

NATURAL RESOURCES CONSERVATION SERVICE
MONTANA CONSERVATION PRACTICE STANDARD

IRRIGATION LAND LEVELING (ACRE)

CODE 464

DEFINITION

Reshaping the surface of land to be irrigated, to planned lines and grades.

PURPOSE

To facilitate the efficient use of water on irrigated land.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to the leveling of land irrigated by surface or subsurface irrigation systems. The leveling is based on a detailed soils characteristics inventory, engineering survey, design, and layout. This standard does not apply to Precision Land Forming (Code 462) or Land Smoothing (Code 466).

CRITERIA

Land to be leveled shall be suitable for irrigation and for the proposed methods of water application. Land shall not be eligible for leveling if the designed flow rate needed to irrigate the level field exceeds the producer's water right.

Land is eligible for leveling if the yardage of cut is greater than 161 yards per acre, if less than this value, refer to Field Office Technical Guide (FOTG), Section IV, Conservation Practice Standard, Land Smoothing (Code 466).

Leveling operations shall not be performed if the ground is frozen or if soil moisture conditions will cause excessive compaction.

If the field to be leveled is in permanent vegetation, the field shall be tilled up and planted to an annual crop at least 6 months prior to construction.

Soil intake family shall be determined during the planning stage for this practice. High or low intake families impose design limitations based on intake rates, runoff, deep percolation, irrigation frequency and set time.

Where furrow or corrugation irrigation of crops is planned, design grades shall not cause irrigation induced erosion in excess of soil loss tolerance (T). A procedure for documenting irrigation induced erosion (sediment yield) can be found in the Montana Irrigation Manual, Irrigation Method Design, pages 6-36 to 6-42.

If irrigation induced erosion will be greater than soil loss tolerance (T), alternatives shall be address which will reduce erosion, such as surge irrigation or applications of water soluble Anionic Polyacrylamide (PAM), FOTG, Section IV, Conservation Practice Standard, Anionic Polyacrylamide (PAM) Application (Code 450).

An Irrigation Water Management plan, meeting NRCS, FOTG, Section IV, Conservation Practice Standard, Irrigation Water Management (Code 449), shall be developed for this practice.

Soils shall be deep enough so that after leveling, an adequate usable root zone remains for the crops to be grown at the site that will permit satisfactory crop production with proper conservation measures. See management root depths as shown in the National Engineering Handbook (NEH), Part 652, Irrigation Guide, Chapter 3, Table 3-4. Limited areas of shallow

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Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard contact the Natural Resources Conservation Service.

NOTE: This type of font (AaBbCcDdEe 123..) indicates NRCS National Standards.
This type of font (AaBbCcDdEe 123..) indicates Montana Supplement.

soils **within the field to be leveled (10% or less)** may be leveled to provide adequate irrigation grades or an improved field alignment. **The depth of cuts shall not reduce available plant rooting depths caused by hardpan, saline soils, shallow water tables or other limiting factors.** The finished leveling work must not result in exposed areas of **high Calcium Carbonates (CaCO₃), salts, sodium, extreme impermeability,** or highly permeable soil materials that would inhibit proper distribution of water over the field.

All leveling work shall be planned as an integral part of an overall farm irrigation system to enhance the conservation of soil and water resources. The boundaries, elevations, and direction of irrigation of individual field leveling jobs shall be such that the requirements of all adjacent areas in the farm unit can be met.

Field grades. If more than one method of water application or more than one kind of crop is planned, the land must be leveled to meet the requirements of the most restrictive method and crop. All leveling work must be designed within the slope limits required for the methods of water application to be used, to provide for the removal of excess surface water, and to control erosion caused by rainfall. Reverse grades in the direction of irrigation shall not be permitted.

The determination of field grades shall include survey points on spacing of 100 feet by 100 feet, unless fields to be leveled are already on uniform grades, where 200-foot grids may be used. Additional survey points shall be included as needed to define the existing topographic features.

When other survey patterns with random ground survey points are used, the survey shall include a minimum of nine (9) survey points per acre for fields with down slopes less than 0.3 foot per hundred. The minimum number of survey points per acre may be reduced to six (6) for field gradients greater than 0.3 foot per hundred. For fields already on uniform grades, there shall be no less than four (4) survey points per acre.

Slope for level irrigation methods. The maximum fall for level border (level basin) irrigation in the direction of irrigation shall not exceed one-half the design depth of application for a normal irrigation. The difference in elevation across an individual border strip shall not exceed 0.1 foot.

Slope for graded irrigation methods. The maximum slope in the direction of irrigation, if rainfall erosion is not a significant problem, shall be as follows:

- Furrows - 3 percent
- Corrugations - 8 percent
- Borders for non-sod forming crops, such as alfalfa or grain - 2 percent
- Borders for erosion-resistant grass or grass-legume crops or for non-sod forming crops on sites where water application by the border method will not be required until after good crop stands have been established - 4 percent.

In areas where **easily eroded soils have great potential for irrigation induced erosion or erosion from** rainfall, the maximum slope for furrows shall be 0.5 percent, 2 percent for borders for sod forming grasses, and 0.5 percent for other crops. **Easily eroded soils typically have soil textures of fine sand, silt, sandy loam, and silty loams.**

On slopes in the direction of irrigation of more than 0.5 percent, and where leveling designs provide for increasing or decreasing slopes, the following limits shall apply:

- The change in slope in any 100-foot reach shall not exceed one-half the maximum permissible change along the length of run. However, short level sections are permissible at the upper or lower ends of irrigation runs to facilitate water control or to reduce runoff.
- The maximum permissible slope change is the difference between the flattest and steepest design slope along the length of run.

Settled border dikes shall confine irrigation water without overtopping. Dikes shall include 0.2 foot of freeboard above the designed water surface; crown widths shall have a minimum of 0.5 foot.

Crown width shall be increased to 1.0 foot and additional height added to dikes that are located at field boundaries, benches, low escarpments.

Cross slope. The maximum cross slope for borders shall be 0.1 feet across the border strip width. **The intended purpose of this cross slope**

limitation is to ensure that the irrigation water advance does not accumulate at one edge of the border. Fields with down slopes that are 0.3 feet per hundred or less, cross slope should not exceed one-third of the slope in the direction of irrigation.

The allowable cross slope for furrows and corrugations depends on the stability of the soil, the size of furrows that are to be used, and the rainfall pattern in the area. Cross slopes must be such that breakthroughs from both irrigation water and runoff from rainfall are held to a minimum.

Slope for subsurface irrigation methods. In areas where irrigation is practiced through ground water level control, the field surface shall be shaped to parallel the expected subsurface water elevations. The design shall be based on the desired depth from the soil surface to the elevation of the ground water.

Surface drainage. Farm irrigation systems shall include provisions for removing or otherwise controlling excess irrigation and storm water runoff. Leveling designs must provide field elevations and field grades that will permit proper functioning of the planned surface drainage system facilities.

Maximum field elevation. All leveling work shall be designed to permit the delivery of required irrigation flows to the highest point on the field surface. Field elevations shall be at least 0.33 foot below the water surface elevation at the point of delivery.

Excavation and fill placement. Borrow shall be obtained from the required cut excavation or from designated sites specified in the design.

CONSIDERATIONS

In the design consider the excavation and fill material required for or obtained from such structures as ditches, ditch pads, and roadways. The appropriate yardage shall be included when balancing cuts and fills and determining borrow requirements.

Cut fill ratios should be based on local conditions, the volume of cut should exceed the volume of fill by at least 30 percent (1.3 C/F ratio). Rarely will cut volumes be twice that of the fill volumes (2:1 C/F ratio). Soil textures, soil moisture, large cut and fill depths and equipment traffic routing will affect the

C/F ratio. Adjustments maybe required for soil conditions during construction.

Consider the effects of crop residue, trash and other vegetative material that may affect the land leveling operation and earthwork volumes.

Consider related structures and measures needed to control irrigation water and/or storm water runoff.

Consider **irrigation water management elements such as:** crops, method of irrigation, soil intake rates, field slope, irrigation stream size and resulting deep percolation and runoff when determining or evaluating length of irrigation runs.

Planning considerations for border irrigation should be based on efficient application of water according to the Irrigation Water Management Plan. The selected border widths should be compatible with the owner/operator's tillage and harvesting equipment.

If the leveled field has saline soils within its boundary, consider the effects of leaching on these soils.

Border dikes should be constructed to remain stable during the irrigation and cropping season and maintained with normal farming operations.

Consider the depth of cuts and the resulting available plant rooting depths **to any soil limiting features such as saline soils or to shallow water tables.**

In areas with sediment-laden irrigation water, consider increasing the required height of the water surface at the point of delivery.

Consider effects on water flows and aquifers, and the affect to other water uses and users.

Consider the effects on adjacent wetlands.

PLANS AND SPECIFICATIONS

Plans and specifications for irrigation land leveling shall be site specific, and show the requirements for installing the practice to achieve its intended purpose. Site specifics include field boundaries, planned cuts and fills, earthwork volumes, cut/fill

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ratio, direction of irrigation, design run slope and cross slope, required water surface and location of irrigation water delivery, tail water return/disposal, and appurtenant structures.

OPERATION AND MAINTENANCE

The maintenance on leveled fields includes the periodic removal or grading of mounds and/or depressions. Land grading may periodically be needed to restore the design gradient.