NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

CONTOUR FARMING

(Ac.)

CODE 330

DEFINITION

Using ridges and furrows formed by tillage, planting and other farming operations to change the direction of runoff from directly downslope to around the hillslope.

PURPOSE

This practice is applied to achieve one or more of the following:

- Reduce sheet and rill erosion
- Reduce transport of sediment, other solids and the contaminants attached to them
- Increase water infiltration

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on sloping land where annual crops are grown. For orchards, vineyards and nut crops use the practice Contour Orchard and Other Fruit Areas, code 331.

CRITERIA

General Criteria Applicable to All Purposes

Minimum Row Grade. The crop rows shall have sufficient grade to ensure that runoff water does not pond and cause unacceptable crop damage.

Maximum Row Grade. The maximum row grade shall not exceed:

- One-half of the up-and-down hill slope percent used for conservation planning, or10 percent, whichever is less.

Up to a 25% deviation from the design row grade is permitted within 150 feet of a stable outlet.

When the row grade reaches the maximum allowable design grade, a new baseline shall be established up or down slope from the last contour line and used for layout of the next contour pattern.

Minimum Ridge Height.

- **Row spacing greater than 10 inches.** The minimum ridge height shall be 2 inches during the period of the rotation that is most vulnerable to sheet and rill erosion. Ridge height will be determined using the current approved erosion prediction technology.
- **Row spacing 10 inches or less.** The minimum ridge height shall be one inch for close-grown crops, such as small grains. Plant height shall be at least 6 inches high and the spacing between plants within the row shall not be greater than 2 inches during the time most vulnerable to sheet and rill erosion.

The minimum ridge height criteria are not required when the practice Residue and Tillage Management, No Till/Strip Till/Direct Seed (code 329) is used on the contour and at least 50 percent surface residue cover is present between the rows after planting.

Stable Outlets. Surface flow from contoured fields shall be delivered to stable outlets.

Additional Criteria to Increase Water Infiltration

Row Grade. The maximum row grade shall not exceed 0.2%.

CONSIDERATIONS

General. Several factors influence the effectiveness of contour farming to reduce soil erosion. These factors include: 10-year, 24-hour rainfall in inches; ridge height; row grade; slope steepness; soil hydrologic group; cover and roughness; and slope length. Cover and roughness, row grade, and ridge height can be influenced by management and provide more or less benefit depending on design.

Contour farming is most effective on slopes between 2 and 10 percent. This practice will be less effective in achieving the stated purpose(s) on slopes exceeding 10 percent and in areas with 10-year, 24-hour rainfall of about 6.5 inches. The practice is not well suited to rolling topography having a high degree of slope irregularity because of the difficulty meeting row grade criteria.

This practice is most effective on slopes between 100 and 400 feet long. On slopes longer than 400 feet, the volume and velocity of overland flow exceeds the capacity of the contour ridges to contain them. Increasing residue cover and roughness will change the vegetative cover-management conditions and decrease overland flow velocities, thus increasing the slope length at which this practice is effective. Increasing roughness alone is not sufficient to produce this effect.

The closer the row grade is to the true contour, the greater will be the erosion reduction.

Prior to design and layout, obstruction removal and changes in field boundaries or shape should be considered, where feasible, to improve the effectiveness of the practice and the ease of performing farming operations.

When the intersection of crop rows with the field edge is not perpendicular, a Field Border (code 386) may be needed to allow farm implements room to turn.

If using Residue and Tillage Management, Ridge Till on the contour, avoid crossing over ridged rows at correction areas because this will destroy the effectiveness of the ridges. Sod turn strips may be established if correction areas are unavoidable.

The width of correction areas, and the distance between baselines, should be adjusted for equipment operation widths.

Ridge Height. Ridge height is created by the operation of tillage and planting equipment. The greater the ridge height, the more effective the operation is in slowing overland flow. The RUSLE2 Operations database contains the ridge height value for each field operation.

Stable Outlets. Grassed waterways, water and sediment control basins, underground outlets, or other suitable practices should be used to protect areas of existing or potential concentrated flow erosion.

CULTURAL RESOURCES CONSIDERATIONS

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

ENDANGERED SPECIES CONSIDERATIONS

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation

treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field according to the Criteria, Considerations, and Operation and Maintenance described in this standard. The plans shall include, as a minimum:

- Percent land slope used for conservation planning;
- The minimum and maximum allowable row grades for the contour system;
- A sketch map or photograph of the field showing:
  - ◊ the approximate location of the baselines used to establish the system;
  - ◊ the location of stable outlets for the system

Specifications shall be recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

Perform all tillage and planting operations parallel to contour baselines or terraces, diversions, or contour buffer strip boundaries where these practices are used, provided the applicable row grade criteria are met.

Where terraces, diversions, or contour buffer strips are not present, maintain contour markers on grades that, when followed during establishment of each crop, will maintain crop rows at designed grades. Contour markers may be field boundaries, a crop row left untilled near or on an original contour baseline or other readily identifiable, continuous, lasting marker. All tillage and planting operations shall be parallel to the established marker. If a marker is lost, re-establish a contour baseline within the applicable criteria set forth by this standard prior to seedbed preparation for the next crop.

Farming operations should begin on the contour baselines and proceed both up and down the slope in a parallel pattern until patterns meet. Where field operations begin to converge between two non-parallel contour baselines, establish a correction area that either is permanently in sod, established to an annual close-grown crop.

Where contour row curvature becomes too sharp to keep machinery aligned with rows during field operations, establish sod turn strips on sharp ridge points or other odd areas as needed.

REFERENCES

Foster, G.R. Revised Universal Soil Loss Equation, Version 2 (RUSLE2) Science Documentation (In Draft). USDA-ARS, Washington, DC. 2005.

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting soil erosion by water: A guide to conservation planning with the Revised Universal Soil Loss Equation (RUSLE).U.S. Department of Agriculture, Agriculture Handbook 703.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

340 - COVER CROP

I. SCOPE

The work shall consist of furnishing all materials and placing them on all designated areas to the limits as shown on the drawings, or as staked in the field, and performing cultural operations to grow the crop.

II. MATERIALS

Seed

All seed shall be delivered to the site tagged and labeled in accordance with the California Agricultural Code, and shall be acceptable to the County Agricultural Commissioner.

Bag tag figures will be evidence of purity and germination. Time since date of seed test shall not exceed 9 months.

Seed shall be of a quality that weed seed shall not exceed 0.5% of the aggregate of pure live seed (PLS) (% germination x % purity) and other material.

Fertilizer

Unless otherwise specified on the Practice Requirements sheet, all fertilizer shall be Ammonium Phosphate Sulfate containing a minimum of 16% Nitrogen, 20% available phosphoric acid and 0% water soluble potash plus about 15% sulfur and be uniform in composition, dry and free flowing, pelleted or granular.

Fertilizer shall not be specified if the primary purpose of the cover crop is to capture and cycle nutrients.

All fertilizer shall be labeled in accordance with applicable state regulations and bear the warranty of the producer for the grade furnished.

Inoculants

Inoculants for treating legume seed shall be a pure culture of nitrogen fixing bacteria prepared specifically for the plant species and shall not be used later than the date indicated on the container. A mixing medium, as recommended by the manufacturer or an approved substitute, shall be used to bond the inoculants to the seed.

Inoculants shall be used at rates specified by the manufacturer unless otherwise noted in the practice Requirements sheet. Seed shall be labeled to show the Lot Number, Expiration Date, and Percent Coat of the finished product. Pellet inoculated seed shall be kept cool and sown within 180 days.

Chemicals

Pesticides shall be applied according to label guidelines and all other State, Federal, or local regulation. Chemical containers shall be properly stored, cleaned, and disposed of according to law.

III. SEEDING MIXTURE AND PLANTING DATE

The seed(s) and rate(s) specified on the Practice Requirements sheet shall be used.

The seeding rate(s) shall be the weight exclusive of any coating material. Any legume seed used shall be inoculated. Based on bag tags, seeding rates shall be adjusted to insure the required amounts of pure live seed.

Planting shall be performed during the period that is specified on the Practice Requirements sheet.

IV. SEEDBED PREPARATION

The area to be planted shall be weed free and have a firm seedbed which has previously been roughened by scarifying, disking, harrowing, chiseling, or otherwise worked to a depth of at least 2 to 4 inches, except when planting no-till. No implement shall be used that will create an excessive amount of downward movement of clods on sloping areas.

Rocks, trash, weeds, and other debris that can interfere with seeding or maintenance shall be removed.

Seedbed preparation shall be suspended when soil moisture conditions are not suitable for obtaining a satisfactory seedbed.

V. FERTILIZING AND SEEDING

Fertilizing

Fertilizer specified on the Practice Requirement sheet shall be distributed uniformly over the seedbed.

Fertilizer shall not be specified if the primary purpose of the cover crop is to capture and cycle nutrients.

Fertilizer shall be incorporated into the soil. Incorporation may be included with seedbed preparation, or as part of the seeding operation.

Seeding

Seed shall be drilled or broadcast. Seed shall be incorporated into the soil, but not more than 1 inch deep unless otherwise specified on the Practice Requirements sheet.

Seeding shall be performed as nearly as practical across the slope unless otherwise specified on the Practice Requirements sheet.

VI. IRRIGATION

Irrigation water shall be applied during the establishment period as called for on the Practice Requirements sheet.

VII. ADDITIONAL CULTURAL OPERATIONS

The types of equipment used and the cultural operations performed shall maintain healthy plant growth.

The crop shall be incorporated into the soil.

VIII. OTHER REQUIREMENTS

Other requirements including, but not limited to, livestock and traffic control shall be applied as specified on the Practice Requirements sheet.

Measures and methods that enhance fish and wildlife values, protect visual resources, and maintain key shade, food, and den trees shall be performed when specified on the Practice Requirements sheet.

Operations shall be performed to minimize soil erosion and air and water quality impairment.

The owner, operator, contractor, or other persons shall conduct all work and operations in accordance with proper safety codes for the type of equipment and operations being performed with due regards to safety of all persons and property.

NATURAL RESOURCES CONSERVATION SERVICE
INTERIM CONSERVATION PRACTICE STANDARD

DUST CONTROL ON UNPAVED ROADS AND SURFACES

(sq. ft.)

Code 729

DEFINITION

Controlling direct particulate matter emissions from unpaved roads and other surfaces with vehicle and machinery traffic (commonly called "road dust" or dust) using a palliative on the surface.

PURPOSE

This practice may be applied as part of a conservation management system to address the particulate matter air resource concern by one or more of the following:

- To control dust from unpaved roads which is generated by vehicle or machinery traffic, animal movement, and/or wind.
- To control dust from unpaved areas on farmsteads, materials handling areas, equipment parking lots, or construction sites

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to any non-vegetated, unpaved surface where vehicle movement would normally occur, such as an unpaved road, traffic area, parking lot, staging or assembly area, equipment storage lot, runway, or loading/unloading area. It does not apply to paved roads, lots, or surfaces, or to vegetated areas, or to rangeland or tilled farmland.

CRITERIA

General Criteria Applicable to all Purposes:

The practice shall be applied following all label directives, in accordance with federal, state, and local laws and regulations.

The palliative shall be one of the following:

- Water
- Water absorbing suppressant (hygroscopic palliative)
- Adhesive
- Petroleum emulsion
- Polymer emulsion
- Clay Additive
- Bituminous (petroleum-based road oil)

Examples of product types and names are available in the specification.

Hygroscopic palliatives (those that control dust by absorbing water from the air) are not recommended for arid and semi-arid environments. Calcium chloride and magnesium chloride shall not be used in locations where the daily summertime relative humidity averages below 30%. For more details, see the specification.

The area to be treated shall be graded and/or smoothed before the dust control product is applied.

The area shall be treated to achieve a minimum of 50% dust control at time of application of material. The amount of dust control achieved will be determined by standardized emission reduction factors for the various materials.

The area shall be re-treated if it is heavily disturbed by grading or other major disturbance after prior treatment.

If continued effectiveness of the product is warranted after natural weathering has reduced its effectiveness to where airborne particulate matter from the surface is visible, the palliative control product shall be re-applied.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard contact your Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide for your state.

Where dust control for more than 12 hours is needed, water as a dust control product shall not be used unless it is reapplied.

In locations where runoff from a treated surface could immediately enter into fish spawning waters, lignosulfonate shall not be used as a dust control product.

Where drainage from the treated surface may directly impact a nearby water body bituminous palliatives shall not be used.

When determining an appropriate product to use, do not select products that have a “poor” rating for your specific location and situation. See specification for more detail on ratings.

CONSIDERATIONS

Consider additional activities like speed control or vehicle exclusion on unpaved roads to help control dust.

When there is concern over possible runoff of sediments from the unpaved area to a water body, consider using additional practices or activities like buffers strips on the side of the road or unpaved area to minimize runoff of the palliative to the water body.

Strongly consider using a sieve analysis of the upper layer of the unpaved surface to determine percent fines less than 75 µm. Use the information in the specification to help select an applicable product for use with the surface conditions where the treatment is to be applied.

In regions where snow covers the unpaved area over winter, consider applying the dust control product after the spring melt to minimize the loss of product effectiveness over winter.

Cultural Resources Considerations

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer. http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information. Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species Considerations

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for installation of Dust Control on Unpaved Roads and Surfaces shall be prepared for each site or planning unit according to the criteria. Specifications shall be recorded using State-developed specification sheets, job sheets, practice requirement sheets, narrative statements in conservation plans, or other acceptable documents.

As a minimum, the plans and specifications shall provide the following:

1. Identification and description of the type and amount of material being used for dust control, and method of application.
2. Specifications on grading requirements.

3. Plans for any re-applications of materials.
4. Identification of any adjacent sensitive areas (e.g. fish spawning areas and nearby water bodies).
5. List of criteria to follow during application.
6. List of things to consider during application.
7. Identification of any mitigating practices.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, its intended life, safety requirements, and the criteria used for its design. The plan shall contain requirements including but not limited to:

1. Re-application of dust control materials, as needed, and including any additional grading requirements.
2. Maintenance of any mitigating practices.
3. Documentation requirements for emissions reduction.

REFERENCES

Bolander, P. and A. Yamada, 1999. "Dust Palliative Selection and Application Guide" Project Report 9977-1207-SDTDC San Dimas Technology Development Center, U.S. Dept. of Agriculture, Forest Service, San Dimas, CA.

San Joaquin Valley Air Pollution Control District, 2002. Products available for controlling dust. Online document available at: http://www.valleyair.org/busind/comply/PM10/Products%20Available%20for%20Controlling%20PM10%20Emissions.htm

NRCS, CA

September 2007

NATURAL RESOURCES CONSERVATION SERVICE

INTERIM CONSERVATION PRACTICE STANDARD

ENGINE REPLACEMENT

(No.)

Code 723

DEFINITION

Replacing or retrofitting older stationary agricultural engines with newer engines or electric motors, which meet current federal, state, and local standards and guidelines.

PURPOSE

The purpose of this standard is to manage emissions from fossil fuel or biofuel powered engines to address air pollution from:

- Nitrogen Oxides (NOx)
- Volatile organic compounds (VOCs)
- Direct emissions of particulate matter (PM)

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to any agricultural operation which operates one or more stationary agricultural engines.

CRITERIA

The new engine or motor shall be sized appropriately to accomplish the intended task.

The new engine or motor shall utilize cleaner burning technologies, techniques, and/or fuels or alternative power source.

Where required, the new engine or motor shall be certified to meet currently applicable federal, state, and local standards and guidelines.

The new engine or motor shall be operated and maintained in accordance with the manufacturer's recommendations.

All replaced engines shall be rendered inoperable. Certification of inoperability can be accomplished by:

- Obtaining a receipt for the engine disposal from a scrap metal recycling operation and keeping this receipt available for inspection, or
- Punching a permanent hole through the engine block (minimum size to be determined by federal, state, or local guidelines at http://www.valleyair.org) and maintaining a certification for inspection that this process has been completed.

CONSIDERATIONS

Consider replacement of fuel-fired engines with renewable energy sources, such as solar, wind, and water.

Consider replacement of fuel-fired engines with an electric motor to reduce air pollutant emissions from the site. However, unless the electricity is produced from a source such as solar, wind, hydro, or nuclear power, there will still be air pollutant emissions produced from the electrical generating plant. In general, the incremental emissions produced at the electrical generating plant will be less than those emitted from the fuel-fired engine, although actual emissions may vary from location to location.

Utilize newest available EPA engine TIER technology.

Cultural Resources Considerations

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer. http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard contact your Natural Resources Conservation Service State Office, or download it from the electronic Field Office Technical Guide for your state.

information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.
Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species Considerations

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Specifications for installation of Engine Replacement shall be prepared for each site or planning unit according to the criteria. Specifications shall be recorded using State-developed specification sheets, job sheets, practice requirement sheets, narrative statements in conservation plans, or other acceptable documents.

As a minimum, the plans and specifications shall provide the following:

1. Identification and description of the type of engine being replaced and the replacement engine
2. Requirements on disposal of old engine, including assuring permanent disabling and rendering inoperable.
3. Documentation requirements to determine engine usage and resulting air pollutant emissions.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of this practice, its intended life, safety requirements, and the criteria used for its design.

Records must be retained an updated for a minimum of five years from the beginning of operation of the new engine or motor. The objective of keeping records is to determine engine usage and resulting air pollutant emissions. Annual records must contain, at a minimum, the following:

- Total actual hours operated
- Total amount of fuel used, or electricity used for electric motors
- Documentation of maintenance conducted on the new engine or motor

REFERENCES

NRCS National Air Quality and Climate Change Technology Development Team, National Technical Support Center, Portland, Oregon

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FIELD BORDER

(Ac.)

CODE 386

DEFINITION

A strip of permanent vegetation established at the edge or around the perimeter of a field.

PURPOSE

This practice may be applied to accomplish one or more of the following:

- Reduce erosion from wind and water
- Protect soil and water quality
- Manage pest populations
- Provide wildlife food and cover
- Increase carbon storage
- Improve air quality

CONDITIONS WHERE PRACTICE APPLIES

This practice is applied around the perimeter of fields. Its use can support or connect other buffer practices within and between fields. This practice may also apply to recreation land or other land uses where agronomic crops including forages are grown.

CRITERIA

General Criteria Applicable to All Purposes

Field borders shall be established around the field edges to the extent needed to meet the resource needs and producer objectives. Minimum field border widths shall be based on local design criteria specific to the purpose or purposes for installing the practice.

The field borders shall be established to adapted species of permanent grass, legumes and/or shrubs that accomplish the design objective and do not function as host for diseases of the field crop.

Plants selected for field borders will have the physical characteristics necessary to control wind and water erosion to tolerable levels on the field border area.

Species must be adapted to local soil, ecological sites and climatic conditions, be easily established, long-lived, and manageable. Care will be taken when selecting plants to avoid invasive species. Species shall be in conformance with the respective Major Land Resource Area (MLRA) Vegetative Guide in Section II of the Field Office Technical Guide.

Seedbed preparation, seeding rates, dates, depths, fertility requirements, and planting methods will be consistent with approved local criteria and site conditions.

Ephemeral gullies and rills present in the planned border area will be eliminated as part of seedbed preparation. If present, ephemeral gullies and rills located immediately upslope from the planned border area need to be treated to ensure more of a sheet flow into the planned border area.

Additional Criteria to Reduce Erosion from Wind and Water

Field border establishment, in conjunction with other practices, will be timed so that the soil will be adequately protected during the critical erosion period(s).

Establish stiff-stemmed, upright grasses, grass/legumes or forbs to trap wind- or water-borne soil particles.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the electronic Field Office Technical Guide.

The amount of surface and/or canopy cover needed from the field border shall be determined using current approved water and wind erosion prediction technology. Calculations shall account for the effects of other practices in the management system.

Wind Erosion Reduction. Locate borders to provide a stable area on the windward edge of the field as determined by prevailing wind direction data.

Minimum height of grass or forbs shall be one foot during the critical erosion period.

Water Erosion Reduction. Locate borders to eliminate sloping end rows, headlands, and other areas where concentrated water flows will enter or exit the field.

Orient plant rows as closely as possible to perpendicular to sheet flow direction.

Additional Criteria to Protect Soil and Water Quality

Do not burn the field border if the main goal of the field border is to protect soil or water quality.

Reducing Runoff and Increasing Infiltration. Locate borders around the perimeter of the field, or as a minimum, install borders to eliminate sloping end rows, headlands and other areas where concentrated water flows will enter or exit the field.

Water Quality – Adsorbed, Dissolved and Suspended Contaminants. As a minimum, locate field borders along the edge(s) of the field where runoff enters or leaves the field. The minimum width for this purpose shall be 30 feet and have a vegetation stem density/retardance of moderate to high (e.g. equivalent to a good stand of wheat).

Design border widths to comply with all applicable State and local regulations regarding manure and chemical application setbacks.

Reducing Soil Compaction from Equipment Parking and Traffic. Border widths will be designed to accommodate equipment turning, parking, loading/unloading equipment, grain harvest operations, etc.

Additional Criteria to Manage Pest Populations

Provide a Harbor for Beneficial organisms (e.g. insects, mites, etc.). Include appropriate plants that attract beneficial organisms that prey on target pests.

Mowing, harvesting, pesticide applications and other disturbance activities will be scheduled to accommodate life cycle requirements of the beneficial organisms.

Provide a Habitat to Cause Pests to Congregate. Select plants for the field border that attract pests (e.g. alfalfa strips planted to lure lygus bugs away from a cotton crop).

Additional Criteria to Provide Wildlife Food and Cover

Establish plant species that provide wildlife food and cover for the target wildlife species. [Each state should indicate here what documents are to be consulted by the planner to make the correct species choices for wildlife purposes.]

Schedule mowing, harvest, weed control, and other management activities within the field border to accommodate reproduction and other life cycle requirements of target wildlife species.

Vegetative successional state shall be maintained to accommodate target wildlife species requirements.

When wildlife is a concern, a lower percent groundcover than would be needed if protecting soil and water quality was the only goal is acceptable as long as the soil resource concern is also adequately addressed (i.e. no excessive soil loss). This may be achieved by simply increasing the field border width.

Additional Criteria to Increase Carbon Storage

Establish plant species that will produce adequate above- and below-ground biomass for the site (i.e. a positive soil conditioning index).

Maximize the width and length of the herbaceous border to fit the site and increase total biomass production.

Do not burn if the main goal of the field border is carbon storage.

Do not disturb the roots of the established vegetation with tillage.

Additional Criteria to Improve Air Quality

Establish plant species with morphological characteristics that optimize interception and adhesion of airborne particulates. Select plants with persistent roots and residue that stabilize soil aggregates and capture airborne soil particles.

Establish species resistant to damage from equipment traffic.

CONSIDERATIONS

Consider planting field borders around the entire field, not just on the field edges where water enters or leaves the field, for maximizing multiple resource protection.

Establishing a narrow strip of stiff-stemmed upright grass at the crop/field border interface can increase soil particle trapping efficiency of the field border.

Native plants are best suited for wildlife habitat enhancement and provide other ecological benefits where adapted to site conditions and when consistent with producer objectives.

Include native plants that provide diverse pollen and nectar sources to encourage local pollinator populations.

Use field borders as corridors to connect existing or planned habitat blocks.

Prescribed burning, strip disking, or selective herbicide applications are management tools that can be used to maintain suitable habitat for specifically desired wildlife species.

Overseed the field border with legumes for increased plant diversity, soil quality, and wildlife benefits.

Waterbars or berms may be needed to breakup or redirect concentrated water flow within the borders.

In selecting plant species to establish in the field border, among other items, consider the plant's tolerance to:

- Sediment deposition and chemicals planned for application
- Drought in arid areas or where evapotranspiration can potentially exceed precipitation during the field border's active growing period(s)
- Equipment traffic

Design border widths to match the required field application setback widths for easier management (i.e. land-use and management changes occur in the same location).

Establish plant species that will have the desired visual effects and that will not interfere with field operations or field border maintenance.

Consider the amount of shading that the field border or portions of the field border may experience and select species for those locations accordingly.

The use of native perennial plant species as opposed to annual species provides a longer period of resource protection.

Consider installing a contour buffer system, No Till practice or other conservation practices on adjacent upland areas to reduce surface runoff and excessive sedimentation of field borders.

CULTURAL RESOURCES CONSIDERATIONS

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

ENDANGERED SPECIES CONSIDERATIONS

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the Criteria included in this Standard. Specifications shall describe the requirements for applying this practice to meet the intended purpose. Record practice specifications on the Field Border 386, Conservation Practice Job Sheet. The following components shall be included for recording this specification:

- Field Border widths and lengths based on local design criteria.
- Field Border location(s) within the field(s) or farm boundary.
- Species to be used and the location and planting density of the species used.
- Site preparation requirements.
- Timing of planting and planting method.
- Liming or fertilizer requirements.
- Operation and maintenance requirements.

OPERATION AND MAINTENANCE

Field borders require careful management and maintenance for performance and longevity. The following O&M activities will be planned and applied as needed:

- Repair storm damage
- Remove sediment from above or within the field border when accumulated sediment either alters the function of the field border or threatens the degradation of the planted species' survival
- Shut off sprayers and raise tillage equipment to avoid damage to field borders
- Shape and reseed border areas damaged by animals, chemicals, tillage, or equipment traffic
- Maintain desired vegetative communities and plant vigor by liming, fertilizing, mowing, disking, or burning and controlling noxious weeds to sustain effectiveness of the border
- Repair and reseed ephemeral gullies and rills that develop in the border
- Minimally invasive tillage (e.g. paraplowing) may be performed in rare cases where compaction and vehicle traffic have degraded the field border function. The purpose of the tillage is strictly to decrease bulk density and increase infiltration rates so as to provide a better media for reestablishment of vegetation and field border function
- Maintenance activities that result in disturbance of vegetation should not be conducted during the nesting season of grass nesting birds
- Avoid vehicle traffic when soil moisture conditions are saturated

REFERENCES

K. G. Renard, G. R. Foster, G. A. Weesies, K. D. K. McCool and D. C. Yoder. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), Agricultural Handbook Number 703.

Revised Universal Soil Loss Equation Version 2 (RUSLE2) website (checked May 2007): http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

IRRIGATION SYSTEM, MICROIRRIGATION

(No. and Acre)

CODE 441

DEFINITION

An irrigation system for frequent application of small quantities of water on or below the soil surface: as drops, tiny streams or miniature spray through emitters or applicators placed along a water delivery line [1].

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes.

- To efficiently and uniformly apply irrigation water and maintain soil moisture for plant growth.
- To prevent contamination of ground and surface water by efficiently and uniformly applying chemicals.
- To establish desired vegetation

CONDITIONS WHERE PRACTICE APPLIES

On sites where soils and topography are suitable for irrigation of proposed crops and an adequate supply of suitable quality water is available for the intended purpose(s).

Microirrigation is suited to vineyards, orchards, field crops, windbreaks, gardens, greenhouse crops, and residential and commercial landscape systems. Microirrigation is also suited to steep slopes where other methods would cause excessive erosion, and areas where other application devices interfere with cultural operations.

Microirrigation is suited for use in providing irrigation water in limited amounts to establish desired vegetation such as windbreaks, living snow fences, riparian forest buffers, and wildlife plantings.

This practice standard applies to systems with design discharge less than 60 gal/hr at each individual lateral discharge point.

Conservation Practice Standard 442, Irrigation System, Sprinkler applies to systems with design discharge of 60 gal/hr or greater at each individual lateral discharge point.

CRITERIA

General Criteria Applicable To All Purposes

The system shall be designed to uniformly apply water and/or chemicals while maintaining soil moisture within a range for good plant growth without excessive water loss, erosion, reduction in water quality, or salt accumulation.

Microirrigation systems consist of point-source emitter (drip, trickle, and bubbler), surface or subsurface line-source emitter, basin bubbler, and spray or mini sprinkler systems [2].

The system shall include all irrigation appurtenances necessary for proper operation. Appurtenances shall be sized and positioned in accordance with sound engineering principles and site specific features [3].

Appurtenances include but are not limited to totalizing flow measurement devices, water filtration, air vent valves, vacuum relief valves, pressure relief valve(s), water control valve(s), pressure gauges, pressure regulators, and pressure reducers.

Water Quality. The irrigation water supply shall be tested and assessed for physical,

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chemical and biological constituents to determine suitability and treatment requirements for use in a microirrigation system. [4]

Emitter discharge rate. The design discharge rate of applicators shall be determined based on manufacturer's data for expected operating conditions. The discharge rate shall not create runoff within the immediate application area.

For bubbler irrigation, a basin beneath the plant canopy shall be required for water control, and applications shall be confined to the basin area [1].

Number and spacing of emitters. The number and spacing of emitters along a lateral line (tubing) shall be adequate to provide water distribution to the plant root zone and percent plant wetted area (P_w). Procedures found in Reference 4 shall be used to calculate Pw.

Operating pressure. The design operating pressure shall be in accordance with published manufacturer recommendations. The system operating pressure must compensate for pressure losses through system components and field elevation effects.

Emitter manufacturing variability. The manufacturers coefficient of variation (Cv) shall be obtained and used to assess the acceptability of a particular product for a given application [1].

The C_V shall be less than 0.07 for point source emitters and less than 0.20 for line source emitters.

Allowable pressure variations.

Manifold and lateral lines. Manifold and lateral lines, operating at the design pressure, shall be designed to provide discharge to any applicator in an irrigation subunit or zone operated simultaneously such that they will not exceed a total variation of 20 percent of the design discharge rate. Internal pressure shall not exceed manufacturer recommendations during any phase of operation.

Main and submain lines. Main and submain lines shall be designed to supply water to all manifold and lateral lines at a flow rate and pressure not less than the minimum design requirements of each subunit. Adequate pressure shall be provided to overcome all friction losses in the pipelines and appurtenances (valves, filters, etc.). Mains and submains shall maintain flow velocities less than 5 ft/sec during all phases of operation, unless special consideration is given to flow conditions and measures taken to adequately protect the pipe network against surge [3].

Main and submain lines shall be designed and installed according to criteria in reference 3.

Emission Uniformity. Pipe sizes for mains, submains, and laterals shall maintain subunit (zone) emission uniformity (EU) within recommended limits as determined by procedures contained in Reference 4.

Filters. A filtration system (filter element, screen, strainer, or filtration) shall be provided at the system inlet. Under clean conditions, filters shall be designed for maximum head loss of 5 psi. Maximum design head loss across a filter before cleaning shall be based on manufacturer recommendations. In the absence of manufacturer data maximum permissible design head loss across a filter is 7 psi before filter cleaning is required [1].

The filter shall be sized to prevent the passage of solids in sizes or quantities that might obstruct the emitter openings. Filtration systems shall be designed to remove solids based on emitter manufacturer recommendations. In the absence of manufacturer data or recommendations, filtration systems shall be designed to remove solids equal to or larger than one-tenth the emitter opening diameter [2].

The filter system shall provide sufficient filtering capacity so that backwash time does not exceed 10% of the system operation time. Within this 10% time period, the pressure loss across the filter shall remain within the manufacturer's specification and not cause unacceptable EU.

Filter/strainer systems designed for continuous flushing shall not have backwash rates exceeding 1.0% of the system flow rate or exceeding the manufacturer's specified operational head loss across the filter.

Air/Vacuum relief valves. Vacuum relief shall be designed and installed to prevent ingestion of soil particles if there are summits in system laterals.

Air/vacuum relief valves shall be installed on both sides of all block or manifold water supply control valves.

Pressure regulators. Pressure regulators shall be used where topography and the type of applicator dictate their use. Pressure regulators shall not be planned to compensate for improperly designed pipelines.

System flushing. Appropriate fittings shall be installed above ground at the ends of all mains, submains, and laterals to facilitate flushing. The system shall be designed and installed to provide a minimum flow velocity of 1 ft/sec during flushing. During flushing submain and manifold (pipelines located downstream from a control valve) velocities shall not exceed 7 ft/sec velocity [4]. Each flushing discharge outlet (excluding lateral (tubing) ends) shall include a pressure gauge and/or Schrader valve tap.

Criteria Applicable To Efficiently and Uniformly Apply Irrigation Water

Depth of application. Net depth of application shall be sufficient to replace the water used by the plant during the plant peak use period or critical growth stage [2, 4, & 5].

$$F_n = 1.604 \frac{QNTE}{AF}$$

Where: F_n=net application depth, in/day/design area

Q=discharge rate, gal/hr/emitter

N=number of emitters or orifices

T=hours of operation per day, 22 hours maximum

E=field application efficiency, expressed as a decimal, not greater that 0.90 for design purposes.

A=ft^2 of field area served by N number of emitters.

F=the design area as a percentage of the field area, expressed as a decimal

1.604=units conversion constant

Gross depth of application shall be determined by using field application efficiencies consistent with the type of microirrigation system planned [2]. Applications shall include adequate water for leaching to maintain a steady state salt balance.

System capacity. The system shall have either (1) a design capacity adequate to meet peak water demands of all crops to be irrigated in the design area, or (2) enough capacity to meet water application requirements during critical crop growth periods when less than full irrigation is planned. The rationale for using a design capacity less than peak daily irrigation water requirement shall be fully explained and agreed upon by the end user. Design capacity shall include an allowance for reasonable water losses (evaporation, runoff, and deep percolation) during application periods.

The system shall have the capacity to apply a specified amount of water to the design area within the net operation period. Minimum system design capacity shall be sufficient to deliver the specified amount of water in 90% of the time available, but not to exceed 22 hours of operation per day [4].

Flow Measurement. A flow meter shall be installed at the pump/filter station to manage water applications and for ongoing evaluation of system performance. The meter shall display flow rate (gpm) and volume (ac-ft). Manufacturer's recommendations must be followed regarding length of strait pipe sections, straitening vanes, and pipe diameter [6].

Subsurface Drip Irrigation (SDI). Tubing depth and spacing are soil and crop dependent. Emitter line depth shall consider the auxiliary irrigation methods used for leaching, germination, and initial development. Maximum lateral line distance from the crop row shall be 24 inches for annual row crops and 48 inches for vineyard and orchard crops. EU shall be designed for a minimum of 85 percent.

Criteria Applicable To Preventing Contamination of Ground and Surface Water.

Backflow Prevention. Backflow prevention devices such as air gaps or check valves shall be provided on all microirrigation systems to protect wells and public water sources. Wells without air gaps shall be protected by spring-loaded check valves. Each check valve must

have a low pressure drain (which opens and drains any remaining liquid onto the ground when the pressure drops) on the bottom of the upstream section. A large volume air vent/vacuum relief valve must be installed upstream of each check valve [6]. Check valves are not required for systems used for vegetation establishment if not equipped for chemical injection.

Chemigation and Chemical Water Treatment. System EU shall not be less than 85 percent where fertilizer or pesticides, or treatment chemicals are applied through the system.

Injectors (chemical, fertilizer or pesticides) and other automatic operating equipment shall be located and installed in accordance with manufacturer's recommendations and include integrated back flow prevention protection.

Chemigation shall be accomplished in the minimum length of time needed to deliver the chemicals and flush the pipelines. Application amounts shall be limited to minimum amount necessary, and rate shall not exceed maximum rate recommended by chemical label.

Proper maintenance and water treatment shall be followed to prevent clogging based upon dripper and water quality characteristics [1, 2, & 4].

Irrigation water supply tests shall be used to plan for addressing or avoiding chemical reactions with injected chemicals to prevent precipitate or biological plugging.

Criteria Applicable To Establishing Desired Vegetation

System capacity. The system shall have design capacity adequate to provide supplemental water at a rate that will insure survival and establishment of planned vegetation for a period of at least 3 years. The system shall have the capacity to apply the specified amount of water to the design area within the net operation period.

Gross application volume per plant shall be determined using field application efficiency consistent with the type of microirrigation system planned. If a need is indicated by water test results, applications shall include adequate water for leaching to maintain a steady state salt balance.

Microirrigation systems installed solely to deliver supplemental water for establishment of windbreaks or riparian vegetation shall be designed to deliver a minimum of eight gallons per tree or shrub per week to assist in the establishment process. Design net application volumes per plant are dependent on the species of tree or shrub and the age (first, second, or third year)

Drip lateral lines installed on the ground surface shall be placed along the plant row(s) in a serpentine pattern to allow for expansion and contraction of the line while keeping the emitter close to the tree or shrub. Above ground drip line shall be pinned or anchored to prevent the line from being dislodged or moved away from the trees or shrubs.

Windbreaks shall be planned, designed, and installed according to NRCS, Conservation Practice Standard, Windbreak-Shelterbelt Establishment, Code 380.

When lateral emitter spacing or capacities vary with each row, the laterals must be designed separately.

Operation and maintenance items specific to vegetation establishment are included in Chapter 6 of reference [2].

CONSIDERATIONS

In the absence of local experience field application efficiency (E) of 90% should used to estimate system capacity [2].

In arid climates with subsurface systems natural precipitation and/or stored soil water is sometimes inadequate to provide crop germination. Special provisions should be made for germination (i.e. portable sprinklers), or the microirrigation system should apply water at a rate sufficient to adequately wet the soil to germinate seeds or establish transplants. The depth of subsurface systems on annual crops should be limited by the ability of the system to germinate seeds, unless other provisions are made for this function.

Potential rodent damage should be considered when selecting materials and deciding on above or below ground system installation.

Chemigation may or may not be required at the same time the plant requires irrigation, which may affect the economics of chemigation. Weather conditions should be

considered before applying chemicals. Pest or nutrient management planning should address the timing and rate of chemical applications.

Field shape and slope often dictate the most economical lateral direction. Laying laterals down slope can allow for longer lateral run lengths and/or lateral size reduction. Uneven topography may require use of pressure compensating emitters.

Where practical, valves are recommended at lateral (tubing) inlets to facilitate system maintenance.

For terrain slopes steeper than 5%, lateral lines should be laid along the field contour and pressure compensating emitters specified or pressure control devices used along downslope submains at lateral inlets.

Economic assessments of alternative designs should include equipment and installation as well as operating costs.

Longer, less frequent irrigations of windbreaks during establishment are recommended to encourage deeper root development which increases drought tolerance.

Chemicals should not be applied if rainfall is imminent.

Installation and operation of microirrigation systems have the potential to save energy as a result of reduced seasonal irrigation application, and in some situations reduced operating pressures.

Cultural Resources

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

Endangered Species

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game.

PLANS AND SPECIFICATIONS

Plans and specifications for the microirrigation system shall be in keeping with this standard and shall describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

A site specific operation and maintenance (O&M) plan shall be developed and reviewed with the landowner/operator. The O&M plan shall provide specific instructions for operating and maintaining the system to ensure that it functions properly, including reference to periodic inspections and the prompt repair or replacement of damaged components. Operation and Maintenance Plan should include but is not limited to:

- Install Flowmeter and monitor water application.

- Clean or backflush filters when needed.
- Flush lateral lines at least annually.
- Check applicator discharge often; replace applicators as necessary.
- Check operating pressures often; a pressure drop (or rise) may indicate problems.
- Check pressure gauges to ensure proper operation; repair/replace damaged gauges.
- Inject chemicals as required to prevent precipitate buildup and algae growth.
- Check chemical injection equipment regularly to ensure it is operating properly.
- Check and assure proper operation of backflow protection devices.

REFERENCES:

1. Design and Installation of Microirrigation Systems, American Society of Agricultural Engineers (ASAE), ASAE EP405.1, February, 2003.
2. National Engineering Handbook, Part 652, Irrigation Guide, 1996.
3. NRCS, Conservation Practice Standard Irrigation Water Conveyance, Pipeline, High Pressure Plastic, Code 430DD, 1988.
4. National Engineering Handbook, Part 623, Chapter 7, Trickle Irrigation, 1984.
5. National Engineering Handbook, Part 623, Chapter 2, Irrigation Water Requirements, 1993.
6. Drip and Micro Irrigation for Trees, Vines, and Row Crops, Charles Burt and Stuart Styles, Cal Poly, San Luis Obispo, CA.