LWT- Arched Mesh Pipe Drainage System Lower Groundwater Level Design

AMPS-Arched Mesh Pipe Drainage System

Irrigation is the practice of adding water when the soil is naturally dry, whereas drainage removes the excess water of soil to a proper level where it will not interfere with plant growth. Excess water may be caused by rainfall, high water table, floods or by applying too much irrigation water.

- **Surface drainage**, which removes excess standing water by using drainage ditches.
- **Subsurface drainage**, which removes excess water through a system of Arched Mesh Pipe Drainage System.

AMPS-Arched Mesh Pipe Drainage System is a form of water management that removes water from the subsurface of the soil (Figure 1).

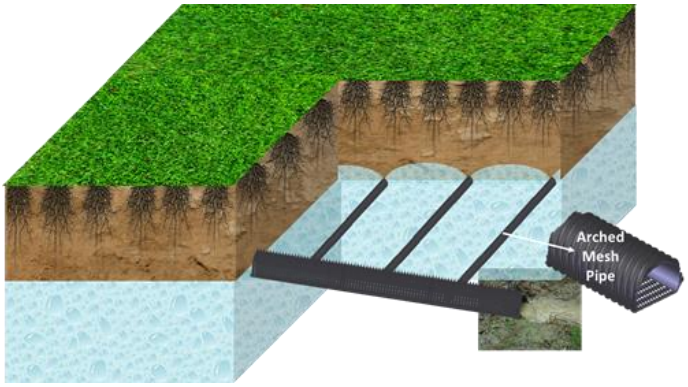
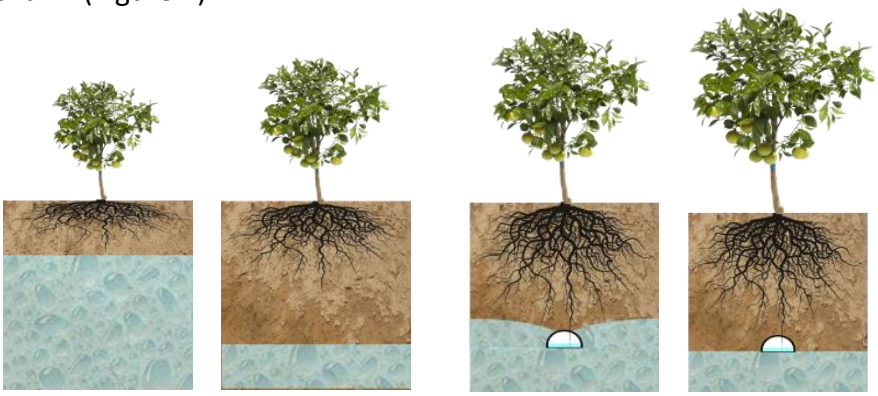


Figure 1. Two common farmland drainage systems for poorly drained agricultural land.

Why use AMPS-Arched Mesh Pipe Drainage System?

Where water stands on the soil surface or drains very slowly from the root zone, soil will remain too wet for a long time. Optimal root growth requires both water and air to be present in the spaces between the soil particles, often in equal proportions. If water fills all the soil spaces (saturated), there is no room for air. The major reason for installing tile drainage is to provide better conditions for crop root growth and improve the yield potential of the farm (Figure 2).



Undrained Land Drained Land

Figure 2. AMPS-Arched Mesh Pipe drainage system promotes better root growth and plant quality when soils have poor natural drainage.

The advantages of AMPS-Arched Mesh Pipe Drainage System can be:

- Improved root development and increased crop yield.
- Earlier and more timely planting.
- Better germination and crop stand.
- Less runoff.
- Less crop stress from waterlogged conditions.

- Higher spring soil temperature.
- More efficient use of nitrogen fertilizers
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- More days of machinery operation.
- Reduced soil compaction.
- Making a better environment for plant health and growth.
- Increased land value.

AMPS-Arched Mesh Pipe Drainage System Design

Planning and designing an effective AMPS-Arched Mesh Pipe Drainage System needs time and, of course, requires consideration of a number of factors, including:

- Water table level.
- Soil texture and class.
- Field elevation and slope.
- Current and future cropping system.
- Quality of the installation.
- Environmental effects (dry or/and wet year).
- The frequency of rainfall.

Depending on the design of the AMPS-Arched Mesh Pipe drainage system, a typical tile drainage has a number of small laterals —2, 3, 4, 6, 8, or 10 inches in diameter — that drain water to larger diameter collectors and the main ditches.

Water collected from the tile laterals and main lines flow into an outlet point on the edge of the field and are discharged into an open drainage ditch outside of the farm or other body of surface water. (Figures 3).

Figure 3. The soil water management for poorly drained agricultural land with artificial drainage.

Sizing pumps to remove/drain water from the field:

In cases that land topography does not allow for free surface drainage outside the farm, using a pump station will be necessary to lift the water over a hill or rise that is between the field and the discharge channel or/and canal.

In such a case there is a need to refer to the "Drainage Coefficient (DC)" value which was selected to design the tile drainage system for the field. The drainage coefficient is the water draining capacity of the drainage system and is typically expressed as a depth of water removed from soil in 24 hours (inches/day). The whole drainage water in 24 hours is the multiplication of the drainage coefficient by the field area. The maximum pump flow rate for a given field area can be estimated with the following formula:

Maximum pump flow rate (gpm) = 18.9 * DC * Area

Table 1 shows a few examples of varying drainage coefficients. Installing a pump station will increase the investment in a tile drainage system, but often it is the only option for moving the tile drainage water to the outlet/ditch. The annual per-acre cost to pump water will depend on the size of the motor, the number of pump starts, the number of pumping hours and local electric rates.

Drainage coefficient (Acre-Inches Per day)	Gallons of water from one acre of land	Average gallons per minute of flow per acre in24 hours (1,440 minutes)
1/4	6,800	4.7
3/8	10,210	7.1
1/2	13,610	9.5
3/4	20,420	14.2

Table 1. The maximum flow rate per acre that will flow rate per acre that will flow into the outlet for a selected

Sizing pumps to irrigate back through the AMPS-Arched Mesh Pipe Drainage System :
The main purpose of this system is to conserve farm irrigation water and water quality by collecting the drain water from the field surface for reuse as subsurface irrigation or/ and overhead pivot system.

The water return flow pump removes water from the source and moves it to the discharge point where it will be reused for irrigation (Figure 5)

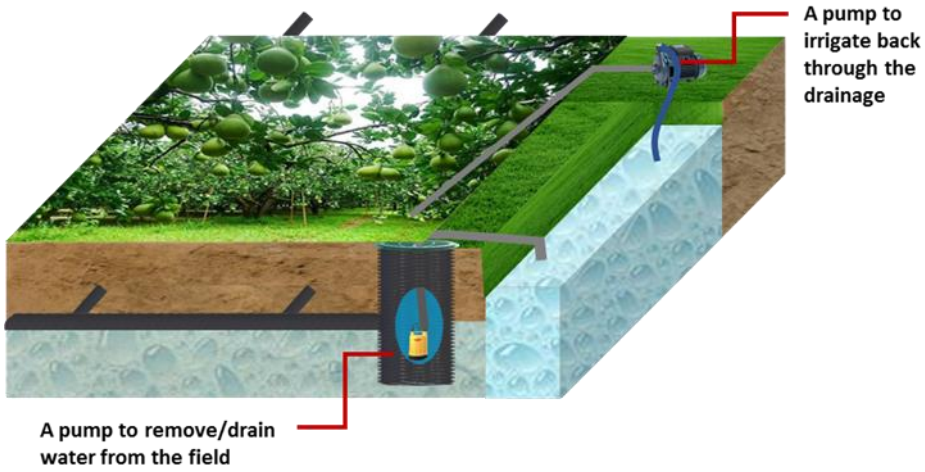

Figure 5. A schematic picture of using pumps to drain water from the field and irrigate back with the drained water.

Drainage design considerations

AMPS-Arched Mesh Pipe Drainage System should be designed to remove excess gravitational water and lower the water table far enough from the ground surface so it does not interfere with plant growth.

The AMPS-Arched Mesh Pipe Drainage System designer must determine:

- The desired depth to which the water table should be lowered
- The amount of rainfall received and the amount of irrigation to be applied
- The proper depth and spacing of the relief and collector lines
- The maximum length of laterals
- The material and diameter of the pipe
- The slope grade at which the lines should be installed

Permeability and hydraulic conductivity

Permeability is the capacity of the soil to transmit water. Soil can have low, moderate or high permeability The hydraulic conductivity is a numerical value of a soil's permeability. It represents the speed that water seeps through the soil; this speed is determined by several properties such as pore size, structure of the soil, and soil chemistry.

Sandy soils have higher permeability and higher hydraulic conductivities than do clay soils.
A designer needs to know the soil texture and conductivity to determine the size of the drains.

Drainage coefficient or water relief outflow rate

The drainage coefficient is the rate of water removal needed to obtain the desired protection of the crop from excess water. It is based on local field experience and is generally expressed in flow rate per unit of area.

AMPS-Arched Mesh Pipe Drainage System are designed to remove water per hour. The designer determines the drainage coefficient according the deep percolation expected, rainfall received, and irrigation depths applied. The designer then uses the drainage coefficients and the amount of area to be drained to determine the diameter of the lateral and collector drains needed.

Drain depth and spacing

The spacing between drain lines may vary from 15 to 100 meters, depending on the soil type, the drain depth, and the crop grown
In soils with moderate permeability, the drains can be spaced between 30 and 50 meters apart. They must be spaced more closely in soils with low permeability. A closer spacing reduces the amount of time to drain a certain volume of water but increases the cost of the system. The spacing will also be influenced by the pipe diameter of the interceptor lines.
The depth of installation of the laterals is affected by the drain spacing, the crop and soil texture, and the desired drop of the water table. The drains are usually placed at a minimum depth of 2meters (minimum of 1.5 meters at the upper end) in arid areas and at 1.5 meters in humid areas.

To install AMPS-Arched Mesh Pipe Drainage System, follow these steps:

Analyze the economic feasibility of installing a drainage system to ensure that the predicted net return will offset the initial cost.
Review regulations and assess the environmental impact of building the Arched Mesh Pipe Drainage System. Consider ways to avoid any harm to the environment, and adopt best management practices to protect the water quality of the area.
Conduct field studies to determine the characteristics of the soil profile, such as soil texture and structure, stratification of the soil layers, field topography, soil variability on the farm, hydraulic conductivity of the soil (movement of a volume of water per hour, both laterally and vertically). Determine the hydraulic conductivity in several parts of the field. Know the variables of irrigation management, such as maximum rainfall and irrigation depths.
Design the AMPS-Arched Mesh Pipe Drainage System. During the design process, determine the depth of installation of the relief laterals, the maximum length and diameter of the laterals and collector lines, and the grade of the drainage pipes.

Install the AMPS-Arched Mesh Pipe Drainage System :

Economics of installing AMPS-Arched Mesh Pipe Drainage System

To be cost effective and generate a return on the investment, the AMPS-Arched Mesh Pipe Drainage System must be designed properly.

The cost of AMPS-Arched Mesh Pipe Drainage System depends on several factors, including the drain spacing, the length and diameter of the collectors, the number of outlets, and the elevation and proximity of the open drains. The elevation of the drain ditch will determine whether the system will require a sump pump and electricity.

The period needed to obtain a return on investment for the installment of the drainage system depends on factors such as actual and potential crop yield gains after the installation of the system, compared to the losses of crop value from salinity and water table conditions before drainage.

Environmental considerations

Water that drains from a property may have been polluted by sediment, nutrients, and pesticides. Runoff from agricultural lands and irrigation sometimes causes natural streams to have low levels of dissolved oxygen.

An indication of low quality could be the increase of fish kills in natural streams. Because water is a precious resource, drainage water may be reused or managed to avoid harming the environment.

To reduce the runoff of nutrients, residues, and sediment from agricultural lands:

Avoid over-fertilization, and control the placement and timing of fertilizer applications.

Manage pests responsibly by monitoring thresholds and taking into account beneficial and harmful pests.

Rotate crops and manage residue to avoid transporting sediment in which nutrients and pesticides can attach.

Apply leaching irrigation depths but avoid over-irrigation and waste by scheduling irrigation.

Where necessary, consider the following additional practices also to reduce erosion and runoff: leveling irrigation land, installing grade stabilization structures, reducing tillage, and installing filter strips between the drainage ditches and irrigated field. Filter strips are areas of herbaceous vegetation situated between cropland, grazing land, or disturbed land (including forestland) and environmentally sensitive areas. The use of artificial drainage practices on lands that are or have a potential to be wetlands is strictly prohibited.

Summary

Soils with poor natural drainage can reduce yields and profits for farmers. Those problems can be solved by installing a properly designed an AMPS-Arched Mesh Pipe Drainage System. In addition to the agricultural factors, farmers need to consider the environmental effects of installing an on-farm AMPS-Arched Mesh Pipe Drainage System.