

Water Renovation in Ukraine

Project no. 22320101



Water Renovation in Ukraine

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The project is co-financed by the Governments of the Czechia, Hungary, Poland and Slovakia through Visegrad Grants from International Visegrad Fund. The mission of the fund is to advance ideas for sustainable regional cooperation in Central Europe.

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Precision irrigation planning Technical solutions and possibilities for crop production

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Irrigation – Main purpose

- Irrigation is the controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall. Crop irrigation is vital throughout the world in order to provide the world's ever-growing populations with enough food.



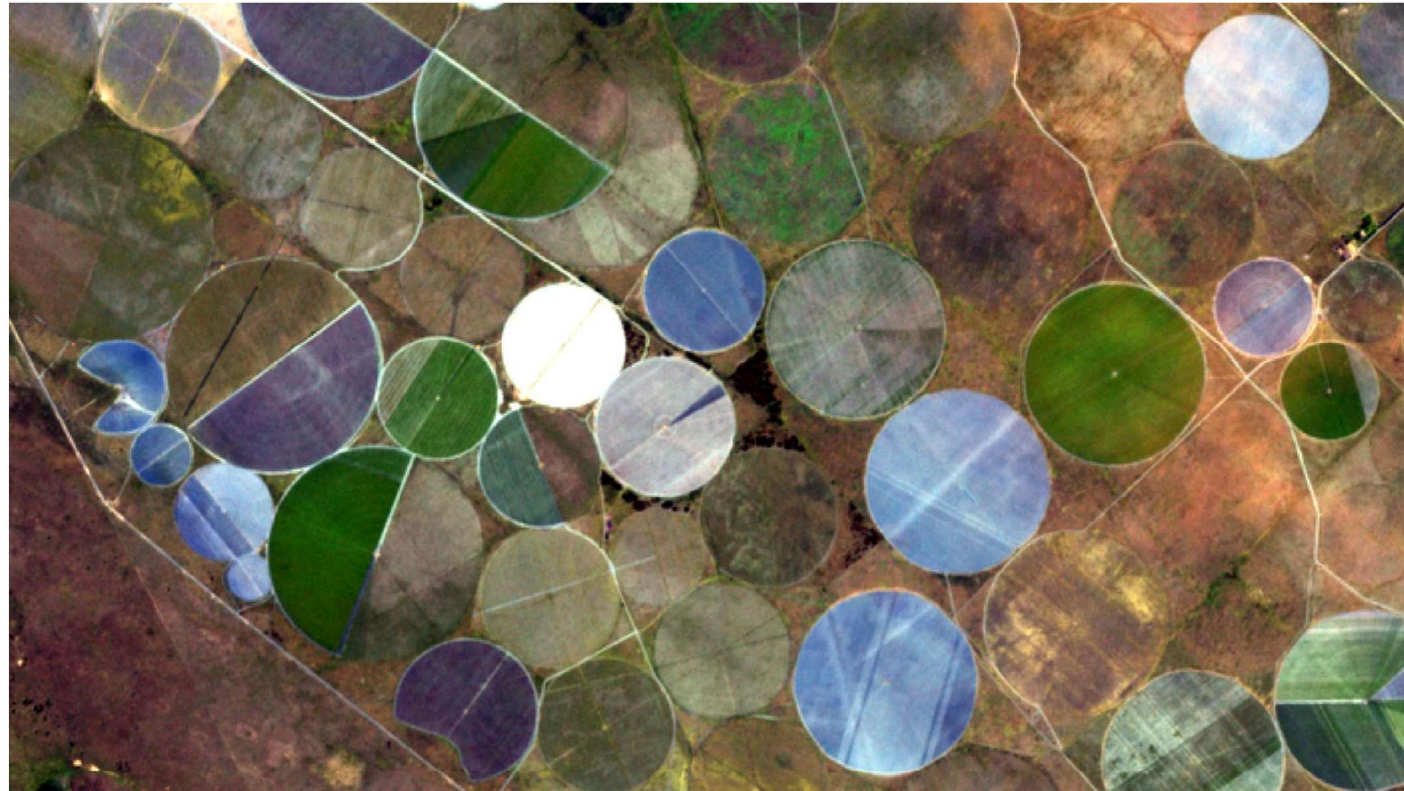
How to start an irrigation project?



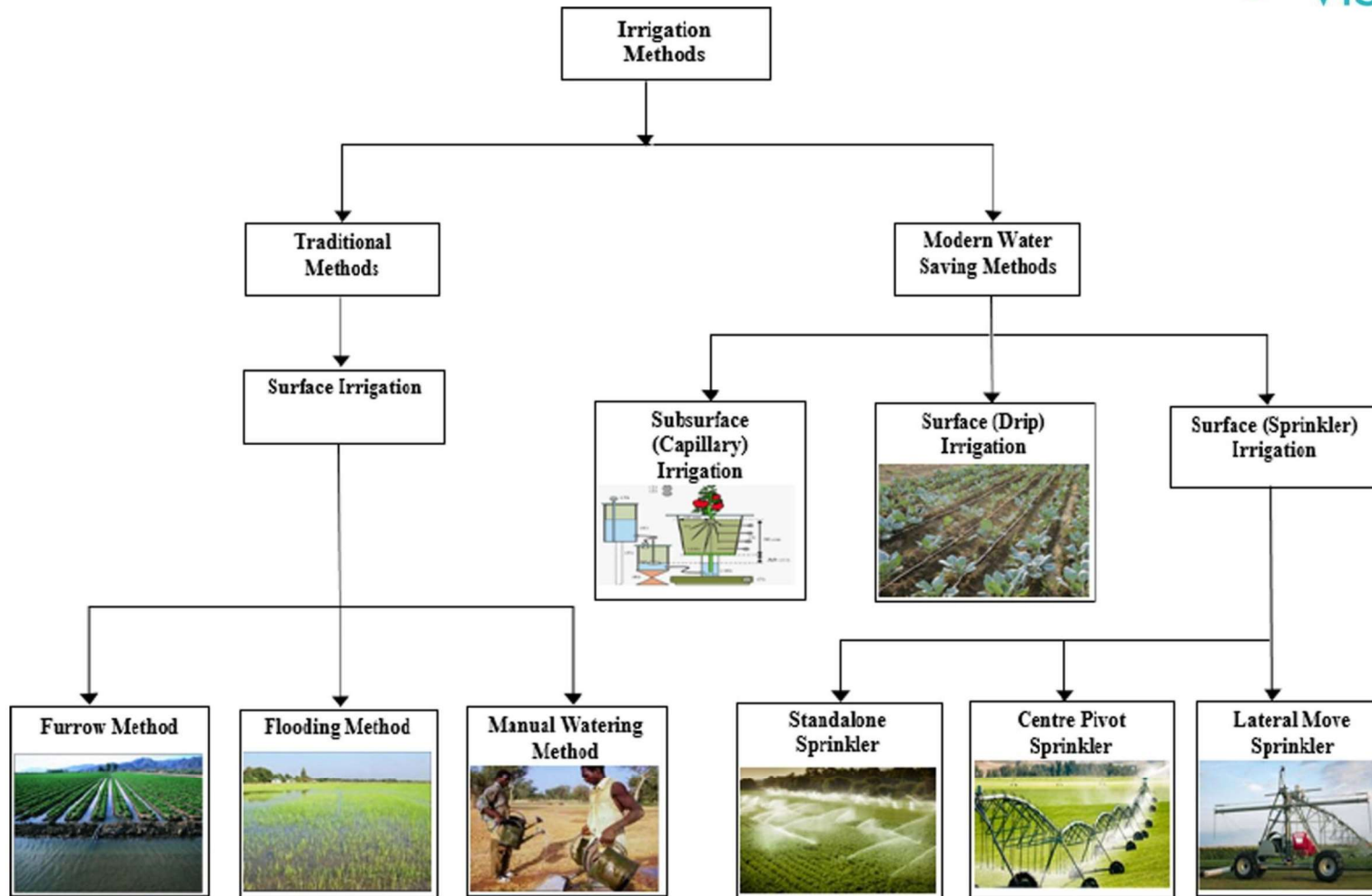
1. Professional Consultation
2. Specialist's Study Of Field
3. Project Development
4. Production And Delivery
5. Mounting And Installation
6. Commissioning Works
7. Training
8. Service Maintenance

Additional services

- Land works
- Laying of main transit pipelines
- Installation of fertigation systems
- Complex works on start-up of a pumping station



Irrigation methods



Types of irrigation - general

Surface irrigation methods

- Traditional irrigation methods (border, basin, and furrow) deliver water to the upper borders of banks/bunds in accordance with traditional plant-based indications, resulting in ponds rather than irrigation.

Modern or pressurized irrigation

- By using pipes as a water transport medium, pressurized irrigation or microirrigation decreases seepage and evaporation, as well as water conveyance losses. The entire area wetting problem is eliminated, and weed development is reduced, thanks to these irrigation strategies.

Types of pressurized irrigation

Sprinkler irrigation

- In the sprinkler irrigation method, water is sprayed into the air and allowed to fall on the ground surface, imitating rainfall. This method is ideally suited for water-scarce places and regions with an uneven ground level where watering with other irrigation systems is impractical. Sprinkler irrigation creates a humid atmosphere for crops that might otherwise perish owing to excessive temperatures.

Drip irrigation

- Drip irrigation uses drip emitters to deliver water to the root zone one drop at a time. A pressurized pipe (laterals) system that runs along agricultural rows is typically used for drip irrigation. Emitters are set at specific distances on the lateral tubes, allowing water to flow to the crop drop by drop. It was discovered that drip irrigation techniques reduced the amount of irrigation water used excessively and saved a significant amount of freshwater

Irrigation efficiency



Irrigation efficiencies	Methods of irrigation		
	Surface	Sprinkler	Drip
Conveyance efficiency	40–50 (Canal) 60–70 (Well)	100	100
Application efficiency	60–70	70–80	90
Water use efficiency	35–40	80–95	80–95
Surface water moisture evaporation	30–40	30–40	20–25
Overall efficiency	30–35	50–60	80–90

Source: Irrigation efficiency of surface and pressurized irrigation methods (%) (Kumar et al., 2020).

Advanced sprinkler irrigation methods for crop production

- Drum / hose reel irrigation system
- Pivot irrigation system
- Linear irrigation system
- Hippodrome irrigation system
- Precision irrigation insights



Drum / hose reel irrigation

- Simplest and most practical method is the reel drum irrigation system.
- It consists of mobile elements, so-called drums, which can be stored anywhere outside the irrigation season.

<https://www.youtube.com/watch?v=T789VImMaEo>



Advantages

- Its advantage is that it has a favorable price, yet delivers sufficient irrigation water to the area, and that it can be used both in arable and horticultural crops.
- The installation of the classic equipment does not require construction work in the field and on the canal, if the distribution of water can be solved economically with pipes.
- An end cannon or an irrigation console can also be attached to the system. On modern equipment, the amount of irrigation water to be applied can also be regulated in millimeters/hectare.
- If there is enough pressure, the drum rolls itself up and watering is carried out at a continuous, slow pace by retracting (winding) the drum.

Disadvantages

- The disadvantage is that every time you irrigate, you have to build the backbone pipeline from the water source to the field, which provides the irrigation water.
- Hard work but it is also possible to install the connection points of the drums (the hydrants) as well as the backbone line in the ground, thus saving the time required to lay out the pipeline.
- The operation of the system is simple, but it requires labor force: the drums must be transported to the board and then connected to the water source.
- Irrigation quality is not as high as of the pivot or linear systems.

Detailed parts of the drum



- A 300-800 m spool of irrigation pipe (hard polyethylene KPE) is wound on a rotating drum.
- After pulling out the nozzle with a tractor, the water flow can be started.
- The drum is slowly retracted by a water motor.
- The irrigated strip is 60 - 100 m wide.
- The water motor is driven by the irrigation water through a piston or turbine gearbox with multiple gear ratios.
- The retraction speed is adjustable, sometimes equipped with a programmable electronic unit



<https://www.youtube.com/watch?v=2V3GUXqWGpY>

Drum with end console

Benefits:

- Better rain quality,
- Less soil damage from irrigation,
- Higher flow [litres/min]
- Lower pressure and energy requirements.

Disadvantages:

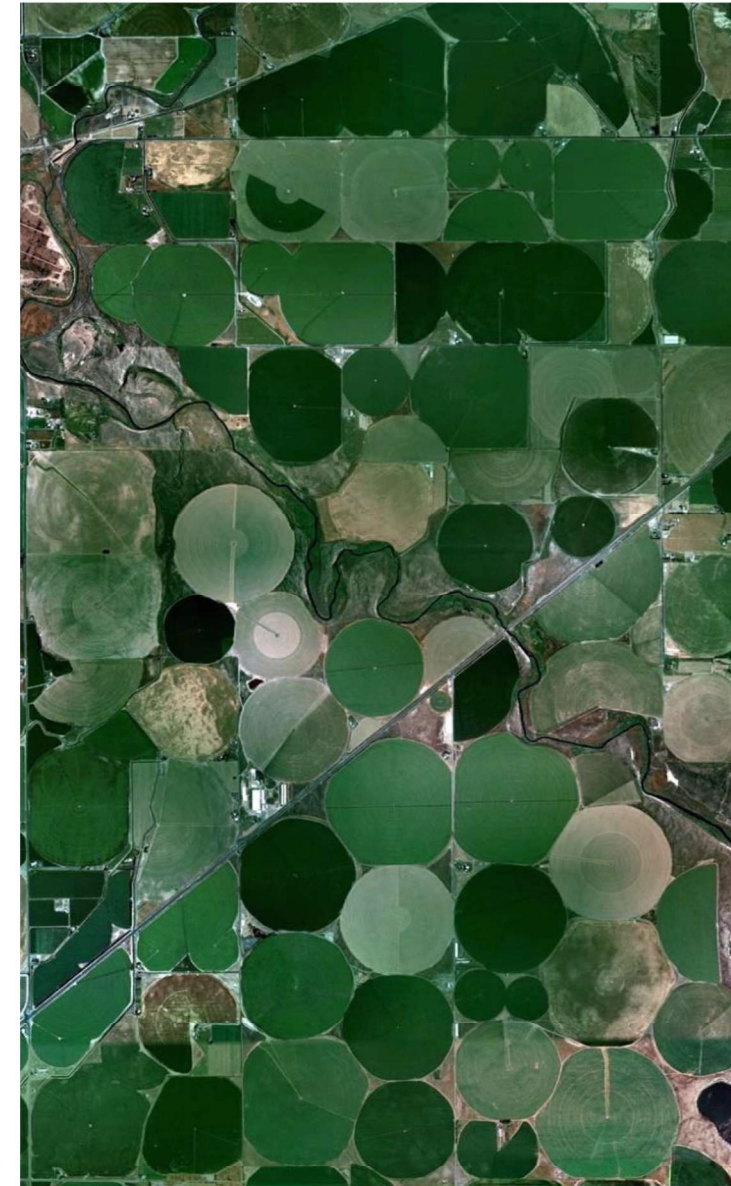
- More difficult to relocate
- Higher initial cost.
- Width: 30-80 meters



Center pivot irrigation



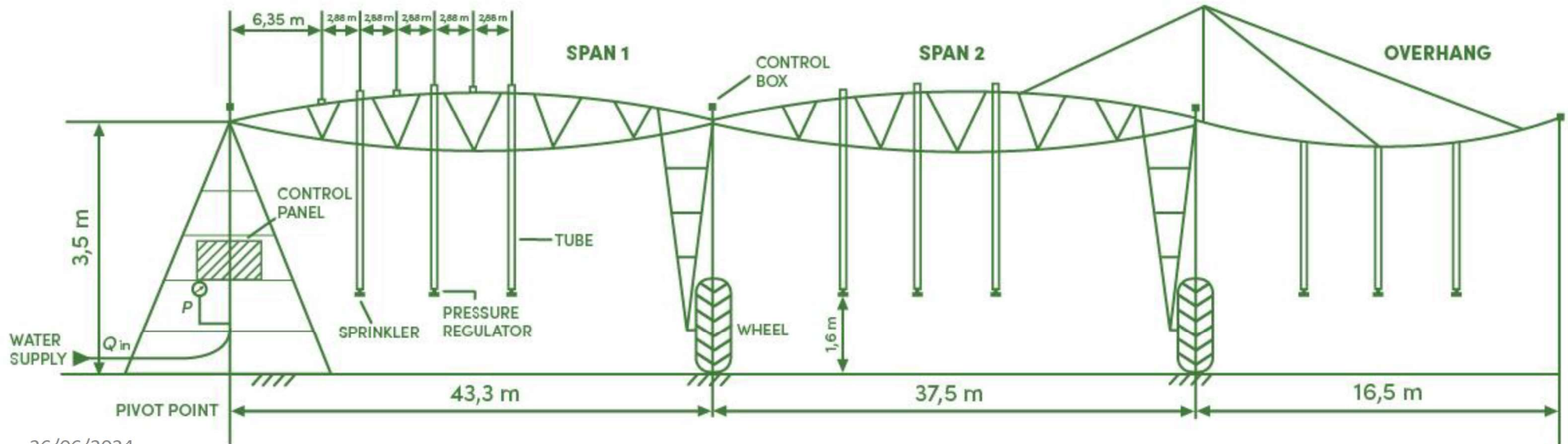
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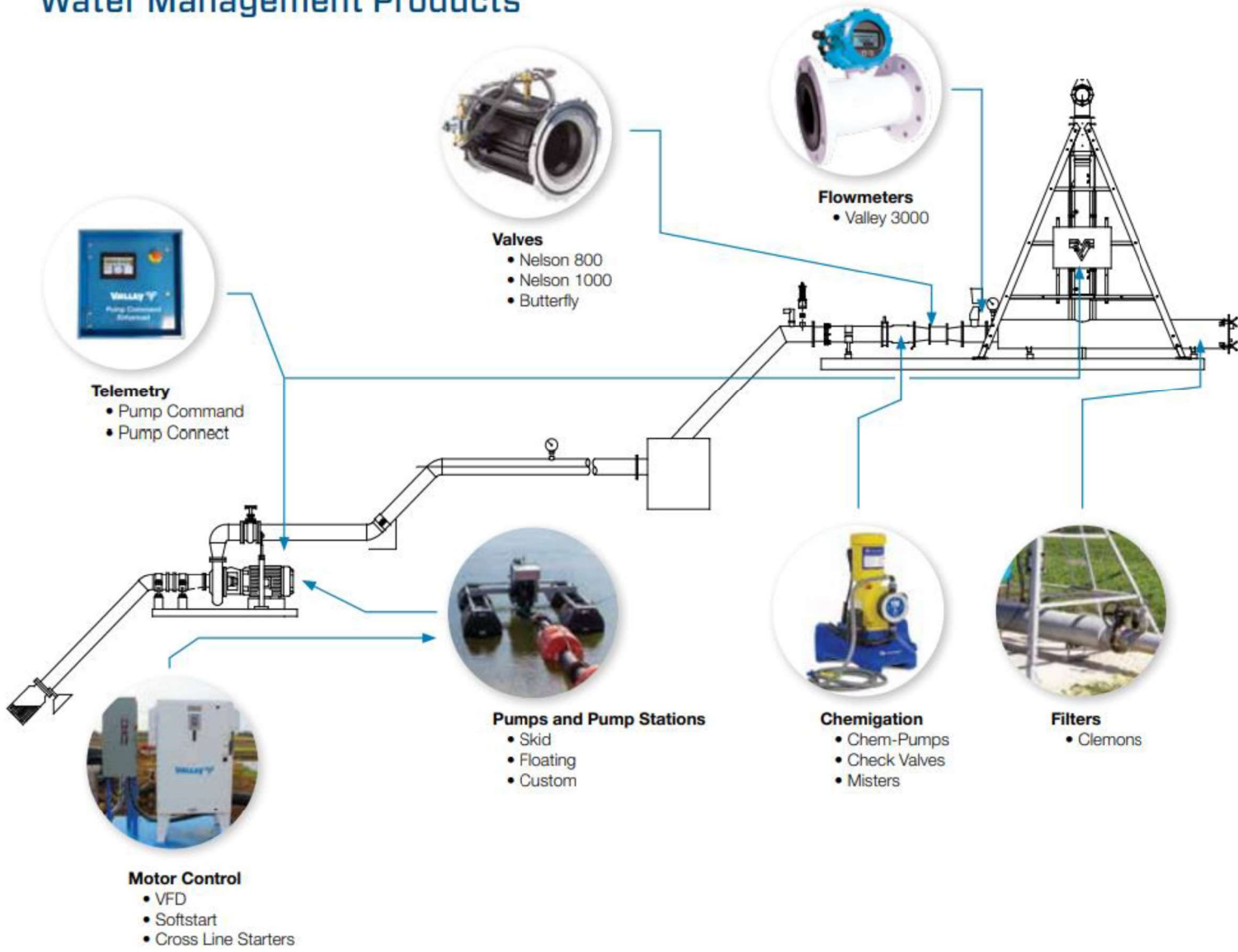
Center pivot irrigation system



- The pivot irrigation system is the most autonomous solution to increase yields and reduce operating costs when irrigating.
- The pivot system allows you to work almost on any configuration of the field, but, often it is used for square shaped fields.



Water Management Products



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Many specialized parts forming a complex irrigation system

Water source – right supplying system

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Challenge #1 - Sizing the Valve for Proper Flow

The most common error occurs in over-sizing a pressure control valve. The error occurs by ignoring the operation and specifying that the size of the pressure control valve be the same diameter as the pipe. While this simplifies installation, it may result in the use of a valve that is too large. **At lower flow rates, this oversizing leads to severe problems, such as cavitation, water hammer and pressure cycling.**

Challenge #2 - Accounting for the Correct Amount of Pressure Drop

The second common error is selecting the control valve from low graphs. This sets the limits of minimum and maximum flow rates for each size but does not account for the pressure drop across the valve. **Incorrect valve sizing can cause loss of pressure in your pivot. Since both flow rate and pressure drop determine valve performance, both must be taken into account for the proper sizing of reactive control valves.**



Advantages of pivot irrigation system

- Autonomy (the possibility to start and control remotely the operation of your irrigation system);
- Does not require labor efforts during operation;
- Irrigation uniformity reaches 95%;
- Ability to work in fields with a slope of up to 15%;
- Adjusting the irrigation speed to select the optimal amount of water or fertilizer for the crop.
- Ease of water supply 1 hydrant outlet and one pumping station are enough.
- Possibility of irrigation of several fields with one system (towable type).
- The end section and console can be equipped with an end jet for watering corners.

Schematic work of the center pivot system

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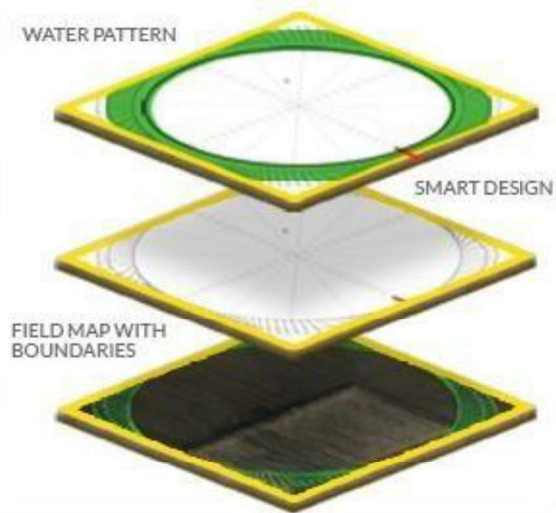
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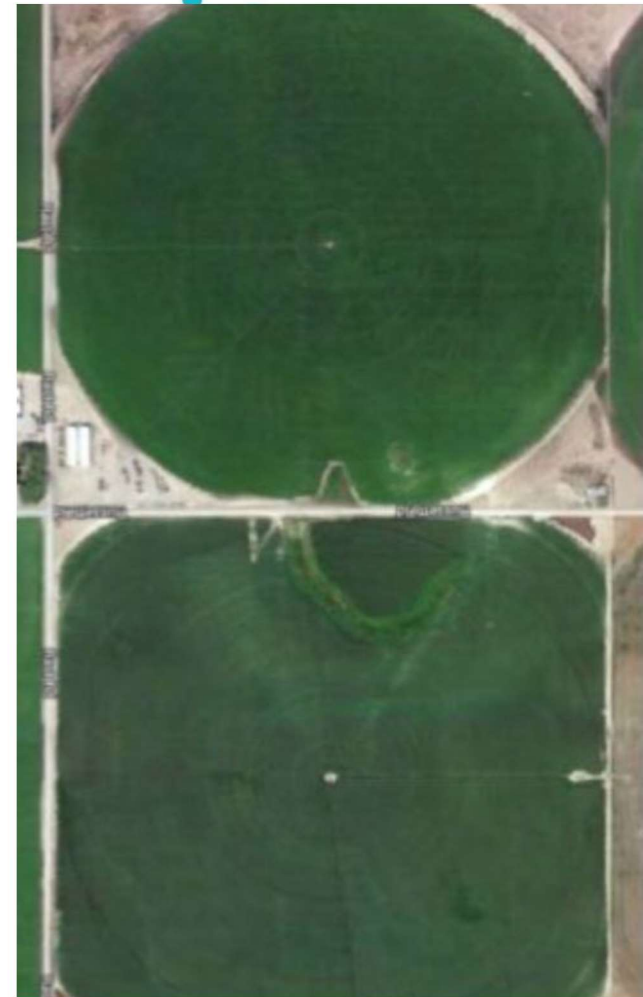
Flexible corner

- The system can also irrigate a rectangular area up to a certain length, with GPS-controlled corner tags.
- End guns and swing arms extend the reach of the center pivot system into the corners bringing more land under production.
- The equipment for these systems is expensive, but the additional expense involved may be recouped with the increased available acreage of high value crops.

https://www.youtube.com/watch?v=_Jrx-6x1cwg



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Bend the system to widen the irrigated area

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- Add acres: Pick up additional acres on part-circle machines at a low cost.
- Flexible: Add multiple bends per machine.
- Options: Optional valves shut off the water to stopped spans while bending.
- Improved application: The speed-up timer improves water application performance while bending.
- Assure performance: Integrated back-up safeties prevent the machine from overextension and ensure return to normal operation after bending.
- Bends up to 30 or to 160 degrees in both directions.
- Can bend in forward and reverse operation.
- Utilizes custom structural components.
- Integrated end gun and auxiliary controls for bending mode.
- Bends automatically; no operator input required.





Variable Frequency Drives

New technologies make it possible for you to spend less in order to operate your irrigation equipment.

Install a Variable Frequency Drive (VFD) to control your pump motor's speed, which results in delivering only what your operation needs to function at optimal efficiency. Dramatically higher energy savings will appear because you're preventing over-pumping and over-pressurizing your irrigation equipment.



Advantages of VFD system

- Constant pressure results in cost savings.
- Multiple pivots can be supplied by a single pump.
- Handles changes in field elevation.
- Adjust pressure in case of end gun shutoff or flow variations (VRI).
- Pumps only what the well can manage.
- Reduces operation and maintenance costs.
- Uses only the horsepower needed.
- Controls multiple pumps without needing additional PLCs.



Linear irrigation system

- Linear irrigation system is the solution for maximum irrigation efficiency (up to 98%) while reducing operating costs.
- Linear irrigation systems are designed for irrigating rectangular and long fields.
- Linear irrigation systems can work with water connection from a closed network and with water intake from an open channel.

How it started....

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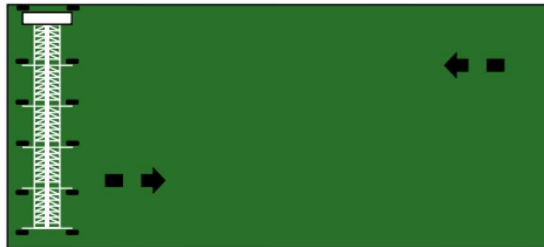
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Types of linear systems



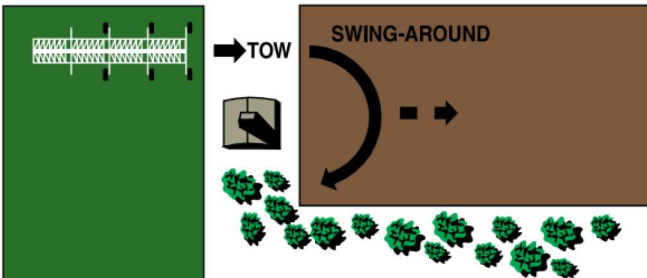
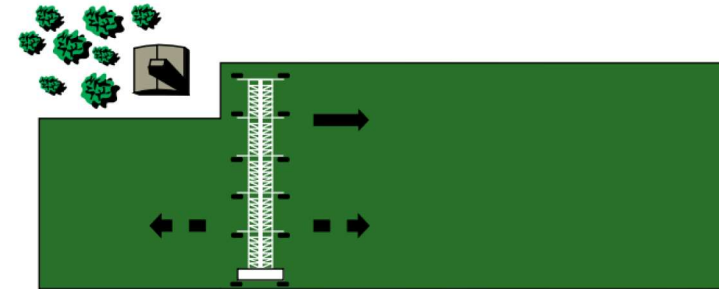
All Valley Linear

The standard linear travels back and forth across square or rectangular fields.



DropSpan™

Available on all linear 6 5/8" pipe with five spans or more.



Two-Wheel and Universal Linear

The forward/reverse tow and swing-around options can be combined to give you the flexibility to irrigate odd-shaped fields with only one machine.

Two-Wheel and Universal Linear

As an option, a swing-around package is available to give you the capability to irrigate L-shaped fields with one machine.



Types of water source

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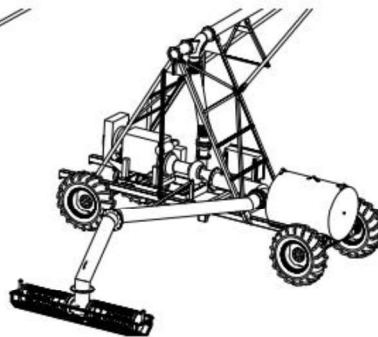
Rainger Cart



Rainger – Swing-Around



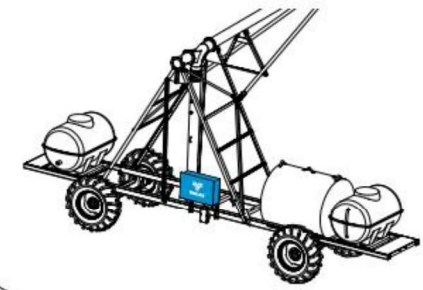
Rainger – Ditch Feed



Rainger – Hose Drag



Rainger – Select Options



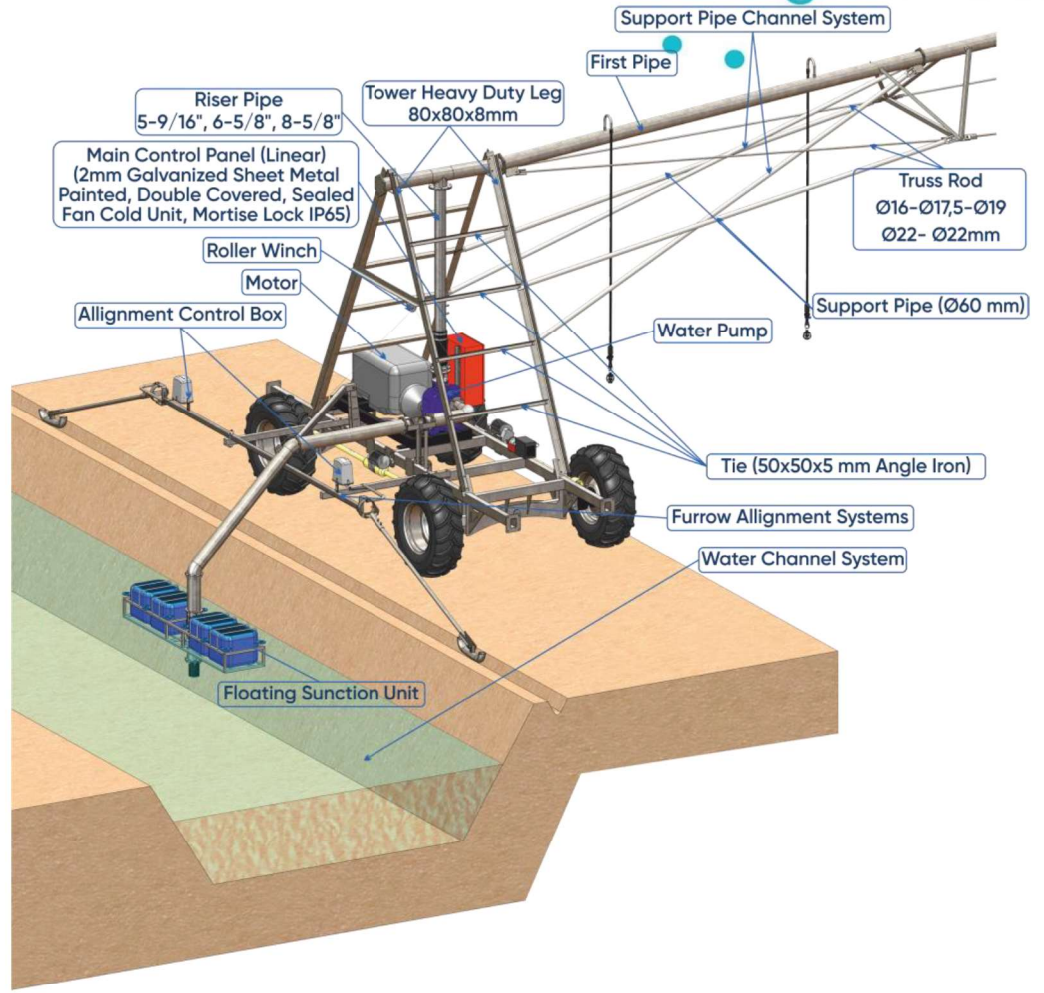
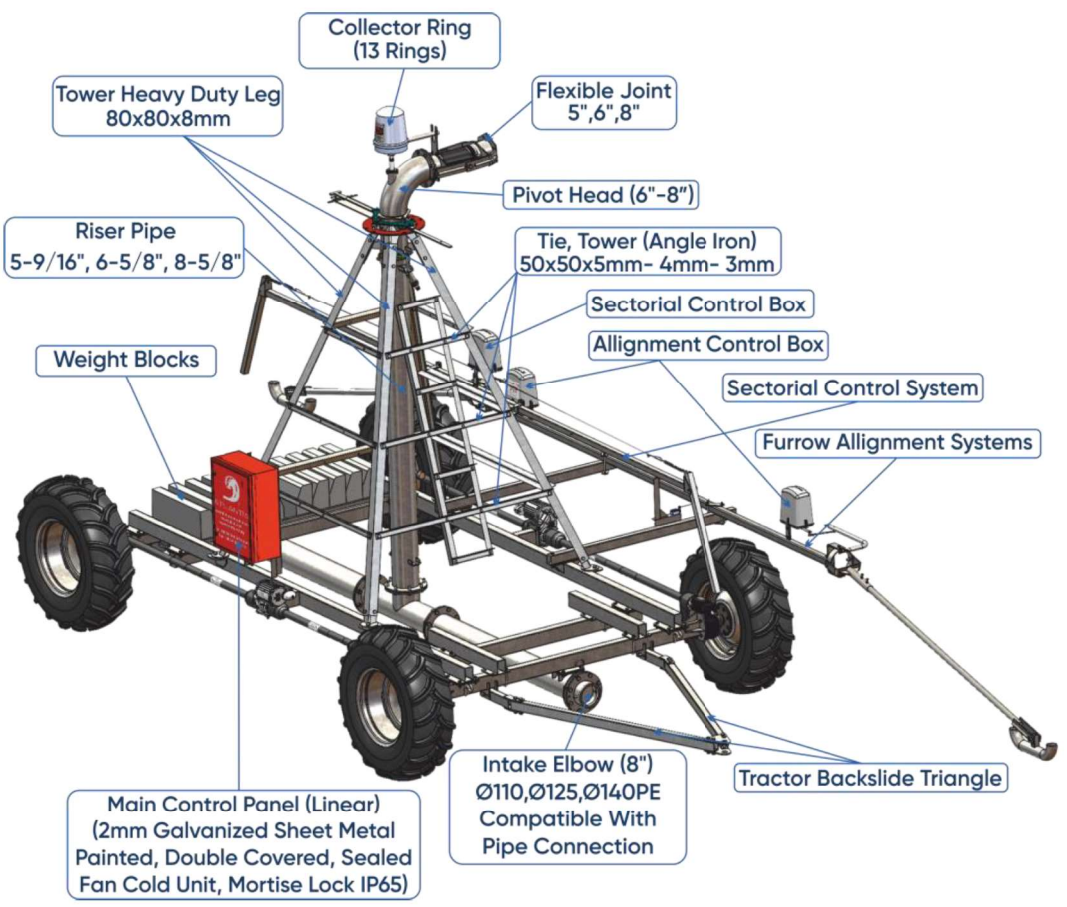
	Ditch Feed	Hose Feed
Water Source	Earthen ditch or concrete canal	Pressurized pipeline
Power Source	Cart-mounted engine or power cord	Cart-mounted engine or power cord
Guidance	GPS, above- or below-ground cable, or furrow	GPS, above- or below-ground cable, or furrow
Typical Field Sizes	301-1,500 acres (130-607 hectares)	22-300 acres (9-121 hectares)
Typical Flow Rates	500-4,500 gpm (32-285 lps)	200-1,400 gpm (12-88 lps)
Chemigation	On-board tank (up to 300 gallons)	On-board tank (up to 300 gallons)

Advantages of linear irrigation system

- Maximum irrigation efficiency - field coverage reaches 92-98%;
- High autonomy and minimal labor costs during operation (in systems with connection from an open channel);
- Individual selection of the system, depending on the required irrigation area (one- and two-winged systems);
- Ability to choose the most suitable source of water supply: an open channel or a closed network;
- Ability to irrigate the field even at low water pressure, saving energy resources;
- Adjusting the irrigation speed to select the optimal amount of water or fertilizer for the crop;
- Possibility of irrigation of several fields with one system (towable installations).

Parts of the linear irrigation system

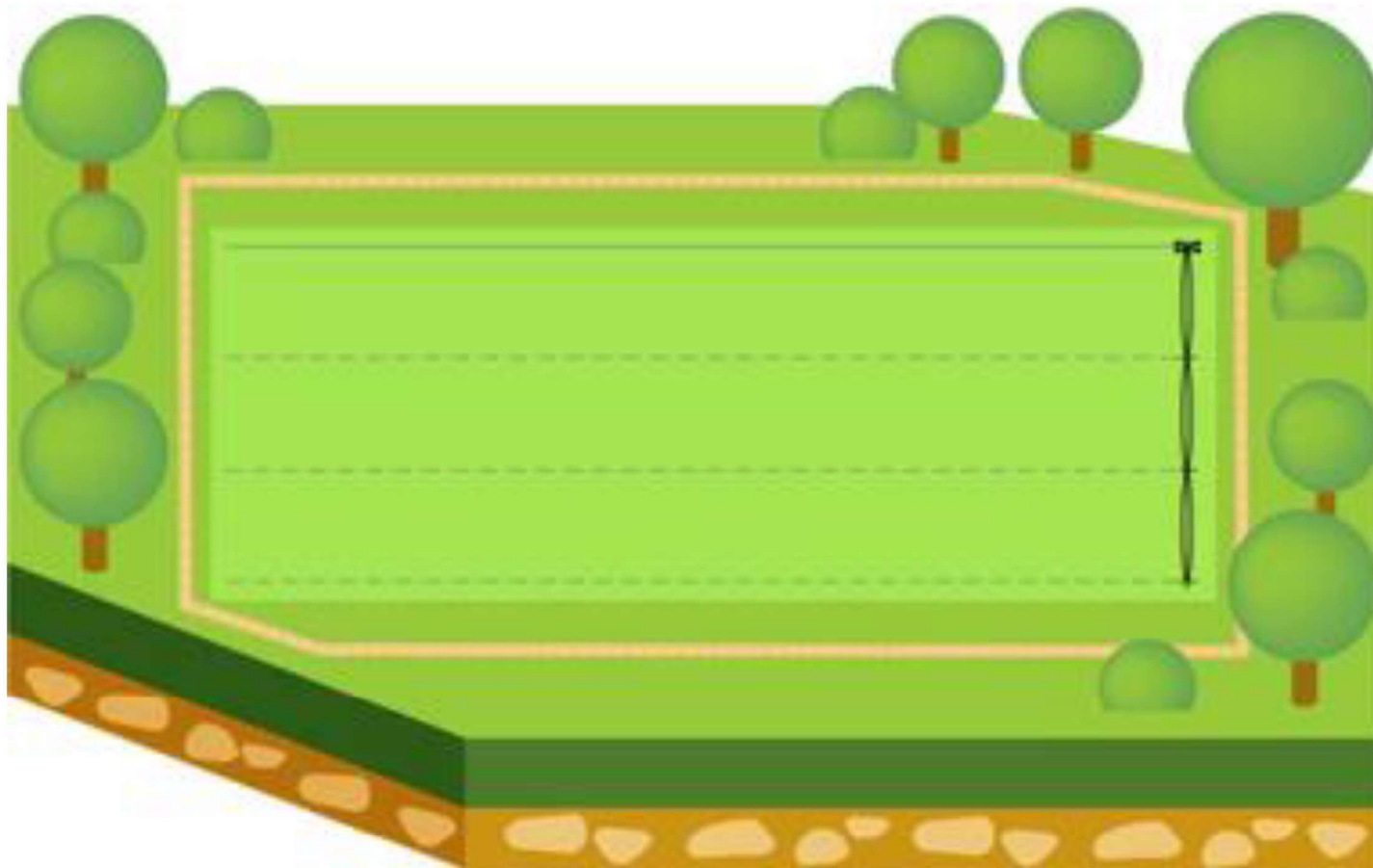
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Schematic work of the linear irrigation system

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[https://www.youtube.com/watch?v= MF_Jv9AvTk](https://www.youtube.com/watch?v=MF_Jv9AvTk)



Linear types and structures

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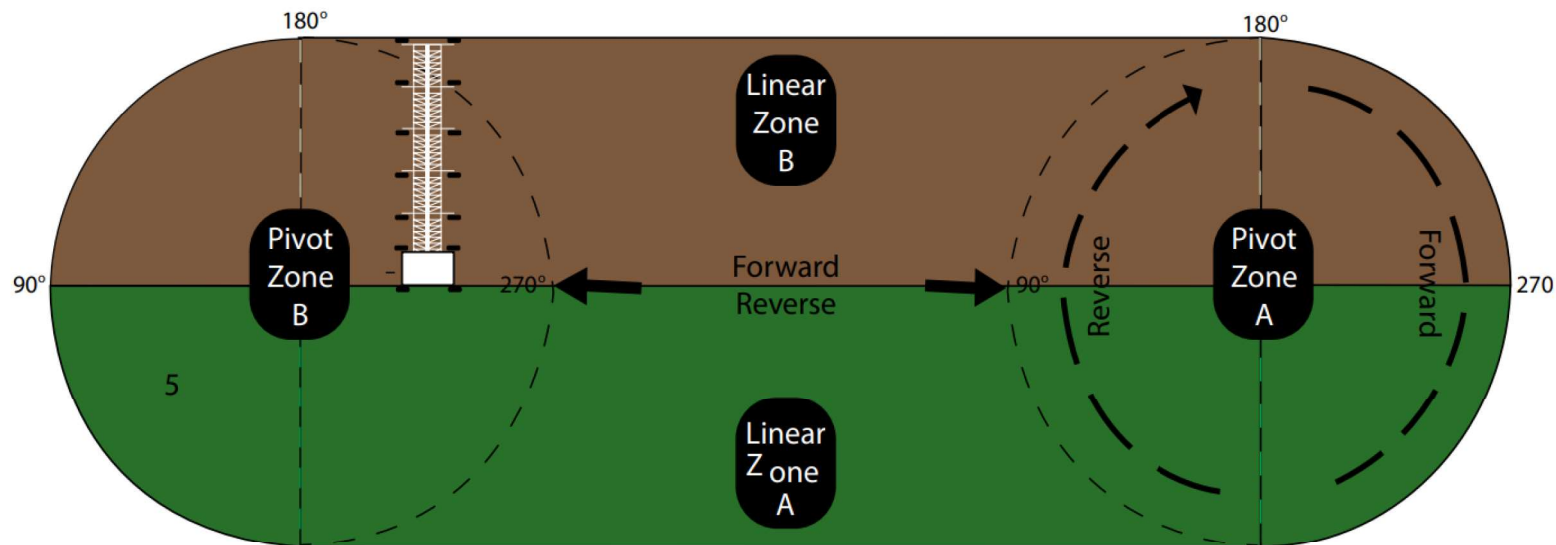


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Hippodrome irrigation system combination of the advantages



- Hippodrome irrigation systems are the ideal solution for irrigating irregularly shaped fields with complex configuration. Due to the sequential movement of the entire installation along the field and turning at several points, the irrigation efficiency reaches 98%.



Advantages of hippodrome irrigation system

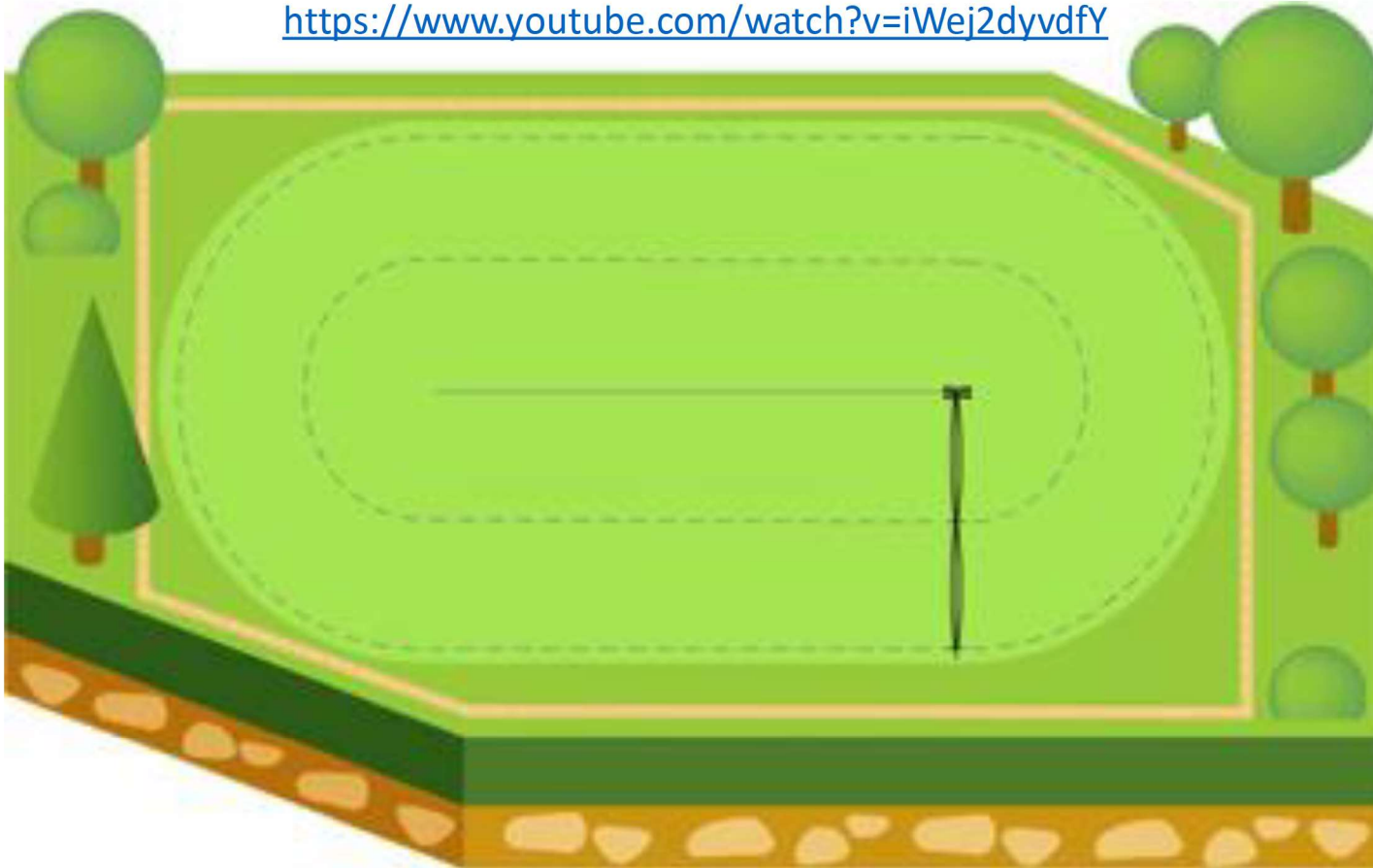


- Irrigation efficiency of the field reaches 92-98%.
- Irrigation of non-standard fields of complex configuration;
- A quick turn for irrigating another part of the field allows you to double the number of irrigated hectares with one system;
- Adjusting the irrigation speed to select the optimal amount of water or fertilizer for the crop.

Schematic work of the hippodrome irrigation system

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<https://www.youtube.com/watch?v=iWej2dyvdfY>



Types of sprinklers for pivot – linear and hippodrome systems



Efficiency and Uniformity

- Droplet sizes are designed to minimize wind drift.
- Combining drops with new sprinkler technology delivers the ultimate water savings.
- Distributing water evenly across the field provides maximum yields.
- Lowering the position of the sprinkler reduces spray and drift caused by wind and evaporation.

Crop Protection and Fertilizer Application

- You can save substantial money when crop protection products and fertilizers are applied through center pivots and linears, rather than through ground rigs or aerial sprays.
- This is especially true for crops that require several applications during the growing season. The efficient application of inputs will produce a more uniform crop and save you money on labor and application costs

Right sprinkler choice



Many factors go into selecting the right irrigation sprinklers for your operation. These include:

Soil Type and Texture

Proper sprinkler selection and design help reduce soil sealing.

Crops

Crop height and the water's ability to penetrate the crop canopy are significant considerations in sprinkler head design.

Terrain

The slope of the field should be taken into account, to minimize runoff and keep water where it's most needed.

Correct Spacing

Each sprinkler head must be positioned correctly to maximize water delivery, and the overlap of the sprinkler pattern is a critical factor.

Energy Conservation

Low-pressure sprinkler technology provides solutions that lower your energy bill because you use less water pressure.



Main types of sprinklers

- Under the concept of “Low Pressure – High Performance,” Senninger® Irrigation products distribute water uniformly and with low application intensity. With a variety of designs available, you can select the product best suited to your individual field, crop and installation needs.
- Komet Irrigation is a family company that has been constructing innovative irrigation sprinklers for more than 60 years. The decades of development have led to the Komet Precision Twister (KPT) and the new Komet Precision Spray (KPS)



Komet Precision Twister



Water Distribution

- Komet's 3-D Motion System concentrates the water force onto the central axis of the sprinkler, putting very little stress on the sprinkler assembly and giving a uniform water distribution throughout the entire water pattern
- Three plate choices – Standard trajectory, Low trajectory and the industry-exclusive Ultra-Low trajectory
- Specially designed body legs reduce dripping to a minimum
- A crop guard is built into the main body of the Komet Precision Twister (KPT) sprinkler preventing the deflector from stalling in heavy crop canopy

Consistency of Droplet Size

- Special groove and surface design provide consistent water droplets across entire water pattern
- Minimal losses to wind drift
- Gentle to sensitive soils

Energy Efficiency

- Operating pressure range 6 - 20 PSI (.41 - 1.38 Bar) for all nozzle sizes #10/128 - #52/128
- Industry-leading performance at the lowest pressures reduces energy inputs to a minimum
- Top-mounted Precision Twister Peak also available



Komet Precision Spray

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Water Distribution

- Variety of dual-purpose fixed spray pads to meet desired performance characteristics
- Optional part-circle 180-degree deflector helps to prevent excessive watering of the wheel tracks near the towers

Consistency of Droplet Size

- Variety of deflectors for different droplet sizes, crop stages and crop sensitivities

Energy Efficiency

- Operating pressure range 6 - 30 PSI (.41 – 2.1 Bar) for all nozzle sizes # 8/128 - #52/128 K



Senninger® Sprinklers - Low Pressure and High Performance



LDN® (Low Drift Nozzle) UP3

- Multiple deflector pads divide larger flows into various streams resistant to wind-drift and evaporation
- Different combinations of grooved pads help direct the trajectory of streams and control droplet size
- Also available with chemigation pads, a LEPA bubbler pad, shroud and part-circle pads Super Spray®

UP3

- Ideal for surface water due to the distance between the nozzle and deflector, and the deflector and the bracket
- 22 interchangeable pads provide more control over spray pattern and droplet size
- Can be mounted on drops or on top of pipe

Senninger® Sprinklers - Low Pressure and High Performance



PSR™ (Pivot Special Regulators)

- Maintains a constant, preset outlet pressure while handling varying inlet pressures
- Easy passage of debris on systems pumping surface water
- Low hysteresis, low friction loss and vandal-resistant housing

Pivot-Master® Impact Sprinklers

- Low, 6-degree trajectory combats the effects of wind
- Bearing assembly design reduces braking friction for dependable rotation and longer life
- Enclosed splash arm spring and bearing provide protection from the elements
- Single- and double-nozzle models available for different flow and distribution needs

End of Pivot sprinklers



R55 End of Pivot Sprinklers

Short-range, low-pressure

- ☪ Flow: 20-105 gpm (4.2-23.6 m³/hr)
- ✔ Pressure: 15-60 psi (1-4 bar)
- Radius: 40-56 ft (12.2-16.9 m)



R75 End of Pivot Sprinklers

Mid-range, low-pressure

- ☪ Flow: 24-70 gpm (5.4-15.4 m³/hr)
- ✔ Pressure: 25-60 psi (1.75-4 bar)
- Radius: 50-70 ft (14.9-21 m)



SR75 18° Big Gun®

Long range, low pressure

- ☪ Flow: 30-100 gpm (7-23 m³/hr)
- ✔ Pressure: 25-60 psi (1.75-4 bar)
- Radius: 70-90 ft (21-28 m)



P85AS Brass Impact

Mid-range, medium pressure

- ☪ Flow: 20-60 gpm (4.5-13.6 m³/hr)
- ✔ Pressure: 30-60 psi (2.1-4.1 bar)
- Radius: 50-80 ft (15-24 m)

Drive - wheel Solutions



A stuck center pivot has a greater impact than downtime. When your irrigation operation is at a standstill, everything from increased energy costs to expensive repairs to reduced yield are likely.

Improved stability: Wider wheel base improves span stability on rolling ground and in windy conditions

Improved span alignment: Set of four braces on each side improves span alignment and balances the load when crossing deep ridges

Minimizes pipe stress: Valley flex-joint assembly greatly minimizes pipe stress on rolling terrain

Tire options: Several tire sizes available to best meet your field conditions



Drive - wheel Solutions

Articulation 4 Wheel Drive

All four tires are driven to provide better traction and less downtime.

Reduces motor load for longer life performance.

Allows you to add tracks with minimal effort.

Lower ground pressure leads to less soil compaction and shallower rut depth.



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Track Drive

Strength to support center tires on ridges.

Designed to help prevent stuck drive units.

Weight is distributed over a wider area than other tire options to minimize ground pressure.

By lowering ground pressure, soil compaction and rut depth are minimized.





VRI – Variable Rate Irrigation

Every field is different, with varying soil types and topography.

Applying the same amount of water across your entire field doesn't always make sense.

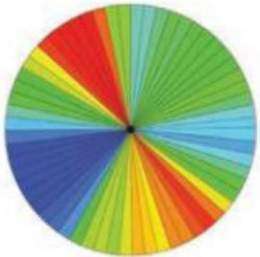
VRI takes the advantages of traditional center pivot irrigation to the next level.

With easy-to-use VRI software, growers can irrigate more efficiently, without compromising yield potential by over- or under-watering.

There are many customizable VRI solutions:

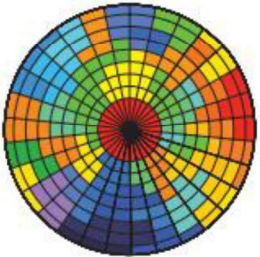
Speed Control, Zone Control and Individual Sprinkler Control (VRI-iS).

VRI methods - detailed



VRI Speed Control

Utilizes existing hardware and adjusts the speed of the center pivot to achieve the application depth desired, based on the customized irrigation prescription.

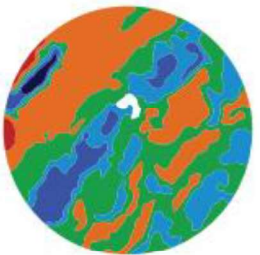


VRI Zone Control

Breaks a sprinkler package into zones to create more than 5,000 sectors, maximizing water application efficiency in more challenging fields, such as those with varying topography, ditches, bogs, varying soil types and canals.

VRI Zone Control for Linears (Laterals)

- This option is ideal for rectangular fields with different soil types and non-irrigated areas.
- Research institutions often use this option in test fields.



VRI-iS - Individual Sprinkler Control

The most precise VRI option available, dividing a field into sectors every 0.1 degree. Individual sprinkler control for maximum prescription resolution. Customized prescriptions utilize GPS positioning, shape files and sprinkler package data to apply water only where growers want it, reducing over/under watering and runoff.

Advantages of VRI systems

Growers can:

- Increase yields by bringing precision irrigation to all areas of their fields
- Create a prescription with the click of a button
- Work remotely, monitoring and controlling VRI water application from wherever they happen to be
- Wirelessly upload prescriptions from computer through the cloud, directly to ICON panels
- Save on water and pumping costs
- Increase efficiency of chemical application
- Protect soil health by minimizing runoff and deep percolation

<https://www.youtube.com/watch?v=8pSnCltGnTE>

Pivot and Linear irrigation monitoring and maintenance



- Know which tower is out of alignment even before arriving at the pivot.
- Stay informed of tire pressure status at each tower*.
- Monitor individual drive train run time to keep track of key maintenance intervals at each tower.
- Monitor your pivot's water pressure at each tower to assure uniform application in varying terrain.

ALIGNMENT

One tower that's out of alignment can cause difficulties with the entire pivot. You'll receive an alert that lets you know which tower needs attention, saving you time during the troubleshooting process.

TIRE PRESSURE*

Receive notification when and where a tire loses pressure or goes flat. Take action when a tire becomes low by stopping the pivot in an accessible part of your field. In case of a flat tire, configure your machine to automatically shut down to avoid drive train component damage.

DRIVE TRAIN

Monitor individual drive train run time to keep track of key maintenance intervals at each tower.

WATER APPLICATION

Pivots require the right water pressure for proper water application over an entire field. Problems at the pump and uneven terrain can prevent your pivot from doing its job effectively. Machine Diagnostics will notify you immediately when and where to adjust.

Take home message – 4 R in irrigation

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Right Source

- Water rights
- Water quality
- Water reliability
- Water leasing programs



Right Rate

- Water measurement
- Nozzle reductions
- Flow rate adjustments
- Irrigation set lengths
- Advanced irrigation scheduling
- Variable-rate irrigation



Right Time

- Irrigation frequency
- Advanced irrigation scheduling
- Avoiding high loss situations
- Pre-/post-season irrigation



Right Place

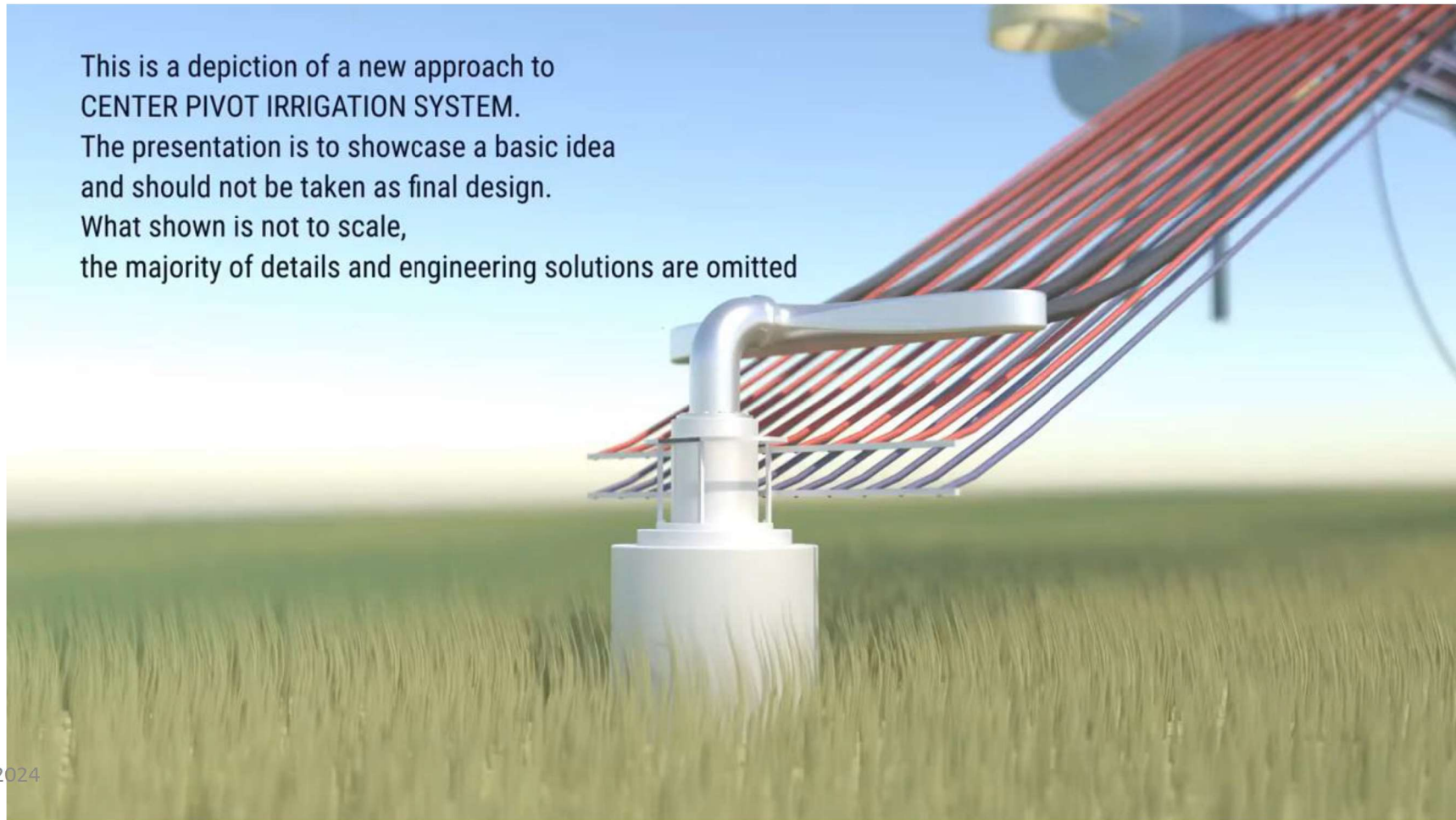
- Irrigation uniformity
- Irrigation application efficiency
- Irrigation allocation in fields
- Irrigation allocation among fields
- Allocation calculators



New approaches - ideas

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This is a depiction of a new approach to CENTER PIVOT IRRIGATION SYSTEM.
The presentation is to showcase a basic idea and should not be taken as final design.
What shown is not to scale, the majority of details and engineering solutions are omitted



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Thank you for your attention!

