Water Capture, Transfer and Storage: Engineering Livestock Water Systems

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Water is commonly the weakest link in grazing systems because it is the most overlooked and neglected nutrient on farms. Many people do good jobs ensuring that the pasture, hay and grain they feed to livestock is high quality and of sufficient quantity, but they ignore the quality and quantity of their herds' drinking water. The key to animal health, grazing distribution, and forage management is readily available, adequate supplies of quality water.

The planning and design of a stock water system may be complex and a significant investment. It is very important that they be properly planned and designed, and be as economical as possible. The purpose of this presentation is to cover the basics of planning and designing a livestock watering system. I will cover water sources, power and pump types, and the basic livestock watering system components. You will learn the important considerations to provide grazing livestock a drinking water source that meets their needs and protects resources in Nebraska pastures. It is my goal to provide information that will help you understand the engineering decisions that are part of developing a grazing plan so you get a watering system that fits your budget and needs.

At the conclusion of this presentation, participants will know the principles of designing livestock watering systems.

Planning

When planning a stock water pipeline, it is always important to follow good resource planning procedures. The planning procedure involves defining objectives, performing an inventory of resources including types of animals, grazing period, area to be serviced, location, and details of existing water sources.

After inventory, the designer must evaluate the system alternatives by calculating the herd water quantity requirements, design flow rate, and storage requirements. The quantity of stock water required during any given period depends on the type and number of stock, climatic conditions and amount of natural water available. It has also been found that water usage is higher for stock in an intensive grazing system. In general, the recommended daily water requirements of livestock in Nebraska are presented in the table at right.

Minimum Daily Stockwater Requirements

Livestock Type	Conventional Water Facility Application (gal/day)	Intensive Water Facility Application (gal/day)
Cow	12	17
Cow & Calf	15	20
Dairy Cow (lactating)	25	30
Horse	15	20
Buffalo	20	25
Sheep	1.5	3
Goats	1.5	3
Hogs	1.5	3
Deer	1.5	-
Antelope	1.5	-
Elk	6	-

These are minimum volumes. If livestock are larger than average or there are other planning issues, the volume of storage should be increased accordingly.

The table below provides guidelines pertinent to spacing of watering facilities.

Maximum Water Facility Spacing

Type of Terrain	Conventional Water Facility Maximum Travel Distance	Intensive Water Facility maximum Travel Distance[1]
Rough	½ mile	1/8 mile (660 feet)
Rolling	¾ mile	1/6 mile (880 feet)
Level	1 mile	¼ mile [2]

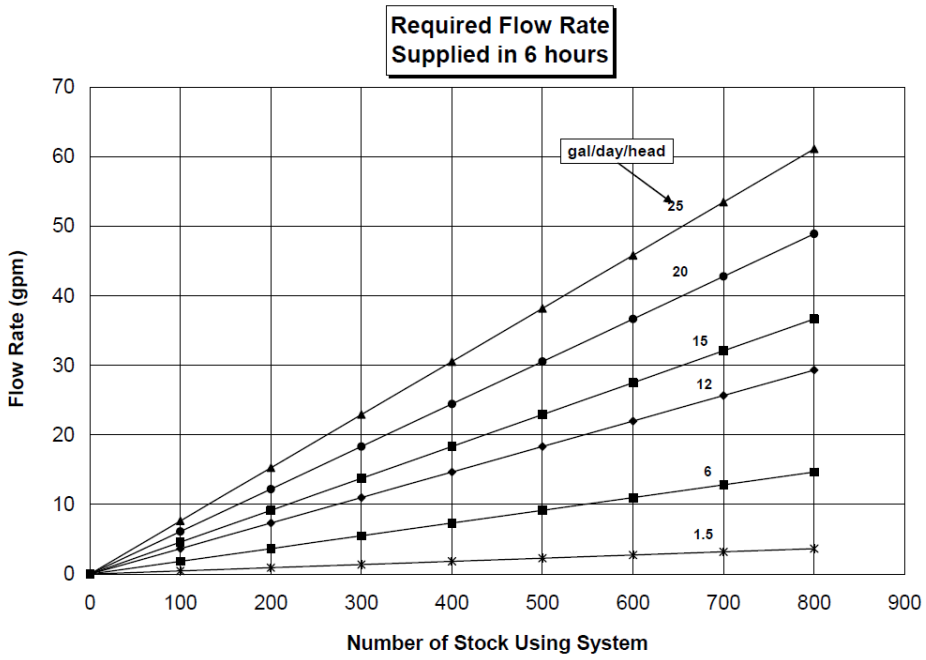
[1] Livestock must be checked daily
[2] Assumes there are no visual obstructions in any direction between the livestock and the watering facility. If there are visual obstructions for an intensive water facility application, then use maximum travel distance for rolling terrain.

The minimum pipeline design flow rate must be at least equal to the flow rate, in gallons per minute, required to provide the peak daily water requirements in a 24-hour period, for the maximum number of livestock in the pasture. It is often desirable to design for a higher flow rate to allow tanks to refill more rapidly during times of peak usage. Reasonable practice is to design pipeline flow rates to provide the full daily water needs in a 4-hour, 6-hour, or 12-hour period.

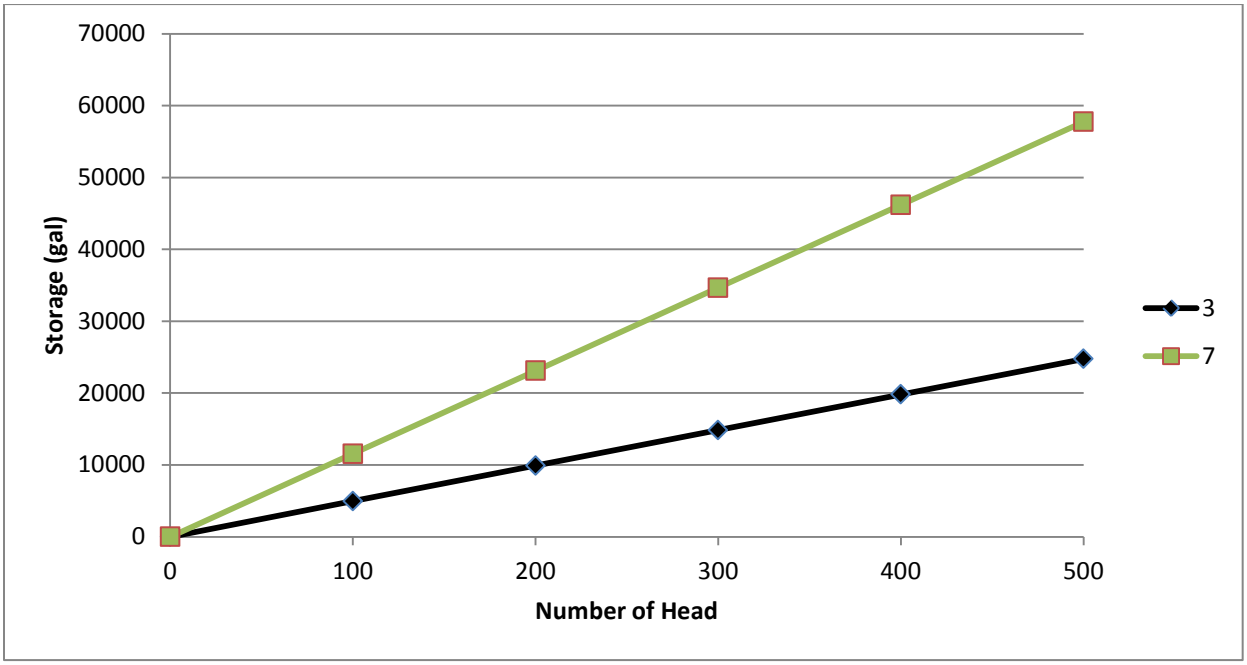
The figure below shows flow rates required to meet daily needs in a 6-hour period. These charts assume a 10 percent loss for evaporation and waste.

FLOW RATE REQUIRED FOR DAILY NEEDS (SUPPLIED IN 6 HRS)

Based on Additional 10% for Evaporation and Waste



The capacity of the water storage facilities within a pasture must be determined on an individual basis in close consultation with the operator. In general, water storage capacity or other water sources in a pasture should be provided to meet water requirements for a minimum of three days where water supply, pipeline, power or pump failure could cause loss of pipeline-supplied water. Minimum storage volume will depend on the reliability of the source, the hazards of exposure of the pipeline, reliability of the supply, management provided by the operator, and how easy it is to move livestock if the water supply fails. These factors should be thoroughly discussed with the operator. The following figure shows approximate total stock water requirements for various storage periods (3-day and 7-day).



After determining storage volume, the tank size can be selected. The following table provides general volumes of circular tanks:

Tank Diameter (ft.)	Volume @ 24" Depth (gal.)
10	1,100
1	1,400
15	2,600
20	4,700
25	7,300
30	10,500

By using the appropriate planning process, a designer can focus on the many engineering alternatives to determine the appropriate water source and design a system's power, pipeline, and water delivery methods.

Source of Water

The importance of good, reliable water sources to successful livestock operations cannot be overstated. Since sources of livestock water vary greatly in cost, quantity and quality, they are major considerations for farmers and ranchers. Wells, ponds, streams, and public water systems are all options that will be discussed during the presentation. The locations of operations, the lay of the land, and the types of soil on farms may limit the number of options. The presentation will focus on discussing the advantages, disadvantages, and design considerations for these frequently utilized water sources.

Power Sources

The presentation will focus on discussing the cost, advantages, disadvantages, and design considerations for the frequently utilized power sources including solar powered, electrical, wind, and variable frequency drive pumps.

Transfer (Pipelines)

Decisions regarding installing pipelines may be the most important decisions ranchers make in designing their water-delivery systems. Well-designed pipelines take dependable water to the livestock on pasture, making them the key point in future operation and flexibility of grazing management.

Stockwater pipelines come in many configurations and sizes in Nebraska. They may consist of anything from a short piece of pipe between a spring and stock tank, to many miles of pipelines, with pressures exceeding 200 psi. Design may be as critical for a short pipeline as for a long one. This portion of the presentation will focus on the many types of pipeline systems and how topography, water source, and pipe material affect the engineering design and installation.

Water Delivery & Storage

A variety of livestock water tanks are available to fit the watering needs and specific site characteristics of farms. The first step producers must take toward selecting tanks that are best for their livestock operations is to determine how large tanks need to be to serve their herds. With the various types of livestock, herd sizes, water sources and tank locations, one type of tank will not fit all watering needs. Producers need to evaluate all of the sources in order to determine which types of tanks are best for them. The presentation will focus on tanks that are frequently installed in Nebraska including rubber tire, fiberglass, steel bottom, and bottomless. Areas around tanks, ponds and streams occasionally need to be protected by gravel or concrete pads. Pads provide firm footing for animals, and they reduce erosion around tanks. The presentation will briefly discuss design of heavy-use protection areas.

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