFORCEMENT REQUIREMENTS & CONCRETE FLOOR THICKNESS

Diameter of Circular Tank (feet)	Floor Area(square feet)	Concrete Floor Thickness (inches)	Minimum Steel Reinforcement
0 to 20	0 to 315	4	6”x6”, 10 gage welded wire fabric
20 to 30	315 to 706	6	6”x6”, 6 gage welded wire fabric
30 to 40	706 to 1,256	6	#4 rebar, 12” center-to-center, both ways
> 40	> 1,256	8	#4 rebar, 9” center-to-center, both ways

Table 4
Steel Rim Tanks and Troughs

Black Sheet

Height Diameter	< 26 inches	26 to 48 inches	48 to 96 inches [1/]
< 12 feet	14 gage	12 gage	10 gage
12 to 30 ft	12 gage	12 gage	10 gage
30 to 40 ft	10 gage	10 gage	3/16”
> 40 feet	3/16 “	3/16”	3/8”

Galvanized Sheet

Height Diameter	< 26 inches [2/]	26 to 48 inches	48 to 96 inches [1/]
< 12 feet	16 gage	14 gage	12 gage
12 to 30 ft	14 gage	14 gage	12 gage
30 to 40 ft	14 gage	12 gage	10 gage
> 40 feet	12 gage	10 gage	3/16”

[1/] Tanks having heights greater than 8 feet shall be individually designed. These designs are to be reviewed and approved by the SCE..

[2/] Tanks constructed of these materials (16 gage or thinner) shall be rolled or reinforced on the top.

Table 5
Weights for Sheet Metal

Uncoated Black Sheet Steel

Gage	Pounds per Square Foot
000 (3/8")	15.00
3 (1/4")	10.20
7 (3/16")	7.65
10	5.63
12	4.38

Galvanized Flat Steel

Gage	Pounds per Square Foot
8 (3/16") [3/]	7.03
10	5.78
12	4.53
14	3.28
16	2.66

[3/] Thickness equivalent for 8-gage galvanized sheet is 0.1681. Weights for 3/16 inch galvanized sheet are not listed in common tables. Use 8-gage where tables call for 3/16 inch.

Galvanized Corrugated Steel

Gage	Pounds per square foot		
	2½ x ½ [4/]	2⅔ x ½ [4/]	3 x ¾
10	6.31	6.31	-
12	4.94	4.94	5.23
14	3.58	3.58	3.79
16	2.90	2.90	3.07
18	2.35	2.35	2.49

[4/] Standard 2½ inch corrugated sheets have 9 corrugations exclusive of side lap and cover a width of 24 inches; therefore, the corrugation pitch measures approximately 2⅔ inches.

Refurbished Tanks. Used steel tanks (oil, gasoline, *et cetera*) shall be acceptable, providing the minimum thickness requirements in **Table 4** are satisfied. Tanks shall be refurbished at a commercial tank refurbishing facility. They shall be cleaned to bare metal and coated with an approved coating for potable water. They are to be certified by the facility as being suitable for the storage of livestock water. Alternative materials to used tanks are to be presented to the producer.

Fiberglass. Prefabricated fiberglass storage tanks and troughs shall meet the thickness requirements of **Table 6**. Used storage tanks may be reconstructed with fiberglass by meeting all the requirements of a newly manufactured storage tank installation.

Table 6
CIRCULAR FIBERGLASS TANKS & TROUGHS - (Up to 20 feet in diameter)

Height (feet)	Wall and Bottom Thickness (inches)
0 to 6.0	1/4
6.1 to 12.0	5/16
12.1 to 16	3/8

All fiberglass troughs shall be reinforced at the top rim.

Any fiberglass tanks exceeding 20 feet in diameter shall be approved by the State Conservation Engineer and shall be certified by the manufacturer as meeting AWWA Standard D 120 (Thermosetting Fiberglass-Reinforced

Plastic Tanks) or ASTM Standard D 3299 (Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks).
Fiberglass structures shall be made of ultraviolet resistant materials or shall have a durable coating to protect the structure from deterioration due to sunlight.

Reinforced Concrete Walls. All reinforced concrete walls shall have a minimum thickness of 6 inches. Reinforcing shall be No. 4 or larger reinforcing steel bars spaced on 12-inch centers both ways. Reinforcing mesh 6-inch by 6-inch and made with 6-gauge steel may be used in walls up to 4 feet in height. Vertical bars shall have an 18-inch leg projecting horizontally into the floor and extending to within 3 inches of the top of the wall.

Concrete Floors. Design of all concrete floors shall conform to **Table 3**.

Rubble Masonry Walls. Troughs or tanks, constructed of rubble masonry and less than 20

feet in diameter or 315 squares feet in floor area, and/or having a water depth of 2 feet or less, shall have a wall thickness of at least 8 inches. Those with a diameter larger than 20 feet or 315 square feet in floor area, and/or with a water depth greater than 2 feet, shall have a thickness of at least 12 inches.

Rubble masonry walls with water depth greater than 2 feet shall be supported with adjustable coupling bands uniformly spaced at intervals not to exceed 18 inches. The band shall be of any shape, but each band shall have a minimum cross-section of 0.3 square inches (*exampli gratia* 5/8-inch diameter rod) of steel and must extend around the perimeter of circular tanks. For square or rectangular tanks, bands must have one coupling for each wall and the band must be bent square at the corners.

Rubble Masonry Floors. Rubble masonry floors may be used with rubble masonry walls and shall be as thick as the wall. Rubble masonry floors shall not be used with steel walls or reinforced concrete walls.

Footings. Footings shall be at least 12 inches thick and 18 inches wide. The footing shall extend at least 12 inches outside the wall and at least 6 inches inside the wall.

The minimum footing width for concrete or rubble masonry walls shall be the minimum footing width plus the wall thickness.

Concrete and steel shall be placed continuously between footing and floor.

A construction joint can be made between footing and wall on reinforced concrete walls.

Inlet, Outlet, and Overflow Pipe. The pipe shall be placed and secured in place before the concrete is placed.

Automatic water level control and/or overflow facilities shall be provided as appropriate.

Plumbing shall be shielded to prevent damage by livestock.

Overflow must be held to a minimum and shall be piped to a stable and suitable point of release. The point of release and appropriate buffer shall be fenced to exclude livestock. Topography must be evaluated to minimize water erosion from overflow.

Overflow pipes must be of a diameter equal to or larger than the inlet pipe. On drinking troughs where automatic float control devices are used, overflow devices are not needed.

An overflow pipe or automatic float shall be installed to provide 2 inches minimum freeboard in the tank or trough. Inlet and outlet pipes must be of a diameter equal to or larger than that of the connecting pipeline.

Prefabricated Tanks. All joints must be of good quality and be watertight. Joints that are crimped or soldered are not acceptable.

Prefabricated tanks must meet the wall thickness requirements of **Table 4**.

Prefabricated Drinking Troughs. Trough size shall be a minimum capacity for a 1-day supply, a maximum of 12 feet in diameter, and a maximum height of 26 inches.

Recharge time shall be considered in sizing a trough to satisfy watering demand. Material for prefabricated metal troughs shall be corrugated galvanized sides and flat galvanized bottom with a 22-gauge minimum thickness.

All joints shall be of good quality and watertight. Trough rims must be reinforced or rolled. When metal troughs are expected to be in contact with corrosive soils, they shall be asphalt-coated or epoxy-coated.

Permanency, Anchoring, and Guarding.

Troughs and tanks shall be permanently installed.

The determination as to whether a trough or tank is "permanently installed" will be left to the judgment of the engineer.

A troughs or tank shall be adequately anchored so that it cannot be moved by livestock or wind, particularly when they are empty. This can be done in, but is not limited to, the following:

- Concrete ballast at least 4 inches thick placed inside the tank or trough,

- Three or more equally spaced posts welded or bolted to facility and anchored in concrete or buried at least 30 inches into soil,
- Three or more equally spaced ⅜-inch diameter guy wires secured to the facility with bolts or welded and anchored, or
- Two cross members of 1½-inch diameter steel pipes bolted to four equally spaced posts. The posts shall be standard steel posts or a minimum 4-inch-diameter juniper, piñon, or treated pine, and shall be set at least 30 inches deep.

They shall be guarded to prevent entry by livestock.

CONSIDERATIONS

Design fences associated with the watering facilities to allow safe access and exit for area wildlife species. To protect bats and other species that access water by skimming across the surface, fencing material should not extend across the water surface. If fencing across the water is necessary it should be made highly visible by avoiding the use of single wire fences and using fencing materials such as woven wire or by adding streamers or coverings on the fence.

For watering facilities that will be accessible to wildlife, give consideration to the effects the location of the facility will have on target and non-target species. Also consider the effect of introducing a new water source within the ecosystem in the vicinity of the facility. This should include things such as the concentration of grazing, predation, entrapment, drowning, disease transmission, hunting and expansion of the wildlife populations beyond the carrying capacity of available habitat.

Consider the following guidelines for materials commonly used for watering facilities.

Concrete	3000 psi compressive strength
Galvanized Steel	20 gauge thickness
Plastic	Ultraviolet resistance
Fiberglass	Ultraviolet resistance
Rubber Tires	Without after market chemical puncture sealer.

Where water is supplied continuously or under pressure to the watering facility consider the use of automatic water level controls to control the flow of water to the facility and to prevent unnecessary overflows.

Watering facilities often collect debris and algae and should be cleaned on a regular basis. Consider increasing the pipe sizes for inlets and outlets to reduce the chances of clogging. Maintenance of a watering facility can be made easier by providing a method to completely drain the watering facility.

Steep slopes leading to watering facilities can cause erosion problems from over use by animals as well as problems with piping and valves from excess pressure. Choose the location of watering facilities to minimize these problems from steep topography.

PLANS AND SPECIFICATIONS

Plans and specifications for watering facilities shall provide the information necessary to install the facility. As a minimum this shall include the following:

- A map or aerial photograph showing the location of the facility
- Detail drawings showing the facility, necessary appurtenances (such as foundations, pipes and valves) and stabilization of any areas disturbed by the installation of the facility
- Construction specifications describing the installation of the facility

Development of plans will be guided by National Engineering Handbook, Part 650 Engineering Field Handbook, Chapter 5, and shall be in accordance with National Engineering Manual, Parts 541 and 542.

OPERATION AND MAINTENANCE

Provide an O&M plan specific to the type of watering facility. to the landowner. As a minimum include the following items in the plan:

- a monitoring schedule to ensure maintenance of adequate inflow and outflow;
- checking for leaks and repair as necessary;
- if present, the checking of the automatic water level device to insure proper operation;
- checking to ensure that adjacent areas are protected against erosion;
- if present, checking to ensure the outlet pipe is freely operating and not causing erosion problems;
- a schedule for periodic cleaning of the facility.

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