B-248

Surveying Farm Drainage Systems

TEXAS AGRICULTURAL EXTENSION SERVICE
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DRAINAGE NEEDS IN THE GULF COASTAL AREA OF TEXAS

There are several hundred thousand acres of land of the Gulf Coastal Area that would be improved by better drainage facilities. Main drainage channels have been dug through some of this country and creeks and rivers which serve as main drainage channels, exist through some of it.

One of the great needs for the area is the construction of shallow waterways to collect rainfall and carry it to the drainage channels that already exist. Some of the land is so near level that the rainfall stands too long on it for good grass growth. On some of the land shallow pockets of considerable area exits.

In some cases, the drainage condition can be improved greatly by the struction of terrace ridges, or rather, two shallow ditches divided by a ridge. Broad, shallow ditches should be built so that the dirt removed can be carried a considerable distance back and spread so as not to interfere with water entering the ditches.

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On many farms the contour of the land is such that excess water causes severe damage. This excess water may stand on the land in ponds for too long, or it may flow across fields during rains and cause damage from washing. USDA Farmers' Bulletin No. 2046 "Farm Drainage" discusses these and other drainage problems in detail. This bulletin limits itself to surveying drainage systems and may be used in conjunction with the above named bulletin.

In draining off standing water, usually the lowest cost plan is desired. Frequently, a leveling instrument must be used to determine the best outlet for water. Sometimes, however, good outlets are evident and poor drainage is due to neglect. The ditches may be grown up with grass and weeds or may be filled with silt and sand. Sometimes a fence row will prevent the water from draining off the crop. It often happens that changing the direction of rows will solve the drainage problem.

Where desirable drainage of the field likely will be influenced by the crop rows or fruit tree rows, a level should be used to determine the slope of the land so that the rows may run in the direction of the greatest fall, if such fall is not over 4 or 5 inches per 100 feet.

Where water stands in a level flat to a shallow depth only, it may be collected in a ditch by building a ridge through the flat with a ditch on each side of the ridge. That is, building a small road grade. The crop rows should cross the ridge to drain the water from the rows into the ditches, from which it may be ditched out of the field. If an ordinary ditch is run through a flat, the dirt removed from the ditch should be carried away from the ditch banks and spread out. If the ditch must be so large that neither of these methods is desirable, openings may be left in the banks at intervals.

If the surface of the land to be drained is irregular and the water will not run down the rows, or if rows are not used, a system of breaking the field in small narrow plots, 30 to 150 feet wide, usually will have the desired effect. After these plots have have been plowed two or three times with the dead furrows at the same places each time, the furrows will be large and deep enough to gather the water from each side so that even if the water stands in the furrows a little while, a large percent of the land will not be under water very long. One or both ends of such dead furrows should have an outlet into a drainage ditch.

Where it is difficult to drain a pond through a ditch, sometimes the water may be turned down through the subsoil to an open stratum below by means of a vertical tile or by opening a hole with dynamite. The success of this method depends largely upon whether or not a ground stratum can be found at a reasonable depth that will receive the surface water. Unless the nature of the subsoil is such that when broken up with dynamite it will remain so, little good is accomplished in using dynamite. If a lower stratum is found that will receive the surface water, a hole to this stratum may be kept open at least a few years with a vertical tile, or by filling the hole with rocks.

Drainage ditches on flat land should be dug a little more deeply than is necessary to carry the water as they will gradually fill up. If the banks are not steep the ditch will give longer service without cleaning. A ditch having a semicircular cross section will carry the most water in proportion to the amount of dirt removed in digging the ditch.

The proper fall to give a ditch is usually regulated by the amount available at a reasonable cost. A ditch carrying a large quantity of water requires less fall to make it clean itself, than one carrying a small amount of water. A large clean ditch with a fall of one inch per 100 feet might scour readily while in the same soil it might require a fall of 6 or 8 inches per 100 feet to keep a smaller ditch from clogging, especially if grass or weeds grow in the ditch. A suitable fall for large farm ditches may vary from almost level to 3 inches per 100 feet, while for small ditches it may be advisable to use grades up to 4 or 6 inches per 100 feet, if such can be obtained, and if the ditch will not be kept clean. It is not uncommon that any grade available, however small, must be used.

For digging small or shallow ditches, one of the steel ditchers or a road grader, with a plow for loosening the soil, is the best implement to use. If the ditch is to be rather deep and large the dirt may be removed economically with fresno scrapers. Dynamite is sometimes used for ditching and is very satisfactory in wet land where machinery cannot be used. Where teams or tractors can be used, they will move the dirt more economically than it can be moved with dynamite in most cases.

Surveying for Surface Drainage

Where it is necessary to take levels for ditching, the ordinary farm level may be used, although a more accurate level is desirable, especially if the ditch is to be quite long, or if but little fall can be obtained.

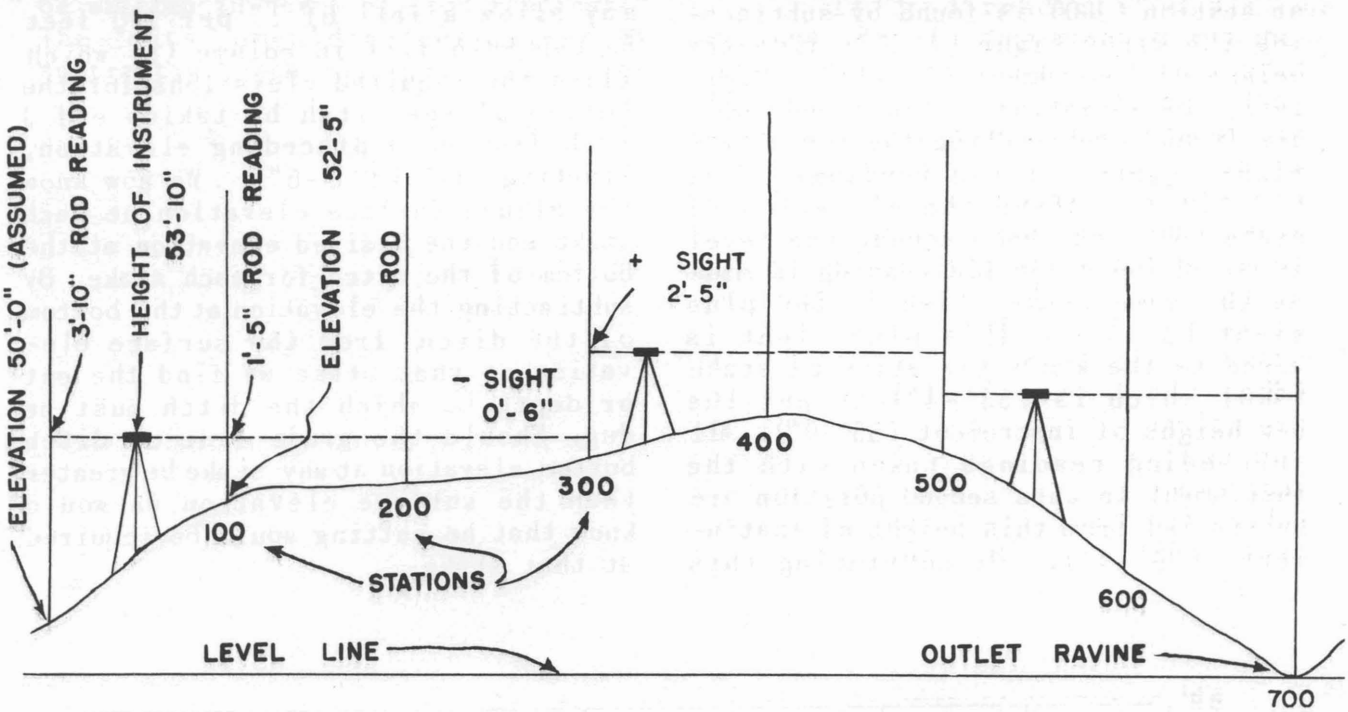
To take levels for ditching usually a few preliminary sights will assist in deciding on the best route for the ditch. After the instrument has been set up and adjusted, if necessary, the rodman may be sent to the lowest point in the land to be drained where a reading is taken. He should then take readings in various directions from the pond in all possible outlet ditches or ravines to see where sufficient fall may be obtained to drain the field. After points have been located that are sufficiently low, readings should be taken on the higher ground between the pond and the outlet to see if it would be necessary to make an excessive cut to get the proper grade in the ditch bottom.

In this way the best route for the ditch may be determined. The same plan may be used in selecting the best route for a new channel to be used in diverting a stream.

After the course of the ditch has been determined, a more accurate line of levels should be run to find out how deep to cut the ditch at various points along it. In taking such levels, a set of notes should be kept something like the sample shown here. A stake should be set in the lowest point of the field to be drained, and then a stake every 100 feet or closer along the proposed ditch to the outlet.

Typical Set of Notes for Profile Leveling

STATION		+ SIGHT	HEIGHT OF INSTRUMENT	- SIGHT	ELEVATION	GRADE LINE	CUT
IN SWALE	0'	3'- 10"	53'- 10"		50'- 0"	49'- 6"	0'- 6"
	100'			1'- 5"	52'- 5"	49'- 5"	3'- 0"
	200'			1'- 1"	52'- 9"	49'- 4"	3'- 5"
T.P.	300'	2'- 5"	55'- 9"	0'-6"	53'- 4"	49'- 3"	4'- 1"
	400'			1'- 7"	54'- 2"	49'- 2"	5'- 0"
T.P.	500'	1'- 5"	54'- 11"	2'- 3"	53'- 6"	49'- 1"	4'- 5"
	600'			3'- 9"	51'- 2"	49'- 0"	2'- 2"
OUTLET	700'			6'- 0"	48'- 11"	48'- 11"	0'- 11"



Sketch showing how profile levels are taken.

Explanation of Leveling Notes

Figures in columns (1), (2) and (4) are filled in while using the level and rod, while the other columns may be filled in later.

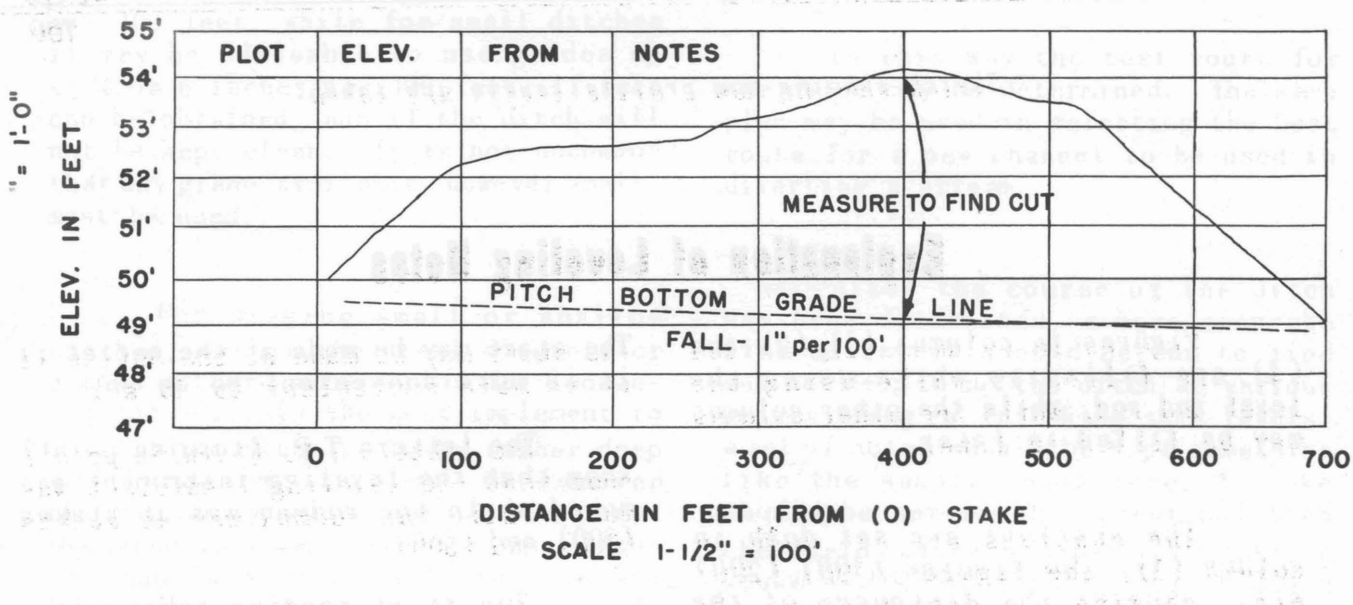
The stations are set down in column (1), the figures (100) (200) etc., showing the distances of the stakes from the starting stake at (0).

The start may be made at the outlet if it is more convenient to do so.

The letters T.P. (turning point) show that the leveling instrument was moved while the rodman was at stakes (300) and (500).

The first reading taken after the instrument is set up each time, is placed in column (2), or is a plus sight because it is added to the known elevation shown in column (5) to get the height of instrument, shown in column (3). All other rod readings, except the first, are set in column (4), under minus sights and are subtracted from the height of instrument to get the ground surface elevation. The first item (50'-0") in column (5) (elevation) is assumed. This refers to an assumed elevation of the ground surface above sea level. The elevation at station (100) is found by subtracting the minus sight (1'-5") from the height of instrument (53'-10"). Similarly the elevations of (200) and (300) are found by subtracting the respective minus sights, or rod readings, from (53'-10"). After the elevation of stake (300) has been found, the level is moved and a new rod reading is made at the same stake which is the plus sight (2'-5"). This plus sight is added to the known elevation of stake (300) which is (53'-4") to get the new height of instrument (55'-9"). All succeeding readings taken with the instrument in this second position are subtracted from this height of instrument, (55'-9"). By continuing this process the elevations of all points in the ditch line are obtained and placed in column (5).

By looking at these elevations we see that the outlet is 1'-1" lower than the starting point in the pond. If we start the ditch in the pond 6" deep we will have a drop of 7" from the ditch bottom there to the outlet. By giving the ditch bottom a uniform drop over the 700' of its length we may allow a fall of 1" per 100 feet We can then fill in column (6) which gives the required elevations for the bottom of the ditch by taking off 1 inch from each preceding elevation, starting with (49'-6"). We now know the ground surface elevation at each stake and the desired elevation at the bottom of the ditch for each stake. By subtracting the elevation at the bottom of the ditch, from the surface elevation at that stake we find the cut or depth to which the ditch must be dug. Should the grade line or ditch bottom elevation at any stake be greater than the surface elevation we would know that no cutting would be required at that stake.

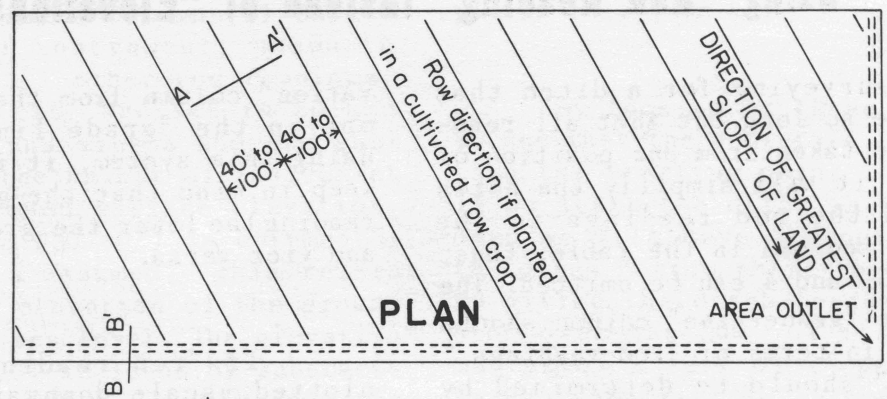


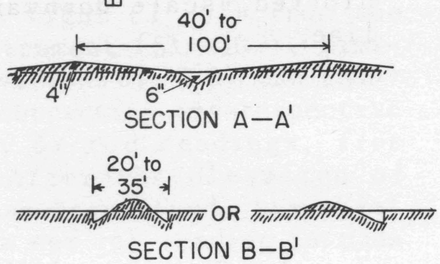
Graphic method of finding cuts for ditch.

Using "Rod Reading" instead of "Elevations"

In surveying for a ditch that will not be so long but that all readings can be taken from *one* position of the level, it will simplify the notes to record the rod readings in the "elevation" column in the table, thus; columns 2, 3, and 4 can be omitted. The items in the "grade line" column should be written in terms of "rod readings." The "cuts" should be determined by subtracting each reading in the "elevation" column from the corresponding one in the "grade line" column. In using this system, it is necessary to keep in mind that the greater the rod reading the lower the ground elevation, and vice versa.

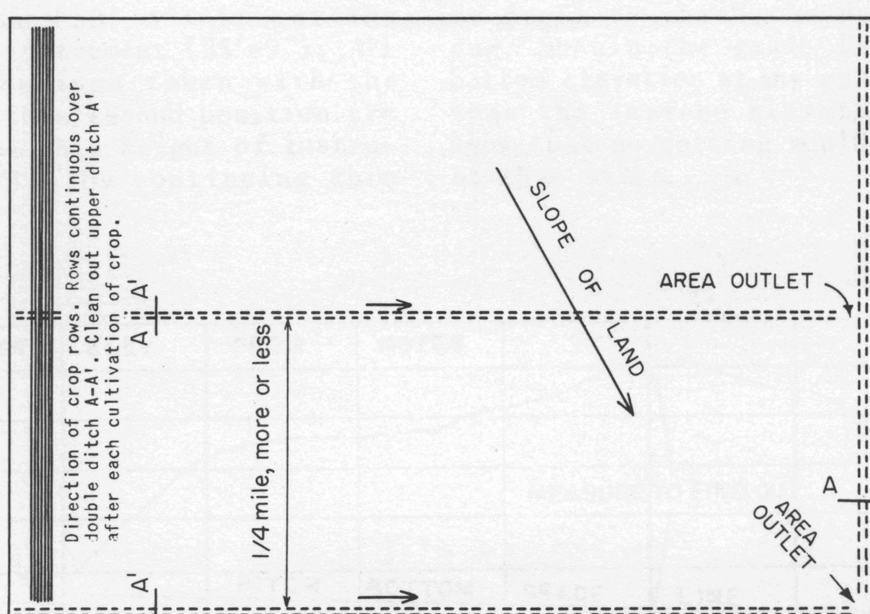
If "rod readings" are to be plotted, scale downward from a base line.

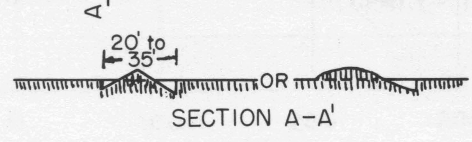




SURFACE DRAINAGE LAYOUT
For a pasture or field.

Corrugations made with a grader or back-furrowed with a plow, or both.





SURFACE DRAINAGE LAYOUT
For row crops on a flat, nearly level, field that needs drainage in a rainy season

Ditches with section A-A', are spoken of as turn-rows, road-ways, terrace ridges, and two ditches with ridge between.

Suitable fall for rows, $\frac{1}{2}$" to 3" per 100'
Suitable fall for ditches, $\frac{1}{4}$" to 2" per 100'

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