

**NATURAL RESOURCES CONSERVATION SERVICE  
 CONSERVATION PRACTICE STANDARD**

**PIPELINE**

(Feet)

**CODE 516**

**DEFINITION**

Pipeline installed for conveying water for livestock or for recreation.

**PURPOSES**

To convey water from a source of supply to points of use.

**CONDITIONS WHERE PRACTICE APPLIES**

Where conveyance of water in a closed conduit is desirable or necessary to conduct water from one point to another, to conserve the supply, or for reasons of sanitation.

**DESIGN CRITERIA**

**Capacity - Livestock Water.** Pipeline designs for livestock water must have the capacity to supply at least the following minimum:

**MINIMUM WATER USE PER ANIMAL**

Animal	Gal/Day
Milking Cow	25
Dry Dairy Cow	20
Heifer or Range Cow	15
Range Cow & Small Calf	20
Calves (500–700 lb)	10
Swine, finishing	5
Nursery	1
Sow & litter	8
Gestating sow	6
Horses and beef animals	15
Sheep and goats	2
100 chicken layers	9
100 turkeys	15

Other livestock animals require minimum daily water use of 1-1/2 gal per 100 lb. body weight. Pipelines installed for livestock grazing distribution shall provide total daily animal needs minus the amount stored at the drinking location in a four hour period, at the design flow rate.

For other storage considerations, refer to practice standard Troughs and Tanks (614).

Minimum livestock pipeline capacity will be 2 gpm except when the pipeline is within 1000 feet of dwellings or farmsteads (on the same property). The minimum pipeline capacity will be 10 gpm when other farmstead water uses are recognized.

**Capacity – Farmstead Water.** Pipelines that serve other farmstead uses must be designed to supply needs. Examples follow:

**MINIMUM WATER SUPPLY**

Automatic waterers for:	Gallons/Minute
Cattle, hogs, or sheep (20-40 head per bowl)	2
Poultry (100-150 layers)	1
Cleaning hose for milkhouse and dairy utensils.	5
Cleaning and manure removal hose for milking barn or hog house	10
Outdoor hydrant for uses other than firefighting	5
Firefighting hydrant	20

A suggested reference for farmstead water use is: Midwest Plan Service Structures and Environment Handbook - MWPS-1.

On large, extensive systems, peak use based on maximum flow from all outlets may not be expected to occur. In these cases, capacity may be based on the number of outlets expected to be in use and the number of livestock served by the outlets. System design will include analysis by an accepted method.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, download it from the [electronic Field Office Technical Guide](#) or contact your local NRCS office.

**Capacity - Recreation Water.** For recreation areas, water capacity shall be adequate for all planned uses. Typical examples are drinking, fire protection, showers, flush toilets, and irrigation of landscaped areas.

**Capacity - Wildlife Water.** Additional capacity will be provided for wildlife water requirements where applicable. Daily wildlife water use may be calculated at one gallon per day per 100 pounds of body weight.

**Capacity - Domestic Use.** Capacity must be adequate for all planned uses. Normal minimum design capacity per household (dwelling unit) is 10 gallons per minute (gpm) and 360 gallons per day (gpd). On group systems where multiple headquarter (dwelling unit) outlets are planned or anticipated, minimum simultaneous system capacity should be based on the following table:

Number of Dwellings	Minimum Gallons per Minute (gpm)
1	10
2	20
3	28
4	35
5	40
10	65
14	85

**Sanitary protection.** If water from the pipeline might be used for human consumption, all ND State Department of Health (NDDH) and State Plumbing Code regulations must be met. If more than 15 dwellings or 25 year-round residents are served by a water system, it is classified by North Dakota Century Code (Chapter 61-28.1-02) as a "Public Water System" with the plans and specifications requiring approval of the NDDH.

All water for human consumption must be tested for contaminants, with appropriate disinfection before use.

Systems utilizing water for domestic purposes from a well, with water of satisfactory quality, shall be disinfected by shock-chlorination prior to use. The chlorine concentration should be 200mg/l; and should remain in the system for 8 hours. Chlorine powder, tablet, or solutions of

various strengths may be used. On smaller systems, laundry bleach containing 5 percent available chlorine may be used at the rate of 3 pints per 100 gallons of water in well or piping system.

To prevent reversal of flow or contamination on systems used for human consumption and not subject to "rural water system" or "public water system" criteria that is more restrictive, double spring-loaded check valves shall be used on all outlets or branch lines. Two single check valves may be used as an alternate

**Pressure Pump System.** Pressure pump types, controls, energy sources, and features vary considerably. Low pressure pumping systems such as nose pumps, solar and wind powered pumps have a wide range of performance and success in specific applications. Power sources and dependability must be determined early in the design process.

Pump systems shall be designed by an engineer, or by an approved engineering procedure. Pump dealers and installers will specify pump systems based on pipeline hydraulic data. Pipelines typically have a wide operating range, and the pump system shall perform with acceptable efficiency throughout the range of design flows and pressures.

**Pipe.** All pipe must withstand the maximum pressure it will be subjected to, including surge pressures. Pipeline sizes, except as outlined below, shall be based on water requirements and economic considerations.

The minimum pipeline nominal diameter shall be 3/4 inch for pipelines with greater than 15 pounds per square inch (psi) pressure and 1 1/4 inch for pipelines under 15 psi pressure. In areas where deposits in pipelines occur, the minimum nominal pipe size shall be 1 inch and 1 1/2 inch respectively.

Where water is to be used for human consumption the requirements of the National Sanitation Foundation (NSF) shall be met. The pipe must be suitably marked.

Pipes must meet the following requirements or must be designed by a registered professional engineer.

Steel pipe shall meet requirements specified in ASTM-A-120 or in AWWA Specification C-200. Steel pipe will be adequately protected from

corrosion. If because of local conditions, coal-tar enamel protective coating is needed for steel pipe, the coating shall meet the requirements of AWWA Specification C-203. In corrosive soils or waters use plastic pipe.

Plastic pipe shall meet the requirements of ASTM D1785 or D2241 for polyvinyl chloride (PVC) and ASTM D2239 or D3035 for polyethylene (PE). Equivalent plastic pipe and fittings conforming to other ASTM or AWWA specifications may be approved for use.

PE pipe for use above ground will be made of materials with 2 percent carbon black to provide ultraviolet light resistance for the life of the pipe. Pipe of this type is suitable for seasonal use.

**Pipe Strength.** The maximum working pressure shall not be more than: (1) one-fourth of the bursting pressure for metal pipe, and (2) the certified working pressure stamped on plastic pipe with adjusted reductions for high water temperatures and water hammer. Instantaneous closure calculations will be used for water hammer calculations. Design consideration must be given to flow reversal, impact and vacuum.

In lieu of detailed pipe strength calculations described above, pipe may be used if the maximum pressure does not exceed 70 percent of the pipe rated pressure, adjusted for high water temperature.

Suggested references are: Unibell "Handbook of PVC Pipe," NRCS Engineering Field Manual Chapters 3 and 12, Montana Pipeline Manual.

**Vents.** For design velocities less than eight feet per second, some provisions for removing the air shall be included in the design. If the hydraulic gradient is at or lower than the pipe elevation, an air vent may be required at that point.

**Joints, Couples, Fittings.** Watertight joints, couples, and fittings shall have strength equal to that of the pipe, and must be of material compatible with the pipe. If they are made of material susceptible to corrosion, provisions must be made to protect them. Solvents, gaskets, butt fusion, electro-fusion, and other joining methods shall conform to the requirements of the appropriate ASTM or AWWA specification for the type of pipe used.

**Flow Restricting Valves.** Flow restricting valves should be used on group pipelines to control the rate and flow to individual outlets and prevent periods of no flow on sections of the pipeline. They should be used where topographic features or watering facilities require regulation to meet design flow needs.

**Appurtenances.** All appurtenances to the pipeline shall be of sufficient strength and longevity to operate, with minimal maintenance, throughout the design life of the system..

**Pipe Mechanical Protection.** Pipelines must be designed to avoid damage from farm and ranch operations, weather, animals, soil movement, vandals and other reasonably expected hazards.

Water bars or similar diversion techniques shall be used to prevent surface water from flowing alongside and eroding the pipe trench, when applicable.

Pipelines shall be buried below frost to provide maximum protection, when economical and practicable. Seasonal pipelines may be shallow buried to a minimum depth of 1 foot, where the soils are suitable. Seasonal pipelines may be laid on the surface when cultural, historical, soils, or other physical land features preclude burial.

Pipelines laid on the surface shall be protected by placement outside of perimeter fences, under cross fences. Vegetation should be allowed to grow over the pipeline where possible to provide additional protection from sunlight and to keep the water cool. Where fire is used as a management tool, specific provisions must be made to protect the pipe.

PE pipelines, laid on the surface or shallow buried, will be snaked as appropriate to prevent damage from thermal contraction and expansion. Unrestrained PE pipe can be expected to expand or contract 1.4 inches per 100 feet for each 10<sup>0</sup> F change in temperature.

**Pipe Freeze Protection.** Seasonal use pipelines that will be subject to freezing shall be drained prior to winter or made of freeze resistant materials. Freeze resistant pipe will allow some expansion without breakage as water freezes. Valves and fittings will be damaged if they freeze with water in them, so voiding water from the pipe is usually required.

Drain valves or unions shall be installed as needed at low points in the pipeline for systems installed above the frost line, so the line can be drained to protect pipe and appurtenances.

Pipelines used for water supply during freezing weather must be installed below the average frost line or be protected with weatherproof insulation, automatic heat, or other effective design. Frost depth is dependent on soil type, moisture content, ground cover, and other variables. Frost depth in North Dakota can be estimated from 6 to 8 feet, from southwest to northeast.

For pipelines from spring developments that will flow constantly, the minimum burial depth for winter use is 18 inches.

**Construction Safety.** Trenching and all other ground disturbing excavations shall not be performed without compliance with North Dakota One-Call and OSHA trench safety requirements.

**Vegetation.** Disturbed areas shall be established to vegetation or otherwise stabilized as soon as practicable after construction. Seedbed preparation, seeding, fertilizing, and mulching shall conform to the instructions provided in technical guides.

**Visual resources.** The visual design of pipelines in areas of high public visibility and those in fragile areas shall be carefully considered.

## PLANNING CONSIDERATIONS

This practice may adversely affect cultural resources and must comply with GM 420, Part 401 during planning, prior to installation and during maintenance.

## PLANS AND SPECIFICATIONS

Plans and specifications for installing pipelines shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. If the pipeline is a component of a system that includes additional conservation practices, the information necessary to construct these additional practices will also be conveyed on the plans.

Development of plans will be guided by the NRCS Engineering Field Handbook, Chapter 5,

and shall be in accordance with National Engineering Manual, Part 541 and 542.

## OPERATION AND MAINTENANCE

An O&M plan specific to the type of installed pipeline shall be provided to the landowner. The plan shall include, but is not limited to, the following provisions:

Opening/closing valves to prevent excessive water surge.

Filling at the specified rate requirements, when applicable.

Inspecting and testing valves, pressure regulators, motors, pumps, switches, and other appurtenances.

Maintaining erosion protection at the outlet.

Checking for debris, minerals, algae, and other materials which may restrict system flows.

Draining and/or cold weather operation of the pipeline system.