Tillamook County Soil and Water Conservation District
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June, 2013

IRRIGATION SYSTEM FOR TILLAMOOK COUNTY

A System That:

1. Manages Soil Moisture and Increases Forage Yields
2. Conserves Water
3. Reduces Energy Use and Costs
4. Decreases Non-Point Sources of Surface and Ground Water
5. Proper Use of Manure

More Grass—Cleaner Water—Happy Cows

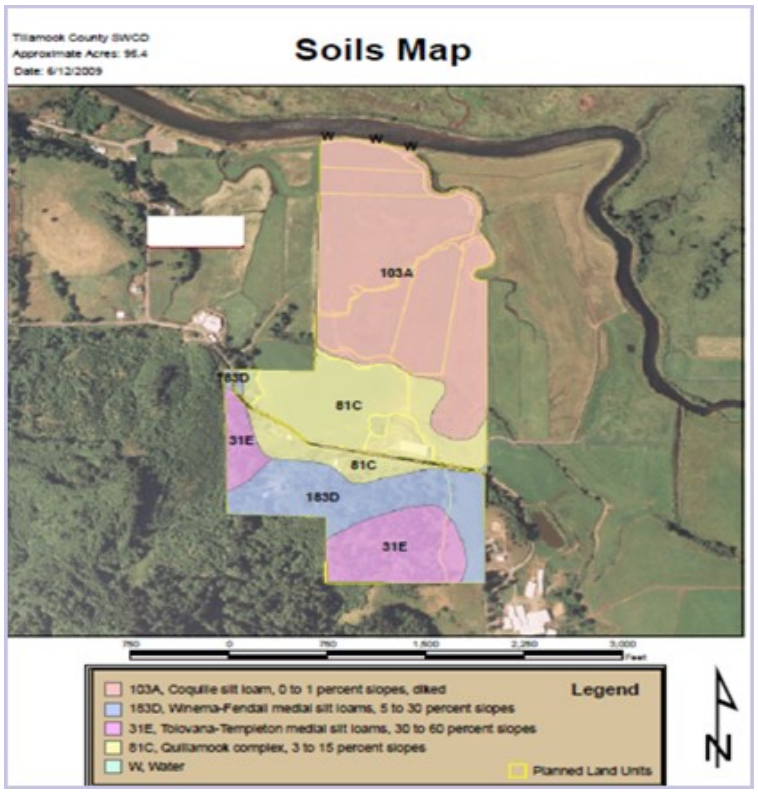
Tillamook County Soil and Water Conservation District

June, 2013

PLANNING CONSIDERATIONS

1. Is there a valid water right for the Tract?
2. Can a water right even be acquired?
3. Fish screens when irrigating from a stream or river.
4. An effective water management system that reduces water losses.
5. A system that distributes water uniformly and efficiently.
6. Wind direction and intensity to minimize spray drift into water courses or onto public roads.
7. The avoidance of equipment and livestock on wet soils to avoid compaction.
8. No over allocation of water following manure, fertilizer, or pesticide applications.

Know Your Soils:



Soil Maps are available through NRCS or at websoilsurvey.nrcs.usda.gov

REFERENCES

THE REFERENCES LISTED BELOW WERE USED TO DEVELOP THIS PUBLICATION. THE DATA IS FOR WESTERN OREGON LIVESTOCK PRODUCERS.

- **Management Measures for Agriculture Sources**
- **Irrigation Water/Polluted Runoff (Nonpoint Source Pollution) US EPA 04/01/2012**
- **Estimating Soil Moisture by Feel and Appearance USDA Program Aid Number 1619**
- **Irrigation Pasture Management-Improving Water And Pasture Quality US Davis, Department of Plant Science**
- **Science of the Total Environment; Volume 250, Issue 1-3, April 24, 2000, Pages 143-167**

AEI/Production Management 4.6 Irrigation Water Management, Pages 225-240

- **Tensiometer Used in Scheduling Irrigation, Mahbub Alam, Extension Specialist; Irrigation Water Management and Danny H. Rogers, Extension Engineer; Kansas State University Agricultural Experiment Station and Cooperative Extension Service, July 1997**

Natural Resources Conservation Service; Conservation Practice Standard Irrigation Water Management Code 449; NRCS Oregon, July 2011

- **US Department of Agriculture, Natural Resources Conservation Service, Oregon, Operation and Maintenance Worksheet Irrigation System-Sprinkler, Code 442**

NOTES

DRAINAGE CLASSES OF SOIL

Drainage Class

Aggregation Method: Dominant Condition
Tie-break Rule: Higher

Tillamook County, Oregon
Survey Area Version and Date: 1 - 09/21/2006

Map symbol	Map unit name	Rating
31E	Tolovana-Templeton medial silt loams, 30 to 60 percent slopes	Well drained
81C	Quillamook complex, 3 to 15 percent slopes	Well drained
103A	Coquille silt loam, 0 to 1 percent slopes, diked	Very poorly drained
183D	Winema-Fendall medial silt loams, 5 to 30 percent slopes	Well drained
W	Water	

Soil Maps and the Drainage Class Report are important tools in developing an Irrigation Management System. The Drainage Classes provide a guide to irrigation considerations and potential for soils to grow various crops.

There are seven drainage classes:

- Excessively Drained. Water is removed from the soil profile very rapid. The occurrence of internal free water in the soil profile is very rare or very deep. Over irrigating these soils most likely will leach nutrients below the root zone and into the water table.
- Somewhat Excessively Drained. Water is removed from the soil profile rapidly. The occurrence of free water in the soil profile is very rare or very deep. Over irrigating these soils most likely will leach nutrients below the root zone and into the water table.
- Well Drained. Water is removed from the soil profile readily but not rapidly. The internal free water occurrence is usually deep or very deep. Water is available through-out much of the growing season. Soil wetness does not impact plant root growth during the growing season. Nutrient leaching and surface runoff from irrigation is less likely to occur.
- Moderately Well Drained. During some periods of the year, in early spring or after rain storm event, water in the soil profile somewhat slowly. Internal free water in the soil is moderately deep. Soils are wet for only a short time within the root zone during the growing season. Nutrient leaching and/or runoff may occur if the irrigation application rate is too high.
- Somewhat Poorly Drained. Water is removed from the soil profile slowly. The soil is generally wet at shallow depths for considerable time during the growing season. The internal free water is normally shallow to moderately deep. Soils generally have a high water table. Soil wetness may adversely affect crop production. These soils are sensitive to irrigation. Filling the shallow soil depth will most likely result in runoff and surface water pollution if drainage system as open ditches, streams, and rivers are close by.
- Poorly Drained. Water is so slowly removed from the soil profile that the soil is wet at shallow depths at times during the growing season or may remain wet for extended periods of time. The internal free water is shallow to very shallow. Artificial drainage generally is present in agricultural producing soils. These areas are very sensitive to irrigation. Runoff and ponding can occur in a short time frame.

TYPES OF IRRIGATION SYSTEMS

Big Gun Sprinkler System

The big gun sprinkler uses a large sprinkler mounted on a sled, trailer or cart.

- A flexible hose is attached to a reel and engine that moves the hose and sprinkler across the field
- Big gun system requires high operation pressure. System operating over 100 psi is common
- Wind direction and intensity may cause excessive drift into open watercourses
- Over irrigation can occur with the system if not properly calibrated
- Energy costs associated with the system

QUESTIONS???

If you have any questions,
Or need assistance,
Please feel free to contact the
Tillamook County Soil and Water
Conservation District
At

(503) 842-2848 ext. 111

Tillamook SWCD

VISION

Maintaining a quality of life by our people working together to enhance our County's most valued natural resources for the generations that follow through promoting local economic growth through wise use of our County's natural resources.

TRAVELING BIG GUN CALIBRATION

Name:____________________ Date:__________

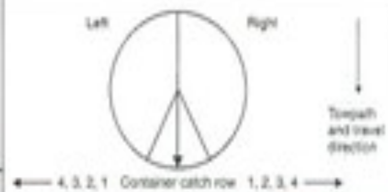
Perform the following operations to calibrate the traveling big gun sprinkler:

- ✓ Use 5 to 10 catch cans to collect the sprinkler-irrigated waste. Use straight-sided buckets for catch cans. Two pound coffee cans work well. Make sure all of the catch cans have the same diameter.
- ✓ Place one of the catch cans on a level surface and fill it with water to a known depth (1-3 inches). Pour the water from the catch can into a large measuring cup. Determine how many measuring cups of water are equal to an inch of water in the catch can.
- ✓ Place at least five catch cans across the towpath of the big gun sprinkler. Try to space the catch cans uniformly from the center of the towpath to the outer edge of the wetted area of the sprinkler. Stake the catch can in place or put a rock in the bottom of the catch can to keep it upright. Allow the traveling big gun sprinkler to completely pass over the catch cans. Use the measuring cup previously used to calibrate the catch cans to measure the amount of liquid collected in each can and convert the volume to inches. Be sure to add together the amount measured from the catch cans that would receive overlap from the adjacent towpath. For example, if catch can #4 will receive liquids from the adjacent towpaths, add the amount from container #4 on the left to container #4 on the right side to compute the total amount applied at the location of container #4 on the right and left sides of the towpath.

Catch Can Calibration:

Example: 1 inch = 5 Cups
1 cup = 0.2 Inches

Your Catch Cans: 1 inch = _____ Cups
1 cup = _____ Inches



Travel Rate Setting During Test:

Data and Calculations:

Catch Can ID	Volume of Liquid							
	Cups	Inches	Cups	Inches	Cups	Inches	Cups	Inches
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
Average =								

TYPE OF IRRIGATION SYSTEMS

Solid Set Irrigation System

- This hand-move sprinkler system is portable
- Pipe sections are light weight for irrigation sets of 40 to 60 feet
- Thee laterals are connected to a mainline that may be portable or buried
- Assures of quality watering because of a more uniform water distribution close to surface. Less affected by winds
- A low pluviometry avoids soil pounding on new seeding
- Easy and quick set up. Some manual labor involved with the setups and moving the system
- Solid set irrigation system equipped with galvanized steel couplings assures quality and reliability at low cost

TYPES OF IRRIGATION SYSTEMS

Wheel Line Irrigation System

A wheel move irrigation system, also known as wheel line, side roll, or lateral roll system.

- The system constitutes a major investment on the part of a farming operation
- Regular maintenance of the system is required to reduce repair costs, help the system last longer, and keep irrigation efficiency at design levels
- The wheel move is a mechanical irrigation system that can be moved intact, from one location in a field to another, by means of an internal combustion engine
- A wheel move system consists of the power mover, lateral pipe with wheels, sprinklers, couplers, connectors, and a flexible supply line
- Often times, one wheel move is placed on a 40 acre 1/4 mile by 1/4 mile field
- An 11 or 22 day irrigation interval is possible depending on whether 12 hour or 24 hour set-time is used
- Assures of quality watering because of a more uniform water distribution close to surface. Less affected by winds

OVER IRRIGATION

Over Irrigation???

Over irrigation may reduce crop yields, nutrient leaching and/or runoff into water systems, increased power costs associated with the system operation, and excessive use of water.

Some Sprinkler Calibration Considerations:

- The sprinkler system calibration should occur during the same time it is generally operating. Water pressure needs to be similar.
- Low water pressure in the system will impact the irrigation water coverage and amount applied.
- As a rule of thumb, water application rates should not exceed ½ to ¾ inch per irrigation.
- Most irrigation mechanisms can be adjusted to assure time settings are accurate.
- If you are only watering a lawn with a hose and sprinkler, a mechanical timer and shut-off switch for the faucet will ensure watering efficiency.
- Do not mix sprinkler head types. Match the sprinkler heads for uniform coverage.
- Monitor the sprinkler system regularly. Replace any broken parts, clear plugged nozzles, and adjust the direction of spray that will result in wind direction and speed.
- Prevent water from spraying on roads, neighbor’s property, sidewalks, and/or driveways.
- Do not waste water.

CALIBRATING IRRIGATION SYSTEMS

Example:
8 cans were placed between two sprinklers. The sprinklers were operated for 45 minutes. Once the cans were collected, water poured into a single can, and measured, there was a total of 2.2 inches of water.

Therefore:
2.2 inches divided by 8 cans = 0.275 inches per can.
45 minutes divided by 60 minutes per hour = 0.75 hours
0.257 inches divided by 0.75 hours = 0.36 inches per hour

We know that our crop requires 1.5 inches of water.
So: 1.5 inches divided by 0.36 inches per hour = 4.16 hours.

The irrigation system must run for 4.16 hours to apply the 1.5 inches of irrigation water to the crop. Depending on the soils, slope, and the amount of water in the soil profile prior to irrigating, runoff may occur if the 1.5 inches is all applied at one time. This may require that the irrigation system be operated two, three, or four times or more to apply the amount of water required. Some monitoring may be required to assure that over irrigation does not occur.

TYPES OF IRRIGATION SYSTEMS

Irripod Irrigation System

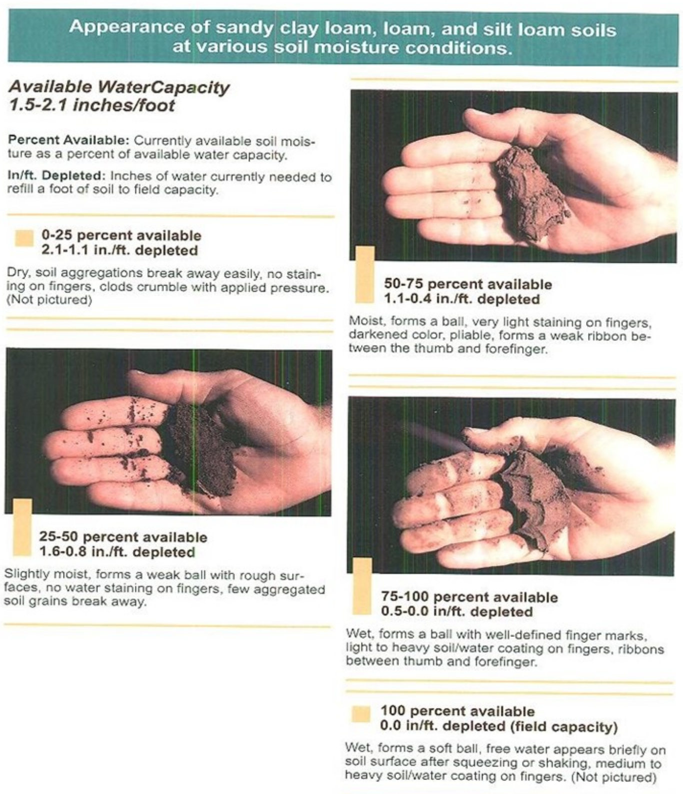
- Designed to operate at low pressure
- Distributes water on a slow absorption rate over a 12-24-hour period
- This allows for effective absorption into the soil eliminating pooling and run off
- The system only requires movement once per 12-24 hour period
- Cost effective irrigation
- Simple installation suits all terrain and property sizes
- Efficient use of water
- Easily expanded
- Non-labor intensive

MANAGING SOIL MOISTURE

Managing Soil Moisture to Schedule Irrigation

The Feel and Appearance Method:
Estimating Soil Moisture for Sandy Clay Loam, Loam, and Silt Loam Soils

The Figure below illustrates a very simple method that may be used to estimate the percent of water by feel and appearance in silt loam soils. Some irrigation systems may apply irrigation water at one inch or more. Applying manure when 0.5-0 in/ft of water is depleted or 75-100% moisture is available. Applying irrigation water to crops and pastures during these conditions will either leach nitrate below the root zone or create a favorable condition for nutrients to runoff the field. Either condition has negative impacts on water quality.



CALIBRATING IRRIGATION SYSTEMS

Knowing the amount of water your sprinkler system applies to your landscape is an important step in efficient water use. Most people irrigate their crops for a given number of minutes without knowing how much water they are really applying. This may lead to over- or under-watering, neither of which will benefit the crop nor the environment. Calibrating will help you to apply the correct amount of water to your crop.

Solid-Set Sprinkler Calibration:

➡ Evenly space 6 or more cans on a straight line between any two sprinklers.

➡ Turn the irrigation on for a given amount of time.

➡ Turn the irrigation system off. Collect the cans and pour the water collected in all the cans into one can.

➡ With a tape measure or ruler, measure the depth of water in the one can.

➡ Divide the measure depth of water in the one can by the number of cans used to obtain the actual amount of water that was applied.

➡ For example, if the time used to collect the water was in minutes divide by 60 to get the hours.

➡ Divide the measure depth of water in the one can by the number of cans used to obtain the actual amount of water that was applied by the hours the irrigation system was on will provide the rate of application.

See examples on next page

OPERATION AND MAINTENANCE

Irrigation systems require operation and maintenance to maintain satisfactory performance to meet crop water requirements, conserve water, and prevent water quality degradation. An operation and maintenance program will increase the life span of the system and prevent excessive system costs.

An operation and maintenance program includes:

- Operating the system when water is needed for plant growth and store moisture within the root zone of the plant.
- Regularly monitor the crops to note areas of moisture stress and/or repair or adjust the system as required.
- Operate the system at the pressure, discharge rate, speed, duration and frequency as designed.
- Examine each sprinkler and spread head periodically for proper operation. Clean any plugged nozzles or replace if worn and defective.
- Promptly repair leaks in the delivery components such as valves, fittings, gaskets, or other worn or damaged parts.
- During non-seasonal use, place accessories where they will not be damaged but are secure.
- Maintain screens, filters, valves, timers, and electrical and mechanical components in good operating condition. Drain equipment to protect from freezing.
- Eradicate all rodents and/or burring animals that potentially could damage delivery system parts or application equipment. Repair any rodent damaged equipment.
- Repair equipment that may be damaged by livestock, vehicular, or vandalism. Prevent livestock near the irrigation system when it is operating.

TENSIOMETERS

Tensiometers are soil water measuring tools that are sensitive to changes in soil moisture. They are sealed water filled tubes with a vacuum dial gauge on the upper end and a porous ceramic tip on the lower end. These instruments are effective devices for irrigation scheduling. The tool assists an irrigator on the timing of irrigation and the amount of water application required for the crop. Not enough water or too much water can result in crop yield reduction. Over irrigation may leach nutrients beyond the root zone and into the ground water. Water is wasted when over irrigating. Over irrigation also cost money to pump.

As plant roots pull water from the soil profile, a water tension is created. Tensiometers measures this water tension. A tensiometer is equipped with a gauge that continuously records the plant roots ability to extract water from the soil. These devices are accurate at low water tensions. Low tensions are the soil's wettest water range.

The vacuum gauge is calibrated in centibar or hundredth of one bar. A bar is the unit of pressure, either positive or negative used to measure (express) the soil suction. The soil suction reading is an indication of soil water for use by the crop. A zero gauge reading indicates the soil is completely saturated. An 80 reading, the functional upper limit for tensiometer readings, indicates a very dry soil condition.

Tensiometer Interpretation Readings:

Reading (centibars)	Status	Explanation/Action
0	**Saturated**	Soil is saturated regardless of soil type. If reading persists, there could be a water-logged soil condition, a high water table, poor soil drainage and aeration, or the water column continuity in the tube may have broken.
5-10	**Surplus Water**	A surplus of soil water is indicated. Drainage continues. Persistent reading indicates poor drainage.
10-20	**Field Capacity**	Additional water will drain. Deep soil percolation will occur, leaching nutrients past the plant root depth and are not available to the plant. Since sandy soils have little storage capacity, the suction values will rapidly increase as plants pull the water from the soil past the 15 to 20 centibars.
20-40	**Irrigation Range**	In fine and medium textured soils the available water and aeration is good for plant growth. Irrigation not required for these soils at this range. Coarse textured soils may require irrigation at the 20-30 range. Finer sandy loams may require irrigation at the 30-40 centibar range.
40-60		Usually the centibar reading range when irrigation is started. Loamy sand soils irrigation mostly like 40 to 50 range. On clay soils, silty clay loams and silty clay soils, the irrigation generally begins between 50 to 60 centibar range. This range ensures available soil water for the plant.

Tensiometer Interpretation Readings:

Reading (centibars)	Status	Explanation/Action
70	**Dry**	Plant stress range. The crop however may not be damaged. Some soil water may be available in clay loam soils. However, it may be too low for maximum production.
80		The top range for the tensiometer accuracy. Tension in the water column inside the tube will break between 80 to 85 centibars. There is a relationship between the irrigation area's elevation and mean sea level. The higher the irrigation elevation the tensiometer tube water may break at a lower reading based on the atmospheric pressure.