AGRICULTURE AND RANGE BMPS

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- **GRAZING**

CONSERVATION PRACTICES:

CONSERVATION COVER

DEFINITION

Establishing and maintaining permanent vegetative cover.

PURPOSE

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

- Reduce sheet, rill, and wind erosion and sedimentation.
- Reduce ground and surface water quality degradation by nutrients and surface water quality degradation by sediment.
- Reduce emissions of particulate matter (PM), PM precursors, and greenhouse gases.)
- Enhance wildlife, pollinator and beneficial organism habitat.
- Improve soil health.

PLANNING CRITERIA & IMPLEMENTATION

This practice applies on all lands needing permanent herbaceous vegetative cover. This practice does not apply to plantings for forage production or to critical area plantings. This practice can be applied on a portion of the field.

CRITERIA

General Criteria Applicable to All Purposes:

- Select species that are adapted to the soil, ecological sites, and climatic conditions that are suitable for the planned purpose and site conditions. Periodic removal of some products such as high value trees, medicinal herbs, nuts, and fruits is permitted provided the conservation purpose is not compromised by the loss of vegetation or harvesting disturbance.
- Inoculate legumes at planting time.
- Choose seeding rates and planting methods that will be adequate to accomplish the planned purpose.
- Planting dates, planting methods and care in handling and planting of the seed or planting stock shall ensure that planted materials have an acceptable rate of survival.
- Prepare the site by establishing a consistent seeding depth. Eliminate weeds that would impede the establishment and growth of selected species.
- Base the timing and equipment selection on the site and soil conditions.
- Apply nutrients as needed to ensure crop establishment and planned growth.

Additional Criteria to Reduce Sheet, Rill, and Wind Erosion and Sedimentation:
Determine and maintain the amount of plant biomass and cover needed to reduce wind and water erosion to the planned soil loss objective by using the current approved wind and/or water erosion prediction technology.

Additional Criteria to Reduce Emissions of Particulate Matter (PM), PM Precursors, and greenhouse gases:
In perennial crop systems such as orchards, vineyards, berries and nursery stock, establish vegetation to provide full ground coverage in the alleyway during mowing and harvest operations to minimize generation of particulate matter.

Additional Criteria to Enhance Wildlife, Pollinator and Beneficial Organism Habitat:

- Plant a diverse mixture grasses and forbs species to promote bio-diversity and meet the needs of the targeted species using approved habitat appraisal guides, evaluation tools, and appraisal worksheets for the respective state.
- Locate habitat plantings to reduce pesticide exposures that could harm wildlife, pollinators, and other beneficial organisms.

Additional Criteria to Improve Soil Health:

- To maintain or improve soil organic matter, select plants that will produce high volumes of organic material.
- The amount of biomass needed will be determined using the current soil conditioning index procedure.

CONSIDERATIONS

- This practice may be used to promote the conservation of wildlife species in general, including threatened and endangered species.
- Certified seed and planting stock that is adapted to the site should be used when it is available.
- Mowing may be needed during the establishment period to reduce competition from weeds.
- On sites where annual grasses are an expected weed problem it may be necessary to postpone nitrogen fertilizer application until the planted species are well established.
- Where applicable this practice may be used to conserve and stabilize archeological and historic sites.
- Consider rotating management and maintenance activities (e.g. mow only one- fourth or one-third of the area each year) throughout the managed area to maximize spatial and temporal diversity.
- Where wildlife management is an objective, the food and cover value of the planting can be enhanced by using a habitat evaluation procedure to aid in selecting plant species and by providing or managing for other habitat requirements necessary to achieve the objective. Encouraging plant species diversity and establishing plantings that result in

multiple structural levels of vegetation within the conservation cover will maximize wildlife use.

- Where pollinator and wildlife habitat are primary purposes consider less dense seeding rates as long as soil loss is within tolerable soil loss limits.
- To provide habitat for natural enemies of crop pests, select a mix of plant species that provide year-round habitat and food (accessible pollen or nectar) for the desired beneficial species. Consider habitat requirements of predatory and parasitic insects, spiders, insectivorous birds and bats, raptors, and terrestrial rodent predators.
- Consult Land Grant University Integrated Pest Management recommendations for beneficial habitat plantings to manage the target pest species.
- Use a diverse mix of cover plant species that come into bloom at different times and provide a sequence of bloom throughout the year (e.g., plant at least three flowering species from each of the three bloom periods (spring, summer, and fall).
- Where practical, use native species that are appropriate for the identified resource concern and
- management objective. Consider trying to re-establish the native plant community for the site.
- If a native cover (other than what was planted) establishes, and this cover meets the intended purpose and the landowner's objectives, the cover should be considered adequate.
- During vegetation establishment, natural mulches, such as wood products or hay, can be used to
- conserve soil moisture, support beneficial soil life, and suppress competing vegetation.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for the site to include, but are not limited to:

- recommended species,
- seeding rates and dates,
- establishment procedures,
- management actions needed to insure and adequate stand

Specifications and operation and maintenance shall be recorded using approved Implementation Requirement document.

MAINTENANCE

- Mowing and harvest operations in a perennial crop system such as orchards, vineyards, berries, and nursery stock shall be done in a manner which minimizes the generation of particulate matter.
- If wildlife habitat enhancement is a purpose, maintenance practices and activities shall not disturb cover during the reproductive period for the desired species. Exceptions should be considered for periodic burning or mowing when necessary to maintain the health of the plant community.

- Control noxious weeds and other invasive species.
- Mowing may be needed during the establishment period to reduce competition from weeds.
- To benefit insect food sources for grassland nesting birds, spraying or other control of noxious weeds shall be done on a “spot” basis to protect forbs and legumes that benefit native pollinators and other wildlife.
- Re-vegetate bare spots.

CONSERVATION CROP ROTATION

DEFINITION

A planned sequence of crops grown on the same ground over a period of time (i.e. the rotation cycle).

PURPOSE

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

- Reduce sheet, rill and wind erosion.
- Maintain or increase soil health and organic matter content.
- Reduce water quality degradation due to excess nutrients.
- Improve soil moisture efficiency.
- Reduce the concentration of salts and other chemicals from saline seeps.
- Reduce plant pest pressures.
- Provide feed and forage for domestic livestock.
- Provide food and cover habitat for wildlife, including pollinator forage, and nesting.

This practice applies to all cropland where at least one annually-planted crop is included in the crop rotation.

CRITERIA

General Criteria Applicable to All Purposes

Crops shall be grown in a planned sequence as outlined in Plans and Specifications. The crop rotation shall include a minimum of two different crops. For purposes of these criteria a cover crop is considered a different crop.

Where applicable, plan suitable crop substitutions when the planned crop cannot be planted due to weather, soil conditions, or other local situations.

Additional Criteria to Reduce Sheet, Rill and Wind Erosion

Select crops, a tillage system, and cropping sequences that will produce sufficient and timely quantities of biomass or crop residue which, in conjunction with other practices in the management system, will reduce sheet, rill and wind erosion to the planned soil loss objective.

Determine the amount of biomass or crop residue needed by using current approved erosion prediction technology.

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Grow crops that will produce a positive trend in the Organic Matter (OM) subfactor value over the life of the rotation, as determined by the Soil Conditioning Index. Make appropriate adjustments for additions to or subtractions from biomass.

Additional Criteria to Reduce Water Quality Degradation Due to Excess Nutrients
To recover excess nutrients from the soil profile, use crops with:

- Quick germination and root system formation,
- A rooting depth sufficient to reach the nutrients not removed by the previous crop, and
- Nutrient requirements that readily utilize the excess nutrients.
- Credit nutrients provided by legumes and manure/compost.

Additional Criteria to Improve Soil Moisture Efficiency
Select crops, varieties of crops, and the sequence of crops based on local climate patterns, soil conditions, irrigation water availability, and an approved water balance procedure.

Additional Criteria to Reduce the Concentration of Salts and Other Chemicals from Saline Seeps
Select crops to be grown in the recharge area of saline seeps that have rooting depths and water requirements adequate to fully utilize all available soil water. Do not use summer fallow. Use an approved water balance procedure to determine crop selection and sequence.
If excess subsoil moisture exists below the rooting depth of crops commonly grown in the recharge area, establish deep-rooted perennial crops for the number of years needed to dry the soil profile.
Select crops with a tolerance to salinity levels that matches the salinity of the discharge area.

Additional Criteria to Reduce Plant Pest Pressures
Design the crop sequence to suppress the pest(s) lifecycle of concern, which may include weeds, insects, and pathogens. Use land grant university or industry standards to determine a suitable crop sequence.

Additional Criteria to Provide Feed and Forage for Domestic Livestock
Select crops that balance the feed supply with livestock numbers. Determine the required amount of selected crops using an approved forage-livestock balance procedure.

Additional Criteria to Provide Food and Habitat for Wildlife, Including Pollinator Forage, and Nesting
Select the crops and crop management activities that provide either food or cover for the targeted wildlife species using an approved habitat evaluation procedure.

CONSIDERATIONS

When used in combination with NRCS Conservation Practice (CPS) Stripcropping (Code 585), the crop sequence should be consistent with the stripcropping design.
Soil compaction can be reduced by adjusting crop rotations to include deep rooting crops with deep roots that extend to and penetrate compacted soil layers.
Where improving water use efficiency on deep soils is a concern, rotating or combining deep-rooted crops with shallow rooted crops can help utilize all available water in the soil profile.

Select crops that have the potential to provide larger amounts of biologically fixed nitrogen.

Considerations to Reduce Water Quality Degradation Due to Excess Nutrients:
Include perennial or annual legume crops in the rotation to provide nitrogen for the non-legume crops, especially in fields where manure applications are restricted by high or excessive soil phosphorus or potassium levels.
Use carbon/nitrogen ratio of 25:1 to 35:1 crop residues returned to the soil throughout the rotation.
This ratio can build the soil's capacity to provide slow- release N to crops while minimizing N leaching.

Considerations to Increase Cropping System Diversity
Minimize the fallow years in the rotation and where the climate and soils are favorable establish cover crops during the fallow periods. For crop diversity, the planned crop sequence should contain different crop types; for example a mix of the following: warm season grass; warm season broadleaf; cool season grass; cool season broadleaf.

- A two-crop sequence that contains a warm season and a cool season crop;
- A three-crop sequence that contains warm and cool season crops. The same crop species should not be grown in successive years in the same field.
- A four-crop sequence that contains two different crop types, neither should occupy more than half of the sequence;
- Longer crop sequences (four or more years) are more effective with no more than two consecutive years with the same crop;
- In tropical regions or regions with distinct wet and dry seasons (Mediterranean climate), grass crops should alternate with broadleaf crops.

Additional Considerations to Reduce Sheet and Rill or Wind Erosion.
When used in combination with NRCS CPSs for Residue and Tillage Management (Codes 329 and 345), selection of high-residue producing crops and varieties, use of cover crops and adjustment of plant density and row spacing can enhance production of the kind, amount, and distribution of residue needed.
When used in combination with NRCS CPSs Stripcropping (Code 585) or Contour Buffer Strips (Code 332) on steeper slopes, the effectiveness of each practice is significantly enhanced by inclusion of the other practice(s) in the conservation system.
Crop damage by wind erosion can be reduced with this practice by selecting crops that are tolerant to abrasion from windblown soil or tolerant to high wind velocity.
If crops sensitive to wind erosion damage are grown, the potential for plant damage can be reduced by crop residue management, field windbreaks, herbaceous wind barriers, intercropping, or other methods of wind erosion control.

Additional Considerations to Improve Soil Health
Consider including perennial sod crops with deep or extensive fibrous root systems to build organic matter throughout the soil profile.

In semiarid regions, where seasonal fallow is often used to store moisture in the soil for a subsequent crop, consider leaving sufficient residues to protect the soil surface during fallow, or growing a shallowrooted cover crop that allows deep moisture storage. Reduce the intensity of tillage and increase soil surface coverage with vegetation and crop residues.
The effects of this practice can be enhanced by utilizing animal wastes, green manure crops (cover crops), or applying non-synthetic mulches to supplement the biomass produced by crops in the rotation.

Other considerations for soil health/organic matter management include:

- For at least one-third of the crop sequence (time basis) include high- biomass annual or perennial crops.
- For rotations dominated by low- residue crops, such as vegetables, include sufficient cover crops and high residue crops for one-half the rotation.
- Utilize cover crops and high residue production crops comprising at least one-half of the rotation sequence.

Additional Considerations to Reduce Plant Pest Pressures

- Consider lengthening the rotation to include several years of perennial cover to break pest life cycles.
- Use a mix of crops from at least three different plant families, and allow three years or longer between successive plantings of production crops within the same family.
- Enhance biological pest control by designing the crop rotation to:
- Include flowering annuals or perennials that provide food and habitat for beneficial insects, such as buckwheat, clovers, or Phacelia.
- Include plant species that release into the soil natural substances that suppress plant pathogens, nematodes or pests (biofumigation).
- Include crops in the rotation that provide habitat for natural enemies of pests.
- Retain bolting or flowering crops after harvest to provide food for beneficial insects.

Additional Considerations to Provide Food and Cover Habitat for Wildlife, Including Pollinator Forage, and Nesting

Crop residues may be a valuable food source for wintering wildlife where winter browse is sparse. Leaving several rows unharvested around the edges of the field, or planting borders of various forbs will provide protection and/or food for overwintering wildlife and for beneficial insects and pollinators.
Crop plantings may be developed to benefit particular communities, species, or life stages of wildlife. Food plots or crops for wildlife can provide part of a habitat restoration, an initial food and cover for wildlife until food and cover producing vegetation becomes established.
Retaining bolting or flowering crops after harvest may provide beneficial insects with an important food source.
Careful consideration should be given to pesticides applied to crops raised for wildlife, particularly if nesting habitat or pollinator forage species are present.
When insect-pollinated crops are part of the rotation, planting the insect-pollinated crop no more

than 800 feet from their previous location may help maintain local populations of native bees that have become established because of the presence of that crop.
To maintain stable pollinator and beneficial insect populations, ensure that the same overall density of floral resources is maintained from year-to-year. For example two years of flower-rich plantings, followed by a year of only grasses, will cause a rapid decline in pollinator populations. Such a scenario is undesirable.

PLANS AND SPECIFICATIONS

Develop plans and specifications for each field or treatment unit according to the Criteria and Operation and Maintenance requirements of this standard. Specifications shall describe the requirements to apply this practice to achieve the intended purpose. Record the following specification components in an approved Conservation Crop Rotation, 328, Implementation Requirements document. The following items
will be documented as a minimum.

- Field number and acres,
- Purpose(s) of the crop rotation,
- The sequence of crops to be grown,
- The crop types to be grown,
- Tillage type and times,
- Length of time each crop/crop type will be grown in the rotation, and
- Total length of rotation
- Suitable crop substitutions to address weather, soil conditions, market, or other situations that may prevent the planned crop from being planted.

MAINTENANCE

Rotations shall provide for acceptable substitute crops in case of crop failure or shift in planting intentions for weather related or economic reasons. Acceptable substitutes are crops having similar properties that will accomplish the purpose of the original crop.
Evaluate the rotation and the crop sequence to determine if the planned system is meeting the planned purposes.

BUFFER STRIP

DEFINITION

Buffer strips are narrow plantings of perennial plants that are primarily used to reduce water runoff from fields, including loss of pesticides and fertilizers.

PURPOSE

They can help provide habitat for pollinators and other beneficial insects as well as wildlife. Most often, buffer strips of perennial grasses are planted around the edge of the field, particularly in downslope positions; woody plants are sometimes used in riparian buffer strips along streams, ponds, or lakes. Buffer strips can also be planted along contours across a field to reduce water erosion.

CRITERIA

The width of the buffer strip should be based on the amount of slope in the field and the particular goal for the buffers, but typical buffer strips are 10 to 30 feet wide.

PLANS AND SPECIFICATIONS

Types of buffers

- Harvestable buffer strip – buffers that may also serve as a forage harvest opportunity for farmers.
- Contour buffer strip – used in sloped agricultural fields to prevent erosion and slow the velocity of rainwater as it moves downhill.
- Shoreline gardens – buffer between a lake and a manicured residential lawn.

Benefits of buffers

- Soil erosion – helps hold soil in place.
- Wildlife habitat – provide food and cover for wildlife.
- Protect and extend stream health – prevents the filling of drainage ditches and streams with loose sediment.
- Stream bank integrity – added vegetation stabilizes the stream bank.
- Aesthetically pleasing.

MAINTENANCE

Buffer strips are low maintenance but there are a few things to consider. Make sure mulch doesn't slough off onto the sidewalk, especially if the buffer strip is on a slope. Prune plants if they grow too tall (over 3 feet) or hang over onto the sidewalk to maintain sightlines and clear access to sidewalks. Choosing the right plant and giving it the proper area to grow will often

minimize this maintenance. Regularly check your irrigation for leaks and proper function.

INTERCROPPING

DEFINITION

Intercropping is the practice of growing two or more crops in proximity.

PURPOSE

The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilized by a single crop.

CRITERIA

Examples of intercropping strategies are planting a deep-rooted crop with a shallow-rooted crop, or planting a tall crop with a shorter crop that requires partial shade. Numerous types of intercropping, all of which vary the temporal and spatial mixture to some degree, have been identified: mixed intercropping, row cropping, relay cropping, etc.

PLANS AND SPECIFICATIONS

Advantages of intercropping fall into three basic categories. First, an intercrop may use resources of light, water, and nutrients more efficiently than single crops planted in separate areas, and this can improve yields and income. Second, crop mixtures frequently have lower pest densities, especially of insect pests. This occurs both because the mixture confuses the insects and, if the mixture is chosen carefully, because the mixture attracts beneficial predators. Finally, intercropping may allow more effective management of cover crops.

MAINTENANCE

Intercropping systems require additional management. They often call for careful timing of field operations, and they may necessitate special interventions to keep competition between the intercropped species in balance. A crop mix that works well in one year may fail the next if weather favors one crop over another. A mixture of crops with different growth forms or timing of development may make cultivation and use of mulches more difficult and less effective. Planting crops in alternate rows or strips greatly simplifies management and captures some of the benefits of intercropping for pest control. It may do little, however, to increase resource capture by the crops, unless alternating strips are close together.

WINDBREAK

DEFINITION

Windbreaks are linear plantings of trees and shrubs designed to provide economic, environmental and community benefits.

PURPOSE

The primary purpose of most windbreaks is to slow the wind which creates a more beneficial condition for soils, crops, livestock, wildlife and people.

CRITERIA

Windbreaks, sometimes called shelterbelts, can also function in ways not related to wind reduction. Non-wind related purposes include shade for livestock, visual screening, aesthetics, recreational opportunities, and wood and nontimber forest products. Windbreaks have also been recognized for their value in providing ecosystem services, which often extend beyond the farm. Benefits include enhancement of biodiversity, wildlife habitat, carbon storage, pollinator habitat, and soil and water quality protection.

PLANS AND SPECIFICATIONS

Windbreaks can be and often are designed to serve more than one purpose. However, windbreaks are not a one size fits all practice. The location, orientation to the wind, height, width, density and species selection all play a role in determining the benefits that the windbreak will provide.

There are several types of windbreaks. Field windbreaks protect a variety of wind-sensitive crops, control soil wind erosion, increase crop yields, and increase bee pollination and irrigation and pesticide effectiveness. Field windbreaks can also be designed to spread snow evenly across a field, increasing spring soil moisture. Livestock windbreaks help reduce mortality from cold weather, animal stress, and feed consumption, all of which lead to increased weight gain and milk production. Windbreaks also help reduce visual impacts, noise, and odors from livestock operations. Living snow fences keep roads clear of drifting snow and increase driving safety. Farmstead windbreaks reduce heating costs and improve outdoor working conditions.

MAINTENANCE

Maintenance is done throughout the life of a windbreak to keep it healthy and growing. It is especially important early in the life of the planting. Maintenance includes any post-planting care such as weed control and pruning. Fertilization and watering also may be considered maintenance, although watering is rarely done after the first few years after planting, and

fertilization normally is not needed.

Renovation can be considered a more drastic form of maintenance. It becomes necessary to renovate as a windbreak ages or deteriorates due to poor maintenance or design. If possible, renovation should start early enough to allow any new plantings to become effective before windbreak protection declines. Renovation includes techniques such as adding or removing tree or shrub rows, thinning within rows, and managing natural reproduction and coppice sprouts. Pruning also may be part of renovation.

SOIL HEALTH

DEFINITION

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.

PURPOSE

Healthy soil gives us clean air and water, bountiful crops and forests, productive grazing lands, diverse wildlife, and beautiful landscapes. Soil does all this by performing five essential functions:

- Regulating water
    - Soil helps control where rain, snowmelt, and irrigation water goes. Water flows over the land or into and through the soil.
- Sustaining plant and animal life
    - The diversity and productivity of living things depends on soil.
- Filtering and buffering potential pollutants.
    - The minerals and microbes in soil are responsible for filtering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials, including industrial and municipal by-products and atmospheric deposits.
- Cycling nutrients
    - Carbon, nitrogen, phosphorus, and many other nutrients are stored, transformed, and cycled in the soil.
- Providing physical stability and support
    - Soil structure provides a medium for plant roots. Soils also provide support for human structures and protection for archeological treasures.

CRITERIA

The USDA Natural Resources Conservation Service (NRCS) has identified four principles for improving soil health and sustainability:

1. Use plant diversity to increase diversity in the soil.
2. Manage soils more by disturbing them less.
3. Keep plants growing throughout the year to feed the soil.
4. Keep the soil covered as much as possible.
5. Integrate livestock to recycle nutrients and increase plant diversity.

A healthy soil has good water infiltration and retention. The biological activity within the soil increases soil fertility and helps build good soil structure. These things reduce the need for expensive inputs and increase plant resilience to drought, pests and intense rains.

NUTRIENT MANAGEMENT

DEFINITION

Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve plant health and productivity.
- Reduce excess nutrients in surface and ground water.
- Reduce emissions of objectionable odors.
- Reduce emissions of particulate matter (PM) and PM precursors.
- Reduce emissions of greenhouse gases (GHG).
- Reduce emissions of ozone precursors.
- Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water.
- Improve or maintain soil organic matter.

CONDITIONS WHERE PRACTICE APPLIES

All fields where plant nutrients and soil amendments are applied. Does not apply to one-time nutrient applications at establishment of permanent vegetation.

CRITERIA

- Develop a nutrient management plan for nitrogen (N), phosphorus (P), and potassium (K), which accounts for all known measurable sources and removal of these nutrients.
- Sources of nutrients include, but are not limited to, commercial fertilizers (including starter and in-furrow starter/pop-up fertilizer), animal manures, legume fixation credits, green manures, plant or crop residues, compost, organic by-products, municipal and industrial biosolids, wastewater, organic materials, estimated plant available soil nutrients, and irrigation water.
- When irrigating, apply irrigation water in a manner that reduces the risk of nutrient loss to surface and ground water.
- Follow all applicable State requirements and regulations when applying nutrients near areas prone to contamination, such as designated water quality sensitive areas, (e.g., lakes, ponds, rivers and streams, sinkholes, wellheads, classic gullies, ditches, or surface inlets) that run unmitigated to surface or groundwater.

OPERATION AND MAINTENANCE

Review or revise plans periodically to determine if adjustments or modifications are needed. At a minimum, review and revise plans as needed with each soil test cycle, changes in manure management, volume or analysis, plants and crops, or plant and crop management.
Monitor fields receiving animal manures and biosolids for the accumulation of heavy metals and P in accordance with LGU guidance and State law.
For animal feeding operation, significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.
Calibrate application equipment to ensure accurate distribution of material at planned rates. For products too dangerous to calibrate, follow LGU or equipment manufacturer guidance on proper equipment design, plumbing, and maintenance.
Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation to explain the difference.
Protect workers from and avoid unnecessary contact with nutrient sources. Take extra caution when handling anhydrous ammonia or when managing organic wastes stored in unventilated tanks, impoundments, or other enclosures.
Use material generated from cleaning nutrient application equipment in an environmentally safe manner.
Collect, store, or field apply excess material in an appropriate manner.
Recycle or dispose of nutrient containers in compliance with State and local guidelines or regulations.
Maintain records for at least 5 years to document plan implementation and maintenance. Records must include—
• All test results (soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient management plan is based.
• Listing and quantification of all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports and onsite transfers.
• Date(s), method(s), and location(s) of all nutrient applications.
• Weather conditions and soil moisture at the time of application, elapsed time from manure application to rainfall or irrigation event(s).
• Plants and crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and plant or crop residues removed.
• Dates of plan review, name of reviewer, and recommended adjustments resulting from the review.

For variable rate nutrient management plans, also include—
• Maps identifying the variable application location, source, timing, amount, and placement of all plant and crop nutrients applied.
• GPS-based yield maps for crops where yields can be digitally collected.

EROSION AND SEDIMENT CONTROL

STRAW WATTLES

DEFINITION

Straw wattles can be referred to as straw worms, noodles, straw bio-logs, or straw tubes due to their cylindrical shape. These consist of either a weed-free substance (such as wheat or rice) or a composition of thinly shaved wood fibers. Although they are not extremely heavy, their dimensions can be significant, measuring approximately 25 feet in length and around 9 feet in diameter. Straw wattles are easy to work with because of their flexibility.

PURPOSE

Straw wattles are intended to help prevent soil erosion, chemical and water runoff, and increase healthy infiltration within the ground.

CRITERIA

They are installed on slopes that have less than 30% of its original ground cover and are considered at risk for increased erosion. They can also be installed to help control on certain slopes and areas, such as:

- Around temporary stockpiles
- As perimeter control
- Top or bottom of slopes to intercept runoff
- Parallel to contours of the slope
- Perpendicular to flow lines and ditches

Wattles are a temporary, long-term solution that are usually positioned during building and construction projects to help avoid contributing any further harm to the surrounding environment by stopping any runoff. They can also be installed to rehabilitate and restore habitats in high-risk areas for erosion and flooding.

PLANS AND SPECIFICATIONS

These cylindrical bales of straw-like substance serve as an effective means of slowing down and spreading out sediment and water. They also collect the sediment that runs down with the dirt and water in areas where the ground has been displaced. When installed properly, straw wattles can:

- Increase the infiltration of water
- Control stormwater runoff
- Divert the flow of water to appropriate areas

- Add roughness to the ground
- Reduce erosion from an overly saturated area
- Keep already eroded soil on a slope

MAINTENANCE

- Repair or replace split, torn, unraveling, dislodged or slumping wattles.
- Pay attention to any animal burrows that may be channeling water under wattles.
- Inspect wattles when rain is forecast, following rainfall events and once daily during prolonged rainfall. Perform maintenance as needed.
- Seed upstream/uphill sediment during rainy season to aid in establishment of vegetation.
- Wattles are designed to be left in place. If wattles must be removed, remove all stakes and plastic debris and fill in trench or apply other treatment to control erosion.
- If water flows around wattle and creates rill or feeds gully erosion, fill and compact cuts, extend with additional wattle, rock mulch, etc with slight uphill grade.

CONTOUR FARMING

DEFINITION

Aligning ridges, furrows, and roughness formed by tillage, planting and other operations at a grade near the contour to alter the velocity or the direction of water flow.

PURPOSE

This practice is used to accomplish one or more of the following purposes–

- Reduce sheet and rill erosion.
- Reduce sediment transport to surface waters.
- Reduce excess nutrients in surface waters.
- Reduce pesticide transport to surface waters.
- Improve the efficiency of moisture management.

CRITERIA

Row grades must be designed to be as near level as possible while allowing drainage. The maximum row grade must not exceed one-half of the up-and-down-hill slope percent used for conservation planning with a maximum 4-percent row grade.

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

Design the row grades with positive row drainage of not less than 0.2 percent on slopes where ponding is a concern. This includes sites with soils with slow to very slow infiltration rates (soil hydrologic groups C or D), or where crops are sensitive to ponded water.

Up to a 10-percent deviation from the design row grade is permitted within 50 feet of a stable outlet. 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 nonparallel contour baselines, establish a correction area (areas in the field where two different contour systems meet) that is permanently in sod or 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. For row spacing’s greater than 10 inches, the minimum ridge height will be 2 inches during the period of the rotation that is most vulnerable to sheet and rill erosion. Document ridge heights from the operations using the current approved water erosion prediction technology.

For row spacing 10 inches or less, the minimum ridge height will be 1 inch for close-grown crops, such as small grains. Document ridge heights from the operations using the current approved water erosion prediction technology. Concentrated flow from contoured fields must be delivered to stable outlets.

CONSIDERATIONS

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 6.5 inches or greater. 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 the erosion reduction and the greater the improvement in soil moisture use efficiency.

Prior to design and layout, obstruction removal and changes to field boundaries or shape should be considered, where feasible, to improve the effectiveness of the practice and the ease of performing farming operations. CPS Field Border (Code 386) may be needed to allow farm implements room to turn and control erosion along the field edge.

If using ridge till on the contour, avoid crossing over ridged rows at correction area, 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 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 ridge height value for each field operation can be viewed in the currently approved soil erosion tool. CPSs Grassed Waterways (Code 412), Water and Sediment Control Basins (Code 638), Underground Outlets (Code 620), or other suitable practices should be used to protect areas of existing or potential concentrated flow erosion.

PLANS AND SPECIFICATIONS

Prepare specifications for each site and purpose on the implementation requirements document. Document must include—

- Percent land slope and slope length.
- Planning soil map unit.
- Planned contour row grade.
- Minimum ridge heights and row spacing.
- Minimum and maximum allowable row grades for the contour system.

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 must be parallel to the established marker. If a marker is lost, reestablish a contour baseline within the applicable criteria set forth by this standard prior to seedbed preparation for the next crop.

FILTER STRIP

DEFINITION

A filter strip is a narrow band of grasses, legumes, and forbs used to limit sediment, nutrients, pesticides, and other contaminants from entering water bodies. Filter strips can provide valuable winter cover, nest sites, nectar and pollen for pollinating insects, and food for wildlife.

PURPOSE

This practice is used to accomplish one or more of the following purposes–

- Reduce suspended solids and associated contaminants in runoff and excessive sediment in surface waters.
- Reduce dissolved contaminant loadings in runoff.
- Reduce suspended solids and associated contaminants in irrigation tailwater and excessive sediment in surface waters.

CRITERIA

Filter strips are typically located on cropland immediately adjacent and parallel to streams, lakes, ponds, ditches, sinkholes, wetlands, or groundwater recharge areas.

PLANS AND SPECIFICATIONS

The filter strip will be designed to encourage water to flow in a thin sheet. When water is concentrated, it will be spread across the width of the filter strip.
Filter strips are designed to fill with sediment. To maintain the function and value of filter strips:

- Any channels or rills must be immediately repaired.
- Terraces, dikes, berms, trenches, or vegetative barriers can be used to treat concentrated flow areas.
- Sediment within the filter should be removed before it accumulates to a height higher than 6 inches. Level and re-establish sheet flow. Re-seed if necessary.

OTHER MANAGEMENT CONSIDERATIONS

Noxious weeds and other undesirable plants, insects, and pests shall be controlled, including such maintenance as necessary to avoid detrimental effects to the surrounding land. For optimum wildlife habitat, plant a diversity of grasses, legumes, and wildflowers. These mixtures will provide winter and nesting cover and food for a variety of wildlife.

COVER CROP

DEFINITION

Grasses, legumes, and forbs planted for seasonal vegetative cover.

PURPOSE

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

- Reduce erosion from wind and water.
- Maintain or increase soil health and organic matter content.
- Reduce water quality degradation by utilizing excessive soil nutrients.
- Suppress excessive weed pressures and break pest cycles.
- Improve soil moisture use efficiency.
- Minimize soil compaction.

CRITERIA

Plant cover crops in a timely matter and when there is adequate moisture to establish a good stand. When applicable, ensure cover crops are managed and are compatible with the client's crop insurance criteria. Maintain an actively growing cover crop as late as feasible to maximize plant growth, allowing time to prepare the field for the next crop and to optimize soil moisture. Select cover crops that are compatible with the production system, well adapted to the region's climate and soils, and resistant to prevalent pests, weeds, and diseases. Avoid cover crop species that harbor or carry over potentially damaging diseases or insects.

Cover crops may be used to improve site conditions for establishment of perennial species. When cover crops are used for grazing, select species that will have desired forage traits, be palatable to livestock, and not interfere with the production of the subsequent crop. Use plant species that enhance forage opportunities for pollinators by using diverse legumes and other forbs.

Cover crops may be selected to provide food or habitat for natural enemies of production crop pests. Cover crops residues should be left on the soil surface to maximize allelopathic (chemical) and mulching (physical) effects.
Seed a higher density cover crop stand to promote rapid canopy closure and greater weed suppression. Increased seeding rates (1.5 to 2 times normal) can improve weed- competitiveness.

Cover crops may be selected that release biofumigation compounds that inhibit soil-borne plant pests and pathogens. Species can be selected to serve as trap crops to divert pests from production crops. Select a mixture of two or more cover crop species from different plant families to achieve one or more of the following: (1) species mix with different maturity dates, (2) attract beneficial insects, (3) attract pollinators, (4) increase soil biological diversity, (5) serve

as a trap crop for insect pests, or (6) provide food and cover for wildlife habitat management.

Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to achieve biological nitrogen fixation. Select cover crop species or mixture, and timing and method of termination that will maximize efficiency of nitrogen utilization by the following crop, considering soil type and conditions, season and weather conditions, cropping system, C:N ratio of the cover crop at termination, and anticipated nitrogen needs of the subsequent crop. Use LGU- recommended nitrogen credits from the legume and reduce nitrogen applications to the subsequent crop accordingly. "If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Time the termination of cover crops to meet nutrient release goals. Termination at early vegetative stages may cause a more rapid release compared to termination at a more mature stage. Both residue decomposition rates and soil fertility can affect nutrient availability following termination of cover crops. Allelopathic effects to the subsequent crop should be evaluated when selecting the appropriate cover crop. Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the planning criteria and operation and maintenance requirements of this standard. Specifications shall describe the requirements to apply the practice to achieve the intended purpose for the practice site. Plans for the establishment of cover crops shall, as a minimum, include the following specification components in an approved Cover Crop, 340, Implementation Requirements document:

- Field number and acres
- Species of plant(s) to be established.
- Seeding rates.
- Seeding dates.
- Establishment procedure.
- Rates, timing, and forms of nutrient application (if needed).
- Dates and method to terminate the cover crop.
- Other information pertinent to establishing and managing the cover crop e.g., if haying or grazing is planned specify the planned management for haying or grazing.

MAINTENANCE

Evaluate the cover crop to determine if the cover crop is meeting the planned purpose(s). If the cover crop is not meeting the purpose(s) adjust the management, change the species of cover crop, or choose a different technology.

NO TILL

DEFINITION

No-till farming (also known as zero tillage or direct drilling) is an agricultural technique for growing crops or pasture without disturbing the soil through tillage.

PURPOSE

No-till farming decreases the amount of soil erosion tillage causes in certain soils, especially in sandy and dry soils on sloping terrain. Other possible benefits include an increase in the amount of water that infiltrates into the soil, soil retention of organic matter, and nutrient cycling. These methods may increase the amount and variety of life in and on the soil. While conventional no-tillage systems use herbicides to control weeds, organic systems use a combination of strategies, such as planting cover crops as mulch to suppress weeds.

CRITERIA

There are three basic methods of no-till farming. "Sod seeding" is when crops are sown with seeding machinery into a sod produced by applying herbicides on a cover crop (killing that vegetation). "Direct seeding" is when crops are sown through the residue of previous crop. "Surface seeding" or "direct seeding" is when crops are left on the surface of the soil; on flatlands, this requires no machinery and minimal labor.

RESIDUE MANAGEMENT

DEFINITION

Crop residue management is a cultural practice that involves fewer and/or less intensive tillage operations and preserves more residue from the previous crop.

PURPOSE

Crop residue management is designed to help protect soil and water resources and provide additional environmental benefits. This practice is generally cost effective in meeting conservation requirements and reducing fuel, machinery, and labor costs while maintaining or increasing crop yields.

CRITERIA

Crop residue management practices include reduced tillage or conservation tillage, such as no-till, ridge-till, and mulch till, as well as the use of cover crops and other conservation practices that provide sufficient residue cover to significantly reduce the erosive effects of wind and water. These practices can benefit society through an improved environment and can benefit farmers through enhanced farm economic returns. However, adoption of CRM may not lead to clear environmental benefits in all regions and, similarly, may not be economically profitable on all farms.

PLANS AND SPECIFICATIONS

Conservation Tillage:
Any tillage and planting system that maintains at least 30 percent of the soil surface covered by residue after planting to reduce soil erosion by water; or where soil erosion by wind is the primary concern, maintains at least 1,000 pounds (per acre) of flat, small grain residue equivalent on the surface during the critical wind erosion period. Two key factors influencing crop residue are (1) the previous crop, which establishes the initial residue amount and determines its fragility, and (2) the type of tillage operations prior to and including planting.

Conservation Tillage Systems (as defined in both the Crop Residue Management Survey and the Cropping Practices Survey):
Mulch till--The soil is disturbed prior to planting. Tillage tools such as chisels, field cultivators, disks, sweeps, or blades are used. The Cropping Practices Survey assumes any system with 30 percent or more residue after planting that is not a no-till or ridge-till system is a mulch-till system.
Ridge till--The soil is left undisturbed from harvest to planting except for nutrient injection. Planting is completed in a seedbed prepared on ridges with sweeps, disk openers, coulters, or row cleaners. Residue is left on the surface between ridges.

No-till--The soil is left undisturbed from harvest to planting except for nutrient injection. Planting or drilling is accomplished in a narrow seedbed or slot created by coulters, row cleaners, disk openers, inrow chisels, or roto-tillers.

Conventional Tillage Systems (as defined in the Cropping Practices Survey)

Conventional tillage with moldboard plow--Any tillage system that includes the use of a moldboard plow.

Conventional tillage without moldboard plow--Any tillage system that has less than 30 percent remaining residue and does not use a moldboard plow.

Other Tillage Systems (as defined in the Crop Residue Management Survey)

Reduced till (15-30% residue)--Tillage types that leave 15-30 percent residue cover after planting, or 500-1,000 pounds per acre of small grain residue equivalent throughout the critical wind erosion period.

Conventional till (less than 15% residue)--Tillage types that leave less than 15 percent residue cover after planting, or less than 500 pounds per acre of small grain residue equivalent throughout the critical wind erosion period.

MULCHING

DEFINITION

Applying plant residues or other suitable materials to the land surface.

PURPOSE

This practice is applied to achieve the following purpose(s):
• Improve the efficiency of moisture management
• Reduce irrigation energy used in farming/ranching practices and field operations
• Improve the efficient use of irrigation water
• Prevent excessive bank erosion from water conveyance channels
• Reduce concentrated flow erosion
• Reduce sheet, rill, & wind erosion
• Improve plant productivity and health
• Maintain or increase organic matter content
• Reduce emissions of particulate matter

CRITERIA

General Criteria Applicable to All Purposes

The selection of mulching materials will depend primarily on the purpose(s) for the mulch application, site conditions, and the material's availability. The mulch materials may consist of natural or artificial materials of sufficient dimension (depth or thickness) and durability to achieve the intended purpose for the required time period. Prepare the soil surface to achieve its desired purpose prior to mulching. Apply the mulch material evenly. Use tackifiers, emulsions, pinning, netting, crimping or other methods of anchoring, if needed, to hold the mulch in place for specified periods. In cases where furrow erosion may occur due to concentrated flows from mulches (e.g., plastic mulches on beds), take appropriate measures to protect the furrows and the furrow outlets.

Apply manufactured mulches according to the manufacturer's specifications.
Remove synthetic mulches from the field prior to the next crop. Do not incorporate (e.g., disk) synthetic mulches into the soil. When mulching with wood products such as wood chips, bark, or shavings or other wood materials, apply a minimum 2-inch thickness of particles that will remain in place during heavy rainfall or strong wind events, or both if applicable. The minimum size of mulching material consisting of gravel or other inorganic mulching is 0.75 inches and applied to a minimum depth of 2 inches. When mulching with cereal grain straw or grass hay, apply at a rate to achieve a minimum 70-percent ground cover. Determine the mulch rate using the current erosion prediction technology for the intended purpose. Do not apply plant-based mulch materials with a carbon (C) to nitrogen (N) ratio less than 20:1 to watercourses.

Additional Criteria to Improve the Efficiency of Moisture Management, to Reduce Irrigation Energy Used in Farming/Ranching Practices, and Field Operations or to Improve the Efficient Use of Irrigation Water

Apply mulch materials to cover at least 90 percent of the soil surface to reduce potential evaporation. Fine-textured mulches (e.g., rice hulls) that allow less oxygen penetration than coarser materials should not be thicker than 2 inches.

Additional Criteria to Improve Plant Productivity and Health

When establishing vegetative cover, apply mulch at a rate that achieves a minimum of 70-percent ground cover to provide protection from erosion and runoff and yet allow adequate light and air penetration to the seedbed to ensure proper germination and emergence.

Additional Criteria to Increase Organic Matter Content

Use plant-based mulching materials of suitable quantity and quality to add organic matter, provide food and shelter for soil biota, and protect the soil surface from raindrop impact and crusting, while allowing for adequate soil aeration. An evaluation of the system using the current approved soil conditioning index (SCI) procedure results in zero or higher.

CONSIDERATIONS

Evaluate the effects of mulching on evaporation, infiltration, and runoff. Mulch material may affect microbial activity in the soil surface, increase infiltration, and decrease runoff, erosion, and evaporation. The temperature of the surface runoff may also be lowered. Mulch materials with low permeability may adversely affect the water needs of plants.

Avoid excessively thick or tightly packed mulches that can result in soggy, anaerobic conditions at the soil surface during wet weather; or prevent rainfall or overhead irrigation from reaching the soil during times of moisture deficit. Organic materials with C:N ratios of less than 20:1 will release nitrate-nitrogen that could cause water quality impairments.

Finely divided plant residues (e.g., sawdust) and those rich in soluble carbohydrates (e.g., fresh green chopped sorghum-sudangrass, corn, or other grasses) that have a C:N ratio greater than 30 can tie up soil N and necessitate supplemental N applications on crops. Coarser materials such as grain straw and chipped brush usually do not reduce crop-available soil N levels unless and until they are incorporated into the soil by tillage or cultivation.

Mulching may also provide habitat for beneficial organisms and provide pest suppression. In attempting to provide habitat for ground beetles, spiders, and other predators of weed seeds and crop pests, use mulch of sufficient ground cover and suitable thickness and texture for the target species. Avoid excessively thick or tightly packed mulches, which can interfere with the movement of ground beetles and other beneficial organisms, and may increase the incidence of crop pests and diseases.

Consider mulching crops only if the selected mulching materials, and rates of application do not contribute to pest problems. During the period when weed seed predation is desired and predators are most active, avoid pesticide applications or pesticide exposures that could adversely affect weed seed consumers. Low permeability mulches (e.g., plastic) may increase concentrated flow and erosion on the nonmulched areas. Light-reflecting mulches such as white or aluminized plastic film or bright straw can repel some pests.

Consider potential beneficial or detrimental effects of mulching materials on the biotic community surrounding the crop, including beneficial soil micro- and macro-organisms, as well as plant pathogens and plant pests. These effects are specific to site, mulch, and crop, and may include enhanced soil microbial activity, increased or reduced levels of crop diseases, and toxic (allelopathic) activity against the crop, weeds, or other beneficial or pest organisms.

Keep mulch 3 to 6 inches away from plant stems and crowns to prevent disease and pest problems. Additional weed control may be needed around the plant base area. Deep mulch provides nesting habitat for ground-burrowing rodents that can chew extensively on tree trunks and tree roots. Light mulch applied after the first cold weather may prevent rodents from nesting. Some mulch material may adversely affect aquatic environments through changes in water chemistry or as waterborne debris. Consider placing mulch in locations that minimize these risks.

Consider potential effects of soil physical, chemical, and biological properties. Refer to soil survey data as a preliminary planning tool for assessment of areas. Consult a resource soil scientist or the Web Soil Survey at: http://websoilsurvey.nrcs.usda.gov/app/ to obtain soil properties and qualities information. For all organic or transitioning to organic operations, follow all National Organic Program rules.

PLANS AND SPECIFICATIONS

Prepare specifications for each site and purpose on the implementation requirements document. Documentation must include—

- Purpose of the mulch.
- Type of mulch material used.
- Percent cover or thickness of mulch material, as applicable.
- Timing of application.
- Site preparation.
- Listing of netting, tackifiers, or method of anchoring.
- Operation and maintenance.

MAINTENANCE

Periodically inspect the mulched areas and reinstall mulch or repair as needed to accomplish the intended purpose. Evaluate the effectiveness of the mulch (application, amount of cover provided, durability, etc.) and adjust the management or type of mulch to better meet the intended purpose(s). Remove or incorporate mulch materials to be consistent with the intended purpose and site conditions. Do not operate equipment near the mulched site that would compromise the intended purpose of the mulch. Prevent or repair any fire damage to the mulch material. Properly collect and dispose of synthetic mulch material after intended use. Monitor and control undesirable weeds in mulched areas.

RIDGING

DEFINITION

In ridge plant, crops are planted into ridges formed during cultivation of the previous crop. A band application of herbicide behind the planter provides weed control in the row. Crop cultivation controls weeds between the rows and rebuilds the ridges for the following year.

PURPOSE

Ridge planting reduces erosion by leaving the soil covered with residue until planting. After planting, 30% to 50% residue may be left, but it is not uniformly distributed. Residue-covered areas between the rows alternate with residue-free strips in the row area. For erosion control, NRCS specifies that ridges must be 3 to 5 inches higher than the furrows after planting and that ridges be shaped to shed water to the furrow. For the most effective erosion control, orient ridges approximately on the contour.

CRITERIA

Crop rotation influences the suitability of ridge systems. Ridges are maintained year-to-year with a cultivator, making ridge plant well suited to continuous row crops. Two cultivations are generally required: the first loosens soil and controls weeds, the second provides additional weed control and rebuilds the ridges. For ease of planting, the ridges should be rounded or flat topped and 6 to 8 inches tall after cultivation. Proper ridge shape and annual maintenance are keys to a successful ridge system. Be careful not to damage or destroy the ridges by wheel traffic, particularly during harvest.

Level or gently sloping fields, especially those with poorly drained soils, are well suited to ridge systems. The elevated ridges warm earlier in the spring. This warming, combined with drainage from the ridge, allows soil in the ridge to be drier at planting than untilled, unridged soil. A ridge system is an excellent choice for soils that are often too wet for early spring tillage, especially in the northern Corn Belt where the growing season is shorter.

Ridge systems complement furrow irrigation. Ditching, furrowing, or hilling for irrigation provides suitable ridges for planting the following year. Chopping stalks or performing a very shallow, high speed tillage operation removes residue from the ridges and aids furrow irrigation, especially on soils with higher infiltration rates.

In ridge plant, row cleaning devices on the planter move a small amount of soil, residue, and weed seed off the ridge top. Ridge-cleaning attachments include sweeps, disk furrowers, or horizontal disks. Except for possible fertilizer injection, no soil disturbance occurs prior to ridge planting.

STORMWATER MANAGEMENT

WETLAND ENHANCEMENT

DEFINITION

The manipulation of the physical, chemical, or biological characteristics of a wetland (undisturbed or degraded) site heighten, intensify, or improve specific function(s) or for a purpose such as water quality improvement, flood water retention or wildlife habitat. Enhancement results in a change in wetland function(s) and can lead to a decline in other wetland function, but does not result in a gain in wetland acres. This term includes activities commonly associated with the terms enhancement, management, manipulation, directed alteration.

PURPOSE

This practice is used to accomplish the following purposes:

- To enhance hydric soil functions (changing soil hydrodynamic and/or bio-geochemical properties).
- To enhance wetland hydrology (dominant water source, hydroperiod, and hydrodynamics).
- To enhance vegetation (including the removal of undesired species, and/or seeding or planting of desired species).
- To enhance plant and animal habitats.

CRITERIA

Wetland enhancement is the modification of specific structural features of an existing wetland to increase one or more functions based on management objectives, typically done by modifying site elevations or the proportion of open water. Although this term implies gain or improvement, a positive change in one wetland function may negatively affect other wetland functions.

Enhancement may also be the alteration of a site to produce conditions that did not previously exist in order to accentuate one or more values of a site. For example, increasing the area of deep water by excavating parts of an emergent wetland may provide more duck habitat (the desired wetland value), but may decrease foraging and cover habitat for young fish.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared for each site. Plans and specifications shall be recorded using approved specifications sheets, job sheets, or other documentation. The plans and specifications for structural features will include, at a minimum, a plan view, quantities, and sufficient profiles and cross-sections to define the location, line, and grade for

stakeout and checkout. Plans and specifications shall be reviewed and approved by staff with appropriate job approval authority.

MAINTENANCE

A separate operation and maintenance plan will be prepared for sites that have structural features. The plan will include specific actions for the normal and repetitive operation of installed structural items, especially water control structures, if included in the project. The plan will also include the actions necessary to assure that constructed items are maintained for the life of the project. It will include the inspection schedule, a list of items to inspect, a checklist of potential damages to look for, recommended repairs, and procedures for documentation.

Management and monitoring activities needed to ensure the continued success of the wetland enhancement objectives may be included in the above plan, or in a separate management and monitoring plan. In addition to the monitoring schedule, this plan may include the following:

- The timing and methods for the use of fertilizers, pesticides, prescribed burning, or mechanical treatments.
- Circumstances when the use of biological control of undesirable plant species and pests (e.g. using predator or parasitic species) is appropriate, and the approved methods.
- Actions which specifically address any expected problems from invasive or noxious species.
- The circumstances which require the removal of accumulated sediment.
- Conditions which indicate the need to use haying or grazing as a management tool, including timing and methods.

NUTRIENT MANAGEMENT:

ON-FARM COMPOSTING (COMPOSTING FACILITY)

DEFINITION

A structure or device to contain and facilitate an aerobic microbial ecosystem for the decomposition of manure, other organic material, or both, into a final product sufficiently stable for storage, on-farm use, and application to land as a soil amendment.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce water pollution potential.
- Conserve energy by reducing mass and improving handling characteristics of organic waste solids.
- Reuse organic waste as animal bedding.
- Transform organic waste into a soil amendment that improves soil health, provides slow-release plant-available nutrients, and suppresses plant disease.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct the composting facility to comply with all Federal, State, and local laws and regulations. The landowner is required to obtain all necessary permits for project installation prior to construction.

Siting

Locate and design the composting facility so it is outside the 100-year floodplain unless site restrictions require locating it within the floodplain. If located within the floodplain, protect the facility from inundation or damage from a 25-year flood event. Additionally, follow the policy found in the NRCS General Manual (GM) (Title 190), Part 410, Subpart B, Section 410.25, "Flood Plain Management," which may require providing additional protection for storage structures located within the floodplain.

Locate facility a minimum of 50 feet from wells, streams, or other water features. Additional distances may be required by local or State laws. Redirect upslope surface runoff away from the composting site. Locate the composting facility to ensure the floor is 2 feet or more above the site-identified seasonal high ground water table unless special design features are incorporated that will address the potential for leaching of contaminants to the water table. The water table may be lowered by use of drains to meet this requirement. Ensure all-weather access to the composting facility. Use NRCS CPSs Access Road (Code 560) or Heavy Use Area (Code 561) if the site lacks appropriate existing access.

Capacity
Size the composting facility in accordance with NRCS National Engineering Handbook (NEH) (Title 210), Part 637, Chapter 2, "Composting." Design the composting facility to accommodate the amount of organic waste feedstock generated for active composting and compost curing, along with the needed volume of additional bulking material or carbon source to achieve the composting action. Active composting includes both the primary and secondary stages of composting. Space for both the active composting and compost curing are required for making a stable finished compost product. Select facility dimensions to accommodate all stages of composting with space for turning, handling, and processing.

Moisture
Orient and design the facility to enable the management of the compost moisture content. A water source is needed for adding moisture in dry conditions. If considerable precipitation is likely, design a cover. Minimize blown in precipitation on covered facilities by providing a roof overhang or orient the open side of the facility away from the prevailing wind direction.

Roofs and roof runoff
If a roof is needed, design the roof using NRCS CPS Roofs and Covers (Code 367). Use NRCS CPS Roof Runoff Structure (Code 558) when designing the collection, control, and conveyance of runoff from a roof that could pose a resource concern. Use NRCS CPS Underground Outlet (Code 620) when designing pipe outlets to prevent erosion or contamination of clean runoff water by composting materials.

Foundation and structure
Design the facility to prevent the contamination of ground water resources. Evaluate site soils for depth to water table, permeability, texture, and bearing strength based on the design load and frequency of use. For the design of a stable surface treatment, where appropriate, use criteria in NRCS CPS Heavy Use Area Protection (Code 561). Use the criteria in NRCS CPS Waste Storage Facility (Code 313) when designing composting facility slabs, walls, and floors. Prevent seepage of compost stack leachate in amounts that would pollute surface or ground water with collection and disposal of liquids in a safe manner, as necessary. Where seepage will be an issue, use NRCS CPSs Pond Sealing or Lining—Geomembrane or Geosynthetic Clay Liner (Code 521), Pond Sealing or Lining—Concrete (Code 522), or Pond Sealing or Lining—Compacted Soil Treatment (Code 520). Guidance on restricting seepage through foundation and subgrade material can be found in NRCS 210-NEH, Part 651, Chapter 10, Appendix 10D, "Design and Construction Guidelines for Impoundments Lined with Clay or Amendment-treated Soil." Seepage control may not be necessary on sites that have a roof, waste material with little seepage potential, or in certain climates.

Power supply
Where needed for mechanically stirred composting systems, all power supply and electrical components, including wiring, boxes, and connectors, must meet the requirements of the National Electric Code. If the power supply is located in an area that is reasonably accessible by

machinery, protect it with strategically placed bollards or other appropriate safety measures.

Wastewater
If leachate or contaminated runoff is anticipated, use NRCS CPS Waste Transfer (Code 634) for collection and conveyance of any leachate or contaminated runoff from the composting facility to a wastewater storage or treatment facility for further management or reuse. Use NRCS CPS Waste Storage Facility (Code 313) or other applicable NRCS CPS for that purpose.

Safety
Incorporate safety and personnel protection features and practices into the facility and its operation to ensure biosecurity and minimize the occurrence of equipment and fire hazards associated with the composting process as appropriate. For composting bins, limit the stack height to 6 feet unless a forced aeration system is provided. This will allow air to reach the center of the pile for proper composting and minimize the potential for spontaneous combustion.

CONSIDERATIONS
Select the type of composting facility and composting method based on landowner's goals, kind of organic waste solids, planned quality of finished compost, operator's equipment, labor, time, and land available for the facility footprint, and resource concerns. Consider the landscape elements when locating the facility. Landscape features can buffer prevailing winds which will minimize odors and protect visual resources. Where appropriate, consider all-weather access roads for the composting facility site. When locating the facility, consider a location away from crops typically consumed raw, food contact surfaces, water distribution systems, and other soil amendment sources where it could become a potential source of contamination.

If the site is located where fields have been artificially drained consider potential water quality issues. Locate or remove field tiles where seepage from the composting facility to ground or surface water is a resource concern. Consider equipment access for the facility location and determine if a heavy use area apron is needed to properly manage the compost.
If the composting facility is in a higher precipitation area or the site will have heavy vehicle traffic, consider using a concrete base for the facility. When designing for windrows, consider the compost site grade and pile alignment. Grade site to prevent ponding from occurring. Align windrows north to south to maximize solar warming.

Consider protecting the composting facilities from wind in cold or dry climates. Wind in cold climates can cause heat loss through convection, limiting microbial metabolism. In low humidity climates wind can cause drying, limiting water availability for microbial metabolism. Dry, pulverized compost is also susceptible to undesirable wind transport from the facility. Consider the options for finished compost storage. Storage space may be included in the compost curing space or in a separate facility that also protects the resources. Consider the impact of using treated lumber for the construction of composting facilities on the quality and acceptability of the compost. For production of certified organic compost have the producer consult with an organic certifier as to the use and acceptability of treated lumber that will meet the design life span for

bins and compost storage structures.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice to achieve its intended use, including, but not limited to—

- Plan view showing layout and location of composting facility; if applicable, access road to facility; and setback distances from water bodies, streams, sensitive areas, property line, etc.
- Drainage and grading plan showing excavation, fill, and drainage containment, as appropriate.
- Pertinent elevations of the facility.
- Notification to the landowner and contractor of their responsibility to locate all buried utilities in the project area.
- Subgrade work (excavation, earthfill/drainfill, compaction requirements).
- Structural details of all components.
- Construction material quantities and specifications.
- Safety features (i.e., fire suppression).

MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes of this practice and the design life of the composting facility. Outline periodic inspections and maintenance of equipment and facilities. Include structural elements of the facility to be inspected or maintained, an inspection interval time frame, and recommendations for preventative maintenance.

Describe essential safety features of the facility to provide protection from or prevention of a compost fire. Provide procedures to monitor and maintain vibrant microbiological decomposition of the organic materials according to the design and site conditions and pertinent nuances of the organic materials to be composted. Guidance provided should be based on the needs and goals of the producer using literature provided by local university extension publication; NRCS 210-NEH, Part 637, Chapter 2, “Composting”; “NRAEAS 54: On-Farm Composting Handbook”; or other appropriate composting literature.

Monitoring the temperature and moisture content of composting material reflects the phases of successive populations of microorganisms and their metabolism as they decompose the organic matter. The operation may need to undergo some trial and error in the startup of a new composting facility while the operator determines an efficient operating process. The operator must keep accurate records to aid in learning how to operate the facility efficiently. Specify the types and volumes of animal waste and other sources of organic feedstock to be composted. Provide information on planned compost recipe ingredients and the sequence for mixing and building the compost piles. Direct the operator to land grant universities and other recognized entities that provide compost mixture calculators to balance feedstocks to meet a target carbon-to-nitrogen (C:N) ratio and moisture content. The NRCS CPS Waste Recycling (Code 633) may be used when nonagricultural byproducts are included in the composting feedstock.

Manage the compost for temperature, moisture, oxygen, and pH, as appropriate. Test the finished compost, as appropriate, to assure the product is stable and no longer heating from biological decomposition. Guidance for composting management, monitoring, and the testing of compost stability is in NRCS 210-NEH, Part 637, Chapter 2, Section 637.0209(h), "Determination of compost stability."

NUTRIENT MANAGEMENT

DEFINITION

Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve plant health and productivity.
- Reduce excess nutrients in surface and ground water.
- Reduce emissions of objectionable odors.
- Reduce emissions of particulate matter (PM) and PM precursors.
- Reduce emissions of greenhouse gases (GHG).
- Reduce emissions of ozone precursors.
- Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water.
- Improve or maintain soil organic matter.

CONDITIONS WHERE PRACTICE APPLIES

All fields where plant nutrients and soil amendments are applied. Does not apply to one-time nutrient applications at establishment of permanent vegetation.

CRITERIA

- Develop a nutrient management plan for nitrogen (N), phosphorus (P), and potassium (K), which accounts for all known measurable sources and removal of these nutrients.
- Sources of nutrients include, but are not limited to, commercial fertilizers (including starter and in-furrow starter/pop-up fertilizer), animal manures, legume fixation credits, green manures, plant or crop residues, compost, organic by-products, municipal and industrial biosolids, wastewater, organic materials, estimated plant available soil nutrients, and irrigation water.
- When irrigating, apply irrigation water in a manner that reduces the risk of nutrient loss to surface and ground water.
- Follow all applicable State requirements and regulations when applying nutrients near areas prone to contamination, such as designated water quality sensitive areas, (e.g., lakes, ponds, rivers and streams, sinkholes, wellheads, classic gullies, ditches, or surface inlets) that run unmitigated to surface or groundwater.

OPERATION AND MAINTENANCE

Review or revise plans periodically to determine if adjustments or modifications are needed. At a minimum, review and revise plans as needed with each soil test cycle, changes in manure management, volume or analysis, plants and crops, or plant and crop management.

Monitor fields receiving animal manures and biosolids for the accumulation of heavy metals and P in accordance with LGU guidance and State law. For animal feeding operation, significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment to ensure accurate distribution of material at planned rates. For products too dangerous to calibrate, follow LGU or equipment manufacturer guidance on proper equipment design, plumbing, and maintenance. Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation to explain the difference.

Protect workers from and avoid unnecessary contact with nutrient sources. Take extra caution when handling anhydrous ammonia or when managing organic wastes stored in unventilated tanks, impoundments, or other enclosures. Use material generated from cleaning nutrient application equipment in an environmentally safe manner. Collect, store, or field apply excess material in an appropriate manner. Recycle or dispose of nutrient containers in compliance with State and local guidelines or regulations.

Maintain records for at least 5 years to document plan implementation and maintenance. Records must include—

- All test results (soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient management plan is based.
- Listing and quantification of all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports and onsite transfers.
- Date(s), method(s), and location(s) of all nutrient applications.
- Weather conditions and soil moisture at the time of application, elapsed time from manure application to rainfall or irrigation event(s).
- Plants and crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and plant or crop residues removed.
- Dates of plan review, name of reviewer, and recommended adjustments resulting from the review.

For variable rate nutrient management plans, also include—

- Maps identifying the variable application location, source, timing, amount, and placement of all plant and crop nutrients applied.
- GPS-based yield maps for crops where yields can be digitally collected.

PRECISION AGRICULTURE

DEFINITION

Precision agriculture or site-specific crop management is a farming management strategy based on observing, measuring and responding to temporal and spatial variability to improve agricultural production sustainability.

PURPOSE

The goal of precision agriculture research is to define a decision support system for whole farm management with the goal of optimizing returns on inputs while preserving resources.

CONDITIONS WHERE PRACTICE APPLIES

The practice of precision agriculture has been enabled by the advent of GPS. The farmer's and/or researcher's ability to locate their precise position in a field allows for the creation of maps of the spatial variability of as many variables as can be measured (e.g. crop yield, terrain features/topography, organic matter content, moisture levels, nitrogen levels, pH, EC, Mg, K, and others). Similar data is collected by sensor arrays mounted on GPS-equipped combine harvesters. These arrays consist of real-time sensors that measure everything from chlorophyll levels to plant water status, along with multispectral imagery. This data is used in conjunction with satellite imagery by variable rate technology including seeders, sprayers, etc. to optimally distribute resources.

OPERATION AND MAINTENANCE

After data is collected, predictive analytics software uses the collected data to provide farmers with guidance about crop rotation, optimal planting times, harvesting times and soil management.

Agricultural control centers can integrate sensor data and imaging input with other data to provide farmers with the ability to identify fields that require treatment and determine the optimum amount of water, fertilizers and pesticides to apply.

This helps the farmer avoid wasting resources and prevent run-off, ensuring that the soil has the right number of additives for optimum health while also reducing costs and controlling the farm's environmental impact.

Some of the most popular applications for precision agriculture today include:

Agricultural mapping and field scouting. Drones equipped with cameras can create high-resolution maps of fields. This data can identify problem areas, track crops and assess yield

potential.

Soil sampling and analysis. Mobile apps can collect data about soil type, fertility, moisture content, and more. This information can decide about irrigation, fertilization and other aspects of crop management.

Weather monitoring. Hyperlocal weather data can help users decide when to plant, how much water to give crops and when to harvest.

Labor management. GPS-enabled mobile apps can track the location and activity of workers in the field. This data can optimize workflows and ensure that tasks are completed efficiently.
Equipment management. Agricultural equipment is expensive, and precision agriculture can help farmers keep track of their equipment, schedule maintenance and plan for repairs.

ANIMAL HUSBANDRY:

ANIMAL WASTE MANAGEMENT

DEFINITION

An animal waste management plan consists of information about manure production, storage, and use. Manure can be disposed offsite. All manure remaining on the farm should be spread according to a plan that distributes nutrients in manure on land according to the uptake rate of the various crops or grasses on the farm.

PURPOSE

Livestock and poultry farmers must maintain a balance between the nitrogen and phosphorus arriving and leaving the farm. These nutrients are contained in feed and fertilizer and leave the farm in animals, animal products, crops, and animal waste. If more nitrogen and phosphorus arrive on the farm than leave it, these nutrients accumulate in the soil. The potential for water quality degradation increases if these nutrients are carried away by storm water into streams and pond or seep into water wells.

CONDITIONS WHERE PRACTICE APPLIES

All animals and plants need nitrogen (N) and phosphorus (P), but when manure is not well managed these nutrients can degrade water quality.

OPERATION AND MAINTENANCE

These are the steps for construction of new waste storage impoundments (aka lagoons or ponds) operated at animal management facilities including Division-permitted CAFOs (Concentrated Animal Feeding Operations) or commercial slaughterhouses. Discharge permit eligibility for such facilities is listed in Nevada Administrative Code (NAC) 445A.228.

1. Submittal: Plans, drawings and technical specifications submitted to this office must be prepared by a Nevada-licensed Professional Engineer (P.E.) in accordance with the Nevada Administrative Code (NAC) 625.611. Please allow a thirty (30) day period for agency review and comment. A permit from the Division must be issued before the construction or modification of any regulated waste storage impoundment in accordance with the Nevada Revised Statutes (NRS) 445A.585.
2. CAFOs: Design of new storage impoundments for NDEP-permitted CAFOs shall incorporate a minimum thickness of a 60-mil geomembrane liner (HDPE, LLDPE or EPDM) and be designed and constructed in accordance with:
    a. NRCS Conservation Practice Standard Code 313, Waste Storage Facility, October 2003 or more recent;

b. NRCS Conservation Practice Standard Code 317, Composting Facility, October 2003 or more recent;
c. and/or, NRCS Conservation Practice Standard Code 359, Waste Treatment Lagoon, October 2003 or more recent, as appropriate. NDEP may require CAFO waste impoundments to be furnished with leak detection.

3. Slaughterhouses: Design of new storage impoundments for NDEP-permitted slaughterhouses shall incorporate a minimum thickness of a 60-mil geomembrane liner (HDPE, LLDPE or EPDM) and be designed and constructed in accordance with NDEP WTS-37: Guidance Document for the Design of a Lined Wastewater Holding Pond (Surface Impoundment). NDEP may also require slaughterhouse waste impoundments to be furnished with leak detection.
4. Clay Liners: New CAFO storage impoundments lined with a compacted bentonite clay liner (12 inch min. thickness) or a Geosynthetic Clay Liner (GCL) shall be limited to the storage of screened stormwater runoff with low nutrient content discharged from an area of the facility where manure has not been stored or accumulated. Clay liners shall meet an in-place hydraulic conductivity of 1 x 10-7 cm/sec. Clay liners should be maintained free of desiccation damage and periodically resealed with fresh borrow clay material to repair any holes, cracks or loss of liner materials from erosion or weathering.
5. Groundwater Separation: Minimum groundwater separation distance between the bottom of the proposed storage impoundment and the seasonal high groundwater table shall be 4 ft. or the design shall incorporate a liner ballast measure to protect liner uplift from high water table.
6. Floodwater: Plans for protection of the storage impoundment from floodwater erosion must be presented. The impoundment construction must be designed to withstand the run-off generated by the 24-hour storm event with a 100-year recurrence interval. The pond should remain operational after such an event, with no structural damage.
7. Floodplain: In accordance with NAC 445A.285, storage impoundments shall not be located within a 100-year floodplain unless protected from floodwaters and groundwater intrusion (uplift) to the satisfaction of the Division.
8. Water Balance: A water balance demonstration to properly size the storage impoundment must include adequate storage capacity for the maximum anticipated process wastewater flow events and the inflow (incident precipitation) from the 25-year, 24-hour storm event. A minimum freeboard of 2-feet is required for all CAFO storage impoundments unless it can be determined that wave action will not be a problem based upon a wave fetch analysis using local wind (meteorological) data. Surface evaporation loss for the water balance demonstration shall be applicable to the design location.
9. Cleaning: Storage impoundments shall be cleaned as needed, and maintained on a regular basis to maintain adequate storage capacity, freeboard requirements and liner integrity. Liners must be suitably protected when the impoundments are cleaned to remove manure, accumulated sludge and other debris. The liner inspections should record any repair or replacement activities before the impoundment is placed back into

service. Disposal of solid wastes, including manure composting for public distribution, is under the authority of the NDEP Bureau of Waste Management (BWM). Please contact the BWM office at (775) 687-9462 for further information regarding solid waste disposal.

10. Irrigation/Fertilization: Irrigation with effluent and land application of manure at CAFOs shall be conducted be in accordance with the Division-approved Comprehensive Nutrient Management Plan (CNMP). Other permitted land application sites shall be operated in accordance with the Division-approved Operations and Maintenance (O&M) Manual. Provision for adequate storage capacity in impoundments must be provided in the non-growing season (e.g. winter) to prevent groundwater degradation from the application of effluent when forage crop growth is dormant.
11. Gas Control: When used for high-strength (e.g. BOD5 or FOG) waste pre-treatment or the storage of gas (methane) production, appropriate covering and gas storage measures must be considered to limit the emission of malodorous (e.g. hydrogen sulfide) or flammable (e.g. methane) gases from anaerobic waste storage impoundments.
12. Aesthetics: The storage impoundment design shall consider good neighbor aesthetics including odor and vector (e.g. flies, mosquito) control. Impoundments creating a general public nuisance will not be allowed. The engineer's design must include a plan for achieving effluent limits, maintaining proper oxygen levels (e.g. aerobic digestion) and/or providing general odor control.
13. Security: Storage impoundments shall be adequately gated, fenced and posted to deter livestock or wildlife intrusion and prohibit unauthorized public access. Emergency egress features shall be incorporated for geomembrane liners (i.e. limited traction) or other impoundments posing a drowning hazard based on the design operating depth. It is strongly recommended that geomembrane liners be textured on the exposed side for personnel slip prevention
14. Monitoring: Effluent nutrient (nitrogen and phosphorus) levels and groundwater depth separation will be assessed by the Division in the decision to require or waive groundwater monitoring requirements at waste storage impoundment facilities. A typical groundwater monitoring network will include a minimum of one (1) upgradient and two (2) down-gradient monitoring wells installed in accordance with guidance document WTS-4. Prior to drilling, the Nevada State Engineer's office shall be contacted at (775) 684-2800 for approval of any new monitoring wells.
15. OSDS: Commercial septic systems (Onsite Sewage Disposal System or OSDS) are prohibited from receiving CAFO or slaughterhouse process wastewater flows in accordance with the Division's OSDS regulations. Review and approval of a facility's commercial septic systems shall be made through application to the NDEPBWPC Permits Branch. The website link for the NDEP-BWPC OSDS Program is: http://ndep.nv.gov/bwpc/uic_lcssinfo.htm
16. Dam Safety Permit: Construction of dams in the State requires filing an application form with the Nevada Division of Water Resources ((775) 684-2800). Any surface

impoundment storing a movable material with berm depth greater than 20 feet or storing a volume more than 20 acre-feet (AF) also requires a dam safety permit. The website link for the State's Dam Safety Permitting Program is: http://water.nv.gov/programs/dams/

BARNYARD RUNOFF MANAGEMENT

DEFINITION

A planned system to reduce, collect, and treat or utilize runoff from a barnyard, including concentrated livestock areas.

PURPOSE

To control the amount, rate, and quality of runoff or leachate from barnyards, including concentrated livestock areas.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies:

- As part of an Agricultural Waste Management System (Standard 312);
- Where the barnyard water runoff results in a potential for water pollution;
- Where barnyard soils, site conditions, and topography are suitable for successful implementation of the component practices.

CRITERIA

Planning

Runoff from barnyards must not be discharged directly into streams, watercourses, lakes, aquifers, or other water bodies. Necessary components must be planned and designed to eliminate most outside water from entering the barnyards. The runoff water discharged from barnyards shall be collected for treatment, utilization, or storage when a potential pollution hazard exists.

To minimize pollution potential, relocation, reduction, or elimination of the barnyard area will be evaluated, especially where a stream or watercourse flows through or is adjacent to the site. All federal, state, and local laws, rules, ordinances, and regulations governing waste management, pollution abatement, health, and safety shall be followed.

General Design

Barnyard runoff management systems shall be designed in accordance with the individual practice standards, and be compatible with each other in capacity and function. The system will be designed to be capable of handling the 25 year, 24 hour storm event.

Outside Water Exclusion

All components that are needed to keep uncontaminated runoff from entering the barnyard shall be installed. This includes runoff from:

1. Outside land area: Runoff from outside land areas shall be excluded from the barnyard

area by use of diversions (NRCS Conservation Practice Standard 362), drop inlets with underground outlets (NRCS Conservation Practice Standard 410), etc. Practices that divert clean runoff from barnyards and manure storage facilities shall be designed for the 25 year, 24 hour storm event.

2. Roof runoff: Runoff from roof areas draining to barnyards shall be excluded using NRCS Conservation Practice Standard 558, Roof Runoff Management System.
3. Ground water seepage: Ground water seepage shall be intercepted by a drainage system sized to carry the anticipated seepage water. Installation of drainage systems in the vicinity of silos and barnyards shall not allow silage juices or contaminated barnyard water to enter clean water drainage systems. Conduits under farm roadways or concentrated tractor traffic areas shall withstand the intended load. Refer to NRCS Conservation Practice Standard 606, Subsurface Drainage.
4. Other water sources: Measures will be installed to prevent all other water sources, such as overflowing waterers or cooling water from draining into the barnyard.

Polluted Water Control

Polluted runoff and seepage from a barnyard shall be excluded from all watercourses and streams. This may be accomplished by one or more of the following:

- Barnyard Relocation: Relocate the barnyard to an area that minimizes the risk of polluted runoff.
- Barnyard Size Reduction: Evaluate the purpose of the barnyard and size.
- Barnyard Grading: The barnyard shall be graded when there is a need to redirect the runoff to an acceptable land area or collection point for storage or treatment. Any animal waste and loose soil mixture will be removed to expose a suitable foundation for subgrade preparation. This material shall be disposed of in a suitable manner.
- Barnyard Paving: Barnyards shall be paved with a durable material suitable to the intended use of the paved area. Paving allows for easier cleaning and scraping, improves cleanliness of the animals, and minimizes animal hoof discomfort. The choice of paving material will depend on the amount and type of animal or vehicle traffic, scraping frequency, and the costs of installation and maintenance.

Subgrade Preparation and Base Course:

The subgrade shall provide uniform support to the paving. For concrete slabs, if the subgrade is a soil other than free draining SW, SP, GW or GP (Unified Soil Classification System), then a compacted base course with a minimum thickness of 6 inches shall be placed on the compacted subgrade and beneath the slab. The base course shall consist of granular material (sand, gravel, crushed stone, or sand/gravel mix) meeting quality and gradation requirements.

For concrete slabs where control of cracking is critical for the use and maintenance of the slab, the base course shall either be compacted sand, or gravel or stone with a minimum of 1 inch of compacted sand added to the top of the gravel or stone to reduce slab friction and cracking potential. The water table shall be maintained below the subbase layer, or at least one foot below the bottom surface of the paving if no subbase is required.

Gravel Paving:
Gravel paving shall be considered where redirection of runoff is not critical for collection and in areas where scraping is infrequent. A nonwoven geotextile material shall be specified for placement on the completed subgrade prior to placement of the gravel paving. The top course of gravel shall be a minimum of 6 inches in thickness where travel is intermittent and scraping is very infrequent. On more heavily used areas, the thickness shall be at least 12 inches. A thicker top course layer can prolong the time before repaving is needed.

Other comparable gradations may be used if previously approved by an NRCS engineer. The frequency of scraping, the cost of gravel material, and maintenance cost of gravel replacement shall be considered when selecting the gravel material to be used. Rock dust may be added to the gravel to provide a smoother and more impervious surface.

Concrete Paving, Non-reinforced:
Non-reinforced concrete slabs may be used for slabs subjected to animals only, or to vehicle/equipment loads of less than 10,000 lbs. gross weight. Non-reinforced slabs shall have a minimum thickness of 4 inches with control joints at a maximum spacing of 10 feet, or 5 inches thick with a maximum control joint spacing of 15 feet. The control joints shall be constructed to a depth of 1/4 of the slab thickness. The coarse aggregate in the concrete mix shall have a maximum size of at least ¾ inch. However, a 1-inch maximum coarse aggregate size for 4-inch slabs, or 1½ inch aggregate for 5-inch slabs is recommended to reduce cracking potential.

The minimum compressive strength shall be 3,000 lbs. The slump of the concrete shall be specified to be between 3 and 5 inches when placed. Isolation (expansion) joints shall be placed wherever the slab abuts fixed objects, such as walls, columns, and footings. Construction joints in the slab shall consist of a butt joint with a bond preventer placed between the pours. All construction joints shall conform to the floor control jointing pattern (10 feet for 4-inch slabs or 15 feet for 5 inch slabs), and/or isolation joint pattern. The surface of the concrete shall be roughened for better traction. Concrete slabs subjected to vehicle or equipment loads in excess of 10,000 lbs. shall have reinforcement.

Concrete Paving, Reinforced:
Slab designs shall be based on ACI360R92, “Design of Slabs-On-Grade”. Slab thickness and compressive strength shall be based on the anticipated loading on the slab, but shall be a minimum of 5 inches thick with a minimum compressive strength of 3,000 lbs. Reinforcing steel size and expansion joint spacing shall be based on the subgrade drag theory. The choice of reinforcing steel (bars or wire mesh) to be specified for a job shall consider the requirement that the steel must be supported at a depth of between 2 and 2.5 inches from the top of the slab during and after placement of the concrete. Rolled wire mesh shall not be used. The coarse aggregate in the concrete mix shall have a maximum size of at least ¾ inch. However, when control of cracking is critical for the use and maintenance of the slab, a 1½ inch maximum coarse aggregate size shall be used. The slump of the concrete shall be specified to be between 3 and 5 inches when placed.

Isolation (expansion) joints shall be placed wherever the slab abuts fixed objects, such as walls, columns, and footings. Control joints are not required. If control joints are installed, the reinforcing steel must be discontinued across the joint. The surface of the concrete shall be roughened for better traction.

Bituminous Paving:
The subbase material and thickness, the thickness of the asphalt course, the kind and size of aggregate, the type of proportioning of bituminous materials, and the mixing and placing of these materials shall be in accordance with Specification for Highways and Bridges for the expected loading.

5. Runoff Control: When barnyard runoff presents an actual or potential pollution hazard, the runoff shall be collected and transferred to a filter area or a storage facility.

Collection and Transfer:
Paved barnyards shall have adequate curbs to prevent solids from leaving the pavement during cleanup. The pavement and curbing shall direct the runoff to desired collection point(s).
Curbing may be constructed of concrete, asphalt, wood, earth or other durable material. Curbing shall resist scouring and overturning forces of manure scraping and handling equipment. If the barnyard runoff will be directed to a filter area, then a settling basin or other settling facility must be incorporated into the system to ensure that settleable solids are not carried to the filter area. The settling facility shall be designed to hold the solids resulting from a 25 year, 24 hour storm event from the contributing area. The settling facility must be designed for ease of cleanout. The barnyard may be graded and shaped so that the settling facility is incorporated into the barnyard itself. If the barnyard runoff is to be transferred to a waste storage facility, a settling facility is not required.

Filter Area:
A filter area for barnyard runoff shall conform to the criteria set forth in NRCS Conservation Practice Standard 393, Filter Strip. To prevent continual flows onto the grass filter, positive control of urine and other liquid sources must be achieved. The filter area shall be vegetated and functioning prior to the use of any paving that could contribute polluted runoff to the filter, unless provisions are incorporated to prevent polluted runoff from leaving paved areas until the filter area vegetation is established.

Storage and Treatment:
Barnyard runoff storage facilities shall conform to the criteria in NRCS Conservation Practice Standard 313, Waste Storage Facility. The storage facility shall be installed prior to or concurrently with those paved areas that contribute waste to the facility.

6. Silage Leachate: Where leachate from silage is entering surface or ground waters, silage leachate control measures will be provided as part of the overall barnyard runoff management system. Concentrated silage leachate must be either stored for later

application directly on cropland in an environmentally sound manner, or combined with other animal waste in a storage facility. Caution should be used if silage leachate is diverted to a manure storage facility. Silage juices combined with manure may produce toxic gases, and can be hazardous in enclosed spaces or other areas that are not well ventilated. Concentrated silage leachate will kill vegetation, therefore it must not be directed to a filter area. Only leachate resulting from rainfall, which is highly diluted, may be applied to a filter area. Refer to NRCS Conservation Practice Standard 393, Filter Strip, for design criteria.

Fencing:
The barnyard shall be fenced to contain livestock in accordance with NRCS Conservation Practice Standard 382, Fencing, and to exclude them from filter areas, settling facilities, and storage facilities.

CONSIDERATIONS

Minimize the amount of barnyard paving to what is required for pollution control. Barnyard paving will increase the amount of runoff that must be stored or treated. The use of an intensive rotational grazing system to reduce or eliminate large barnyards should be considered where appropriate.

PLANS AND SPECIFICATIONS

Plans and specifications for barnyard runoff management shall be prepared to show measures needed to meet the requirements of Outside Water Exclusion and/or Polluted Water Control portions of this standard, and the standards of all component practices. The sequence of installation shall ensure that all outside water exclusion practices are installed before or simultaneously with any other components for pollution water control.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be provided to the owner or operator that includes the following general recommendations, as applicable. Specific recommendations particular to the job being installed, but not covered by the following shall be added:

- Barnyard scraping interval. Cleaning should be done daily to weekly, depending on manure deposition rates.
- Collection and treatment requirements.
- Cleaning of settling basins after runoff events to minimize manure solids entering filter areas or leaving the barnyard.
- Periodic inspection and repair of surface paving materials, curbing, clean water diversions and structures, roof gutters and downspouts, fencing, vegetated areas, and other appurtenances.
- On gravel barnyards, regrading may be needed on a periodic basis. Replacement of the

gravel surface will be necessary, depending on the type of gravel surface and the type and frequency of scraping.

- Refer to the operation and maintenance requirements of component practices in their respective practice standards, and include them in one overall operation and maintenance plan for the barnyard.

LIVESTOCK STREAM CROSSING

DEFINITION

A stabilized area or structure constructed across a stream to provide controlled access for people, livestock, equipment, or vehicles.

PURPOSE

This practice is applied to:

- Improve water quality by reducing sediment, nutrient, or organic loading to a stream.
- Reduce streambank and streambed erosion.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where:

- An intermittent or perennial watercourse (stream) exists.
- Controlled access from one side of the stream to the other side is necessary to reduce or eliminate environmental degradation.
- Soils, geology, fluvial geomorphology, and topography are suitable for construction of a stream crossing.

CRITERIA

General Criteria Applicable to All Purposes

Apply this standard in accordance with all Federal, State, Tribal, and local regulations, including floodplain regulations, and flowage easements. Identify significant cultural resources or threatened or endangered species that could be affected by the implementation of the practice. The landowner/contractor is responsible for locating all buried utilities in the project area, including drainage tile and other structural measures. Do not create a passage barrier where aquatic species are present and using the stream.

Location

Locate the stream crossing in an area where the streambed is stable or where the streambed can be stabilized (see NRCS Conservation Practice Standard (CPS) Channel Bed Stabilization (Code 584); and Title 210, National Engineering Handbook (NEH) Part 650, Chapter 16, “Streambank and Shoreline Protection”). Do not place a crossing where the channel grade or alignment changes abruptly, excessive seepage or instability is evident, overfalls exist (evidence of incision and bed instability), where large tributaries enter the stream, or within 300 feet of known spawning areas of listed species. Install the stream crossing perpendicular to the direction of stream flow where possible. Consider potential future lateral migration of the stream in developing the design. Avoid the use of or minimize the number of stream crossings through evaluation of alternative trail or travel-way locations, and land user operations. Where feasible,

use existing roads. Discourage livestock loafing in the stream by locating crossings, where possible, out of shady riparian areas or by including gates in the design.

Access road crossings
Where the stream crossing is installed as part of an access road, design the crossing in accordance with CPS Access Road (Code 560) and Title 210, National Engineering Manual (NEM), Part 536 "Structural Engineering."

Width
Provide an adequate travel-way width for the intended use. Make a "livestock-only" crossing no less than 6 feet wide and no more than 30 feet wide, as measured from the upstream end to the downstream end of the stream crossing, not including the side slopes.

Side slopes
Make all side slope cuts and fills stable for the channel materials involved. Make the side slopes of cuts or fills in soil materials no steeper than 2 horizontal to 1 vertical (2:1). Make rock cuts or fills no steeper than 1.5 horizontal to 1 vertical (1.5:1).

Stream approaches
Where possible, blend approaches to the stream crossing with existing site topography. Use streambank soil bioengineering practices and other streambank stabilization measures such as CPS Streambank and Shoreline Protection (Code 580) as appropriate and feasible. Design stable approaches, with gradual ascent and descent grades that are no steeper than 4 horizontal to 1 vertical (4:1). Construct approaches with suitable material to withstand repeated and long-term use. Design the minimum width of the approaches equal to the width of the crossing surface. Divert surface runoff around the approaches to prevent erosion. Use CPSs Diversion (Code 362), Structure for Water Control (Code 587), Lined Waterway or Outlet (Code 468), or Grade Stabilization Structure (Code 410) as needed.

Rock
Use only rock that is sound, durable, and able to withstand exposure to air, water, and freezing and thawing. Use rock of sufficient size and density to resist mobilization by design flood flows. Use appropriate rock sizes that will accommodate the intended traffic without causing injury to livestock or people, or damage to vehicles using the crossing. For a rock livestock crossing, use a hoof contact zone or alternative surfacing method over the rock.

Fencing
Exclude livestock access to the crossing using fence and gates, as needed. Install cross- stream fencing at fords, with breakaway wire, swinging floodgates, hanging electrified chain, or other devices to allow the passage of floodwater and large woody material during high flows. Design and construct all fencing in accordance with CPS Fence (Code 382).

Vegetation
As soon as practical after construction, vegetate highly disturbed areas in accordance with CPS Critical Area Planting (Code 342). In areas where the vegetation may not survive, use CPS Heavy Use Area Protection (Code 561).

Criteria Applicable to Bridge Crossings
Design the bridge in a manner that is consistent with sound engineering principles and adequate for its intended use. Refer to 210-NEM, Part 536. Design the bridge to fully span the stream, passing at least the bank-full flow where the design flow is not dictated by regulations. At design flow capacity, the structure must convey stream flow, sediment, and other materials without appreciably altering stream flow characteristics and pass the design flow without causing erosion or overtopping of the structure.

For all bridge crossings, perform a geologic subsurface investigation that is in sufficient detail and analysis to support the design. Describe the soil material observed, subgrade conditions, bearing capacity, and depth to bedrock; and any geologic conditions or hazards that needs to be addressed in the design, construction, or operation of the bridge Refer to 210- NEM, Part 531, "Geology." Adequately protect the bridge so that flows exceeding the bridge's flow capacity can safely bypass without damaging the bridge or eroding the streambanks. Follow requirements in 210-NEM, Part 536 on acceptable bridge materials and necessary safety measures.

Criteria Applicable to Culvert Crossings
Design the culvert in a manner that is consistent with sound engineering principles and adequate for its intended use. If the culvert is not associated with a road crossing, design the culvert to have sufficient capacity to pass at least the bank-full flow or the 2-year, 24-hour storm flow, whichever is greater, without appreciably altering stream flow characteristics. Adequately protect the culvert crossing so that flows in excess of culvert capacity can safely bypass the structure without damaging it, or eroding the streambanks or crossing fill material. Do not use culverts in locations where large flows of sediment or large woody material are expected, or where the channel gradient exceeds 6 percent (100 horizontal to 6 vertical).

At least one culvert pipe must be placed with its entire length set 6 inches below the existing stream bottom. Additional culverts may be used at various elevations to maintain terrace or floodplain hydraulics and water surface elevations. The length of the culvert system must be adequate to extend the full width of the crossing, including side slopes, and inlet or outlet extensions. Acceptable culvert materials include concrete, corrugated metal, corrugated plastic, new or used high quality steel, and any other materials that meet requirements of CPS Pond (Code 378). Evaluate the need for safety measures such as guardrails at the culvert crossing.

Criteria Applicable to Ford Crossings
Ford crossings have the least detrimental impact on water quality when their use is infrequent. Ford crossings are adapted for crossing wide, shallow watercourses with firm streambeds. Do not place ford crossings immediately downstream from a pipe or culvert because of potential damage

from localized high-velocity flows. Use a culvert crossing or curbed bridge if the stream crossing is to have frequent or daily use, such as in a dairy operation.

Ensure that the cross-sectional area of the crossing is equal to or greater than the natural channel cross-sectional area. To the extent possible, design the top surface of the ford crossing to follow contours of the streambed. Slope the crossing toward the center of stream to provide a thalweg (low-flow) channel. Where possible, recess the subgrade of the stream crossing so that the constructed surface of the crossing is at or below the original surface of the streambed. Never construct the top surface of the ford crossing to be higher than 0.5 feet above the original streambed at the upstream edge.

Where possible, design the downstream edge of the ford crossing to be at exactly the same elevation as the original streambed. Never install the downstream edge with a low-flow hydraulic drop greater than 0.5 feet above the original stream bottom. Provide cutoff walls at the upstream and downstream edges of the ford when needed to protect against undercutting.
Evaluate the need for water depth signage.

Concrete fords
Use a concrete ford crossing only where the foundation of the stream crossing has adequate bearing strength. Perform a subsurface investigation that is in sufficient detail and analysis to support the design. Describe the soil material observed, subgrade conditions, bearing capacity, and depth to bedrock. Refer to 210- NEM, Part 531, Subpart B, "Engineering Geology."
Use a minimum thickness of 5 inches of placed concrete. Construct the concrete slab on a minimum 4- inch-thick gravel base, unless the foundation is otherwise acceptable. Refer to 210-NEM, Part 536 for design criteria.

Dewatering of the site and toe walls is required during placement of the concrete to lessen the potential for segregation and to maintain the proper water/cement ratio. Flowing water will erode concrete that is not sufficiently hardened. The stream must be diverted or retained from flowing over the concrete until the concrete makes its final set, and a minimum of 12 hours after placement of the concrete. Construct toe walls at the upstream and downstream ends of the crossing. Make the toe walls a minimum of 6 inches thick and 18 inches deep. Extend the toe walls in the stream approaches to the bank-full flow elevation.

Rock fords and the use of geosynthetic materials
In steep areas subject to flash flooding and where normal flow is shallow or intermittent, use coarse aggregate or crushed rock at ford crossings. When the site has a soft or unstable subgrade, use geotextiles to improve the foundation bearing capacity in the design of rock ford crossings. Select geotextile material for separation and stabilization according to American Association of State Highway and Transportation Officials (AASHTO) M-288. Dewater and excavate the bed of the channel to the necessary depth and width and cover with geotextile material. Install the geotextile material to extend across the bottom of the stream and, at least, up the side slopes to at least the bank-full flow elevation.

Use durable geosynthetic materials and install them according to the manufacturer's recommendations, including the use of staples, clips, and anchor pins. Cover the geotextile material with at least 6 inches of crushed rock. Use minimum 6-inch-deep geocells if geocells are installed. Design the rock ford stream crossing to remain stable for the bank-full design flow. Compute channel velocities and choose rock size using procedures and guidelines set forth in the appropriate section in 210-NEH, Part 630, "Hydrology;" 210-NEH, Part 654, Technical Supplement (TS) 14N "Fish Passage and Screening Design;" and 210-NEH 650, Chapter 16, Appendix 16A, "Size Determination for Rock Riprap," or other procedures approved by the State conservation engineer.

CONSIDERATIONS

For culvert crossings, consider incorporating natural streambed substrates throughout the culvert length for passage of aquatic organisms. See Bunte and Abt, (2001) for sampling procedures. Natural streambeds provide passage and habitat benefits to many life stage requirements for aquatic organisms and may reduce maintenance costs.

Consider including a well-graded rock riprap apron on the downstream edge of concrete crossings to dissipate flow energy. Consider all life stages of aquatic organisms in the stream crossing design to accommodate their passage, in accordance with the species' requirements. NRCS aquatic organism passage standards can be found in CPS Aquatic Organism Passage (Code 396). Design criteria are available in 210-NEH, Part 654, TS 14N; Clarkin, Keller, et.al, (2006); and Forest Service stream simulation guidance (USFS, 2008). Also, see Harrelson, et al. (1994), for stream reference site descriptions. Consider the habitat requirements of other aquatic or terrestrial species that may be affected by construction of a stream crossing. For example, a crossing may be designed with features that also promote safe crossing by terrestrial vertebrates.

For concrete fords, consider using precast concrete panels in lieu of cast-in-place concrete slabs. To the extent possible, the panels must follow the contours of the streambed in order to avoid potential problems with sediment accumulation. As with the poured-in-place concrete, install a gravel base and toe walls.

Locate stream crossings to avoid adverse environmental impacts and consider—

- Using the "riffle" section of the stream for the proposed crossing, for it is frequently one of the most stable sections of a stream. When riffles are not present, consider using a stable straight reach.
- Effects of large woody material on the operation and overall design of the crossing.
- Short-term and construction-related effects on water quality.
- Overall effect on erosion and sedimentation that will be caused by the installation of the crossing and any necessary stream diversion.
- Effects on upstream and downstream flow conditions that could result in increases in erosion, deposition, or flooding. Consider habitat upstream and downstream of the crossing to avoid fragmentation of aquatic and riparian habitats.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for stream crossings in accordance with this standard. Clearly describe the requirements for applying the practice to achieve its intended purpose in the plans and specifications must as a minimum, include the following in plans and specifications:

- Location of stream crossing.
- Stream crossing width and length with profile and typical cross sections.
- Thickness, gradation, quantities, and type of rock or stone.
- Type, dimensions, and anchoring requirements of geotextile.
- Thickness, compressive strength, reinforcement, and other special requirements for concrete, if used.
- Applicable structural details of all components, including reinforcing steel, type of materials, thickness, anchorage requirements, lift thickness, covering.
- Load limits for bridges and culverts.
- Vegetative requirements that include seed and plant materials to be used, establishment rates, and season of planting.
- Location, type, and extent of fencing required.
- Method of surface water diversion and dewatering during construction or a statement making the contractor responsible for selecting such.
- Location of utilities and notification requirements.
- Additional site-specific considerations.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan and implement it for the life of the practice. Include the following items in the operation and maintenance plan, as a minimum:

- Inspect the stream crossing, appurtenances, and associated fence at least annually and after each major storm event. Make repairs, if needed.
- Remove any accumulation of organic material, woody material, or excess sediment.
- Replace surfacing stone used for livestock crossing as needed.

LIVESTOCK GRAZING:

NONSTRUCTURAL & STRUCTURAL RANGE IMPROVEMENTS

DEFINITION

A nonstructural range improvement is a temporary change to grazing lands (seedings or prescribed burns are examples). Fences or facilities, such as wells or water pipelines, are examples of structural improvements. Many structural improvements are considered permanent, as they are not easily removed from the land.

PURPOSE

Structural improvements enhance livestock grazing management, improve watershed conditions, enhance wildlife habitat, or serve similar purposes.

OFFSITE WATER DEVELOPMENT

DEFINITION

Constructing or creating a water source for cattle, away from existing waterbodies, that is beneficial for cattle, wildlife, and riparian health.

PURPOSE

Water development in upland areas that lack water can be a key factor in reducing livestock concentrations in riparian areas. Off-site watering systems that offer clean water increase cattle productivity and weight gain and require frequent and potentially daily monitoring.

CONSIDERATIONS

- Larger pastures where cattle travel a longer distance to water will require a higher capacity watering system as cattle tend to water in larger groups.
- To achieve more uniform pasture utilization in high density grazing systems, the ideal distance to water is about 800 feet. In more extensive rangeland systems, typical advice is that cattle should not have to travel farther than about two miles on flat land and no more than one mile on rugged terrain to water.
- Pasture pipeline systems allow for watering throughout a pasture instead of cattle traveling to a central watering system.
- Both ground and surface water sources can be used for off-site watering systems, but ground water sources are the most reliable as long as they are accessible.
- Electricity is the most reliable power source. If using an alternative power source, it is important to have a backup plan in case there is a malfunction in the off-site watering system.
- Off-site watering systems can be used during the winter, but adaptations to the system and frequent monitoring are necessary to prevent freezing.

HOLISTIC/ADAPTIVE GRAZING

DEFINITION

A grazing practice that typically uses high-intensity rotation of animals through many paddocks, continually adapted through planning and monitoring.

PURPOSE

Rather than following a set protocol, the rancher learns to make changes according to current conditions, feedback from the environment, and specific goals and objectives. Generally speaking, the over-arching goal is to avoid over-grazing by using methods that attempt to mimic the patterns of wild migrating herds.

CONSIDERATIONS

The animals stay packed closely together for protection, eat the vegetation to partial level (rather than all the way to the ground), disturb the soil lightly with their hooves (which mixes their manure and urine into the top soil), and then move on to another paddock or pasture. In this way, grazing animals actually improve the condition of the soil rather than damaging it, and a significant amount of carbon can be sequestered because the land is always kept covered and the roots and soil microbiome are nourished and left mostly undisturbed.

PLANNED GRAZING SYSTEM

DEFINITION

A livestock/wildlife grazing system in which two or more grazing units are alternately deferred or rested from grazing in a planned sequence over a period of years. The rest period may vary in duration given the specifics of the grazing area (i.e. season, year, etc.).

PURPOSE

1. To maintain or improve plant cover, plant composition and forage production while properly using the forage on all grazing units.

2. To improve efficiency of grazing by uniform use of all parts of each grazing unit.

3. To provide a supply of forage throughout the grazing season.

4. To improve the quality of forage available to animals during specific seasons.

5. To protect watersheds, reduce runoff and sedimentation for the improvement of surface and ground water quality.

6. To improve wildlife habitat.

APPLICABILITY

Applies to native grazing lands, including those treated by spraying, seeding, etc., grazable woodlands and grazed wildlife lands. Grazing management may be applied to a single grazing unit and may be adequate to meet water quality objectives where proper grazing use and uniform distribution can be obtained.

PLANNING CRITERIA

The grazing system plan should:

1. Consider the climate, soils, range sites, present vegetative conditions, topography and other ecological conditions.

2. Allow forage use allocation for livestock and wildlife.

3. Be coordinated among all effected interests and natural resources. A "watershed" view should be established to identify all of the resources and interests. The coordinated approach should include federal land management agencies, state agencies, private land owners, other grazing users and applicable special interest groups. A variety of Resource Management and/or grazing systems are available given the specifics of the site including Holistic Resource Management, Coordinated Resource Management, and Savory Grazing Systems, to mention a few.

4. Consider specific management measures to alleviate livestock distribution problems such as concentrated use of riparian areas or other critical areas.

5. Should consider the kinds of livestock and the operator's objectives in conjunction with the federal land management objectives if the plan involves public lands.

6. Allow for practical application of the system and be flexible enough to meet the needs of key plant species and communities in relation to climatic fluctuations.

7. Consider the facilities needed for proper distribution and uniform use of grazing units such as fences, stock water developments, stock trails, access roads, salt, and supplemental feeding stations.

8. Provide for prolonged drought or other unusual circumstances. A monitoring plan should be included which monitors plant species use and condition with respect to the desired condition.

9. Consider economic costs in relation to the benefits expected from the entire system.

METHODS AND MATERIALS

1. **Grazing Management Systems** - Appropriate grazing management systems ensure proper grazing use by adjusting grazing intensity and duration to reflect the availability of forage and feed designated for livestock uses, and by controlling animal movement through the operating unit of range or pasture. Practices that accomplish this include:

   A. Deferred grazing - usually is defined as the postponing or resting of livestock grazing on an area for a prescribed period to provide for plant reproduction, establishment of new plants, or restoration of vigor to existing plants.

   B. Deferred-rotation grazing - Provides for a systematic rotation of deferment among two or more units.

C. Rest-rotation grazing - Provides for adequate rest to restore and maintain plant vigor, reduced trampling of mature seeds after plant maturity, and establishment of seedlings. Grazing and rest are systematically rotated until all pastures within the system have received treatment. Rest periods may be throughout the year, during the growing season of key plant species or may include one full year of rest.

2. **Livestock Distribution** - Proper distribution of livestock is needed for the efficient and uniform use of each grazing unit. A livestock operator can implement the management practice of herding or moving livestock when the desired plant use has been attained in a given area:

A. Fencing - Fences are usually required for livestock control and to divide ranges into grazing units of near equal capacity. Fences are also needed to exclude livestock from sensitive or critical areas. (See Appendix G-5 for fencing guidelines and specifications)

B. Stockwater Developments - It is essential to provide adequate water for livestock within reasonable distance of the grazing areas. Implementation of an improved grazing system often concentrates livestock requiring development of new or higher capacity watering facilities. In some applications water alone can be controlled to move livestock from one area to another.

There are several methods of developing stock water, including:

(1) Spring developments - Improving springs and seeps by excavating, cleaning, capping or providing collection and storage facilities.

(2) Wells - Constructed or improved to meet the needs of livestock and wildlife.

(3) Stockwater ponds and dugouts - A water impoundment made by constructing a dam or an embankment, or by excavation of a pit or dugout.

(4) Pipelines, trough or tank - Pipeline to convey water to areas with no water source and a trough or tank for storage.

(5) Photovoltaic pumping systems.

(6) Ram pumps.

(7) Windmills.

C. Stock Trails - May be needed where natural or man-made barriers limit access and movement of grazing animals. (See Appendix G-4 for guidelines and specifications for stock trails)

D. Salt, Mineral and Feed Supplement Locations - These need to be properly placed for good distribution of grazing animals throughout each grazing unit. They may be placed in light use areas away from water.

3. **Access** - It is necessary to have good access to all grazing areas for livestock management and to service and maintain facilities. Refer to NRS.535.010 on permit requirements for stock watering ponds and dams.

MAINTENANCE

Proper grazing use will maintain enough live vegetation and litter cover to protect the soil from erosion; will achieve riparian and other resource objectives; and will maintain or improve the quality, quantity and age distribution of desirable vegetation. Maintain fences and other facilities for efficient operations. Follow proper grazing use, that is, grazing at an intensity that will maintain plant cover and maintain or improve the quantity and quality of desirable vegetation. Adjust system plans based on inspection and records of utilization.

EFFECTIVENESS

A properly operated grazing system provides for efficient use of forage and is an effective means of maintaining a plant cover that will reduce runoff and sediment delivery. How effective grazing management will be is dependent upon both the quality of the design in relation to the land and the skill utilized to implement, monitor and adjust management to meet objectives.

RANGE IMPROVEMENTS

DEFINITION

Improving the existing rangeland through specific treatments including seeding, planting, prescribed burning, and brush/weed management.

PURPOSE

To improve watershed quality, conserve soil and water resources and reduce sediment delivery; produce forage for livestock and wildlife; improve plant species diversity; and improve recreation, wildlife and the natural resource values of the land.

APPLICABILITY

Applies to grazing lands: where the land does not have enough desired plant species diversity to recover in a reasonable period by management alone; where existing vegetation would out compete introduced plant materials; following wildfires or brush management treatment, and where soil, climate, and topography are suitable for establishment of the desired plant community.

PLANNING CRITERIA

Compile the necessary base line data to determine the specific range improvement best suited for the site. Consultation with a qualified range management professional in the private or public sector is recommended.

1. Determine site suitability for seeding or containerized planting - slope, soils, elevation, available moisture, etc.

2. Select species for seeding or planting that are adapted to the site. Mixtures of grasses, forbs, shrubs, etc. are better than single species plantings on most sites.

3. Determine the requirements for acceptable methods of site preparation, soil amendments, planting or seeding.

METHODS AND MATERIALS

The following practices can be utilized to improve rangelands (See Appendix G).

Pasture and Hayland Plantings - Establishing and reestablishing long-term stands of adapted species of perennial, biannual, or reseeding forage plants.

Range Seeding - Establishing adapted plants by seeding on native grazing land.

1. On tillable land, the soil should be tilled with a rangeland plow, chisel plow, or one-way disk. Depth should be as shallow as possible while still eliminating competing vegetation. Double plow if necessary. Perform operations across the slope or on the contour.

2. Pitting or contour furrowing may be used in special situations where complete tillage is not practical or desired, or where other tillage methods would create serious erosion hazards. Chain drags can be used where plowing is not feasible.

3. Tillage operations should leave as much plant residue on the soil surface as possible for seedling protection, moisture conservation and erosion control.

4. Seed with a rangeland drill or, on well-prepared seed beds, a grain drill equipped with agitator and depth regulators. Broadcast seed only on areas that are too rocky or where seeding is not practical for other reasons.

5. Fall or early winter seedings are best. Spring seedings can be used on small areas or sites that remain wet and cold into late spring. (See Cooperative Extension Publication C - 183 for species, mixtures, and seeding rates.)

Critical Area Planting - Planting vegetation, such as trees, shrubs, vines, grasses or legumes on highly erodible or critically eroding areas.

Brush and Weed Management - Managing and manipulating stands of brush and weeds on range, pasture and other areas by mechanical, chemical, biological means or by prescribed burning (See Appendix G-7).

Prescribed Burning - Applying fire to predetermined areas when the intensity and spread of the fire are controlled. (See BMP 6-6, "Prescribed Use of Fire").

MAINTENANCE

1. Seedings must not be grazed until the plants are well established. Usually it is necessary to protect seedings from grazing for one full year and through the growing season of the second year. Some seedings established during adverse weather cycles may need protection for a longer period.

2. After seedings are established, follow established grazing management practices.
(See BMP - 7-9 - "Proper Grazing Use" and BMP - 7-8 - "Planned Grazing System")

EFFECTIVENESS

Well established and managed range seedings protect watersheds from excessive runoff, reduce runoff, reduce erosion and sediment delivery.

IRRIGATION AND DRAINAGE

TAILWATER-RETURN FLOW MANAGEMENT

DEFINITION

Water running off the tail end of a field, as part of normal furrow or border strip irrigation practices, is referred to as tailwater. Tailwater is necessary, especially in furrow irrigation, to adequately irrigate the lower end of a field since sufficient infiltration time is required to allow the desired amount of water to infiltrate.

PURPOSE

Tailwater can be retained on the end of the field using soil berms, and it can be a good management practice to collect and reuse for irrigation.

PLANS AND SPECIFICATIONS

Advantages of tailwater reuse:

- Environmental impacts of tailwater leaving the property are minimized.
- Irrigation efficiency is improved since tailwater is beneficially reused as irrigation water.
- Water costs may be reduced by reusing tailwater. This may be especially important where water costs are high.
- Irrigation water management for flood systems which have no ready outlet for tailwater can be simplified since irrigations, especially those at night, do not need to be as closely monitored to prevent tailwater runoff.
- Tailwater collection systems remove standing water, which can result in crop loss and weed infestations, from the tail end of the field. Border strip-irrigated alfalfa and furrow irrigated corn are examples of where this is commonly done.

Disadvantages of tailwater reuse:

- There is a cost required for installation, maintenance, and operation of the tailwater return system. Land must be taken out of production for the pond and other tailwater recovery system components.
- Good management, requiring timely recycling of tailwater pond contents, is necessary to prevent groundwater pollution by nutrients or chemicals in the tailwater.

SUBSURFACE DRAINAGE

DEFINITION

A conduit installed beneath the ground surface to collect and convey excess water.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Remove or distribute excessive soil water.
- Remove salts and other contaminants from the soil profile.
- Mitigate degraded plant condition, undesirable plant productivity, and health due to saturated soil, ponding, and flooding.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where a shallow water table exists and where a subsurface drainage system can mitigate one or more of the following adverse conditions caused by excessive soil moisture:

- Poor health, vigor, and productivity of plants.
- Poor field trafficability.
- Accumulation of salts in the root zone.
- Health risk and livestock stress due to pests.
- Wet soil conditions around farmsteads, structures, and roadways.
- This practice also applies to water distribution through subsurface drainpipe for utilization or treatment.

PLANS AND SPECIFICATIONS

When planning, designing, and installing this practice, consider:

- Protection of shallow drains, auxiliary structures, and outlets from damage due to freezing and thawing.
- Proper surface drainage to reduce the required capacity of the subsurface drainage system.
- Designs that can incorporate drainage water management practices (or facilitate future incorporation of drainage water management) to reduce nutrient loading of receiving waters.
- Drainage laterals oriented along elevation contours to improve the effectiveness of drainage water management structures.
- The effects of drainage systems on runoff volume, seepage, and the availability of soil water needed for plant growth.
- Confirmation of soil survey information with site investigation, including augering and shallow excavations to identify soil profile hydraulic characteristics, soil texture layering,

water table depth, etc.

- The effects of drainage systems on the hydrology of adjacent lands, especially potential or delineated wetlands and existing wetland easements.
- Subsoiling or ripping of soils with contrasting texture layers to improve internal drainage. Where this treatment is needed use NRCS CPS Deep Tillage (Code 324).
- Installations in dry soil profile to minimize problems of trench stability, conduit alignment, and soil movement into the drain.
- The effects to surface water quality.
- Use of temporary flow-blocking devices to reduce the risk of drain water contamination from surface applications of manure.
- Where removal of nitrate nitrogen in subsurface drainage is needed use NRCS CPSs Drainage Water Management (Code 554), Constructed Wetland (Code 656), Saturated Buffer (Code 604), or Denitrifying Bioreactor (Code 605) in conjunction with this standard.
- The potential existence of a hazardous atmosphere in junction boxes or manholes.

MAINTENANCE

Provide an operation and maintenance (O&M) plan with specific instructions for operating and maintaining the system to ensure proper function as designed. At a minimum, the O&M plan must address:

- Necessary periodic inspection and prompt repair of system components (e.g., structures for water control, underground outlets, vents, drain outlets, trash, and rodent guards).
- Winterization protection from freezing conditions (if applicable) for drainage systems in cold climates.

IRRIGATION WATER MANAGEMENT

DEFINITION

A broad system or scheme for controlling, applying, and removing irrigation water on the farm in a planned and efficient manner. The elements of an irrigation water management system may include:

1. **Water Measuring Devices** - Structures, such as weirs, flowmeters, flumes and open pipe discharges to measure flows.

2. **Water Control Structures** - Permanent structures, such as diversion boxes, checks, turnouts, pipes, or drops which provide positive control of in-system diversion of the irrigation stream.

3. **Regulating Reservoirs** - Relatively small basins constructed at the head of the irrigation system to regulate a fluctuating supply or for temporary storage to provide a larger, more efficient flow of water for irrigation. Regulating reservoirs can be used as desilting basins when operated in conjunction with a tailwater recovery system.

4. **Tailwater Recovery System** - A system of channels, sumps or small reservoirs, pipelines, and/or pumps which will return the drainage water (surface or subsurface) to the irrigation distribution system for reapplication.

5. **Land Grading** - Reshaping of the land surface to provide a uniform or complex slope for efficient, uniform surface irrigation and drainage.

6. **Land Smoothing** - Removing land surface irregularities, such as small ridges and closed depressions, to provide complete drainage of the land surface.

7. **Surface Irrigation System** - A system of facilities designed and constructed for the efficient distribution of irrigation water to the cropland by surface methods such as corrugations, furrows, border checks, basin, contour checks, ditches, wildflooding, drip irrigation, sprinkler and underground pipe. The system should be designed for the most efficient irrigation flow and optimum irrigation run.

PURPOSE

Efficient, economical control of the irrigation and drainage water on the farm is done to: satisfy crop irrigation and soil leaching requirements; maintain soil conditions for suitable plant growth; and prevent degradation of surface and ground water quality. The principal water quality parameters to be considered are suspended solids, dissolved solids, nutrients, biocides, pesticides, herbicides, biological oxygen demand, temperature, pH, and coliform bacteria.

APPLICABILITY

Applies to all irrigated land on which a conservation irrigation system has been developed.

PLANNING CRITERIA

In planning for irrigation water management, consideration should be given to other BMPs, including salinity control, water conveyances, and appropriate conservation crop production elements.

Planning criteria include the following:

1. All facilities and their use, including the diversion and discharge of irrigation water, must conform to the applicable federal, state and local water laws and environmental regulations.

2. General irrigation system design considerations include: soil (agricultural and foundation) characteristics, crop water requirements, topography, material availability, irrigation and drainage water flow paths, farm management capabilities and a cost benefit analysis.

3. Specific determinations are necessary for proper irrigation water management including: water application amount and rate, leaching requirement, system capacities, optimum slopes and/or hydraulic gradients, facility sizes and configuration, time of irrigation set, and uniformity of application.

4. Know the amount that should be applied. Schedule irrigations to meet crop requirements plus a minimum leaching fraction. This will result in improved irrigation efficiencies.

5. Apply water as infrequently and for as long a duration as proper irrigation scheduling will allow. This will minimize total erosion and runoff.

6. Apply water uniformly. This will involve flow measurement, careful land grading (slope), optimum length of run and good design and operation for sprinkler and drip systems.

7. Avoid applying fertilizers, biocides, or amendments in the irrigation water when runoff cannot be confined to the farm.

8. Develop a tailwater recovery system including an adequate drainage system.

9. Utilize sediment retention basins. These can be specific basins, regulating reservoirs, or small basins created by checks in the drain ditches.

10. Utilize vegetated buffer strips or drainageways. Another alternative is to use runoff from row crops to irrigate close growing crops.

11. Since land varies in requirements for irrigation water management, consideration should be given to the identified irrigation land treatment groups described in the Appendix F.

METHODS AND MATERIALS

Since irrigation water management is defined, in effect, as a system of physical facilities for water control, it is necessary that the facilities be constructed of dependable materials and installed properly for proper operation. The materials should be native and/or fabricated which have been determined acceptable by previous experience, testing, or warranty.

A principal objective of irrigation water management is control of the water quality in the downstream receiving waters. The methods suggested in this section for achieving water quality control involve the use of appropriate elements of the system. The design considerations for these elements are discussed in Appendix F.

The degradation of receiving waters is a result of, or associated with, surface runoff from the farm. Following are management methods for controlling this runoff. The degree of control will depend upon the extent and/or practicability of their implementation.

1. **Sprinkler Irrigation System** - A designed and constructed system for the efficient application of irrigation water under pressure through pipelines and above ground nozzles or orifices.

2. **Drip Irrigation** - A designed and constructed system for the efficient application of irrigation water to the land at a low pressure and rate to individual or groups of plants, at or near the soil surface, through a system of pipelines and emitters.

3. **Surge Irrigation/Corrugation** - A system designed to do repeated wetting of irrigated lands in surges and thus reducing the potential for field runoff.

MAINTENANCE

A regular inspection and maintenance program should be developed and implemented to keep the irrigation system or systems operating at its optimum. Repairs and the replacement of system components should be completed as required.

EFFECTIVENESS

Each of the elements and methods of this practice are effective. The degree of total effectiveness will depend upon the extent that they are properly implemented and managed.

IRRIGATED CROPLAND MANAGEMENT

DEFINITION

The use of irrigated cropland for crop production and management of soil and water resources.

PURPOSE

To provide for sustained production of agricultural crops, protect the soil from erosion and maintain or improve water quality.

APPLICABILITY

Applies to all irrigated cropland.

PLANNING CRITERIA

The specifics of the site will govern the development of an irrigated cropland management system. Consideration should be given to soil characteristics, topography, surface drainage, farm management capabilities and the relative cost effectiveness of various management techniques.

METHODS AND MATERIALS

The following are suggested cropland management techniques which may be tailored to the specifics of the site.

1. **Conservation Cropping System** - A cropping system that includes crops that produce plant residue adequate to maintain organic matter and soil tilth. Perennial legume or grass-legume, hay or meadow crops in the system are very effective conservation treatments. Close growing small grain crops and mulching can sometimes be substituted for hay or pasture in a cropping system.

2. **Minimum Tillage** - A tillage system that leaves the crop residue on the soil surface or partially incorporated into the surface soil. Use subsurface tillage equipment and till only enough for weed control and seedbed preparation. Special planting equipment designed for planting in residue may be needed for some crops. Grass-legume crops may be seeded directly into small grain stubble with no tillage if weed control has been adequate in the grain crop. Cultivate intertilled row crops only as needed. The proper use of herbicides for weed control will reduce the need for tillage. Additional nitrogen fertilizer above normal application rates may be needed for residue decomposition.

Care must be taken to avoid over fertilization to the extent that runoff or excessive leaching occurs. Fertilizer amounts and application timing should be well planned to minimize the potential for surface or ground water contamination.

3. **No Till** - A tillage system that leaves the crop residue on the soil surface for maximum protection against soil erosion.

4. **Cover Crops** - Plant cover crops to protect the soil from wind and water erosion following clean tilled row crops, on land laid bare by land leveling, or on development of new lands prior to establishment of the initial crop or cropping system. In development of new land irrigation water should be available for establishing cover crops.

   Small grains are good cover crops. Rapid developing grasses and legumes like ryegrass and annual sweetclover can also be used. On soils where it is adapted, sudangrass is a good cover crop plant for summer seedings. Fertilize and irrigate as needed for rapid development of the cover crop. Use minimum tillage procedures to work down cover crop residue.

5. **Green Manure Crops** - Green manure crops are used when the cropping system does not produce adequate plant residue for soil protection or to maintain soil tilth. Hairy vetch, common vetch, sweetclover, rye or other small grains make good green manure crops. If possible, green manure crops should be worked down with minimum tillage procedures.

6. **Mulching** - The application of plant residues not produced on the site, barnyard manure, or other suitable materials to cropland for erosion control during critical periods. These are usually applied only on small critical areas such as ridgetops or blowouts. Hay straw, manure, cornstalks or other plant residues can be used. Application rates should be adequate to provide the needed soil protection. Hay and straw mulches should be anchored by punching them into the soil surface.

7. **Fertility Management** - Apply fertilizer based on soil tests, agency recommendations and local practice. Excess fertilizer may cause nutrient pollution by runoff or deep percolation.

8. **Pest Control** - Use a combination of cultural, biological and chemical control measures. Apply pesticides in accordance with labeled instruction registered with the Nevada Department of Agriculture or in accordance with specific regulations of the department. Always read the label on the pesticide container before using the material.

9. **Diversions** - Install diversion dikes or ditches to divert excess offsite runoff waters away from cropland to suitable drain outlets. (See Appendix A - Erosion and Sediment Controls.)

10. **Grassed Waterway** - Install grassed waterways where needed to conduct runoff water

through cropland. (See BMP - 2-11 "Grassed Waterways and Outlets").

11. **Irrigation and Drainage Systems** - Install adequate irrigation and drainage systems adapted to soils and crops. (See Appendix F - Agriculture - Farming).

12. **Irrigation** - Use irrigation water management specific for the soil and crops grown. (See BMP - 7-1 "Irrigation Water Management").

MAINTENANCE

Maintenance of the cropland management system will be done through normal tillage and crop culture operations. Additional maintenance will be required to keep irrigation and drainage systems in effective operating condition.

EFFECTIVENESS

Application of a cropland management system that includes the necessary components for the specific soils and crops will maintain the soil resource for sustained crop production and maintain or improve water quality.

NATIVE MEADOWLAND IRRIGATION MANAGEMENT

DEFINITION

A planned irrigation system where all necessary water control structures have been installed for the efficient distribution of irrigation water by surface means. Determining and controlling the rate and amount of irrigation water application to soils for crop water requirements in a planned and efficient manner.

PURPOSE

To effectively utilize available irrigation water in managing and controlling the moisture requirements of native hay and pastures; to promote the desired growth response; to minimize soil erosion and loss of plant nutrients; to control undesirable water loss, and to protect water quality.

APPLICABILITY

This practice is adapted to all native meadowlands that are suitable for irrigation and that have a water supply of suitable quality and quantity.

PLANNING CRITERIA

The layout of a ranch irrigation system should provide for the conveyance and distribution of irrigation water without sustaining soil erosion. All ditches should be located on non-erosive gradients and include the necessary water control structures. Land shaping for proper water distribution should be done in a manner that will least disturb the meadow vegetation. Disturbed areas should be reseeded. Ditches and other structures must be designed and constructed to allow delivery of required quantities of water. They should be designed for the maximum flow conditions that are to be expected.

Irrigation delivery systems should be located out of muck and silt areas to less erosive soil types on higher ground. Stream channels should be re-located only after careful planning. The channels should be re-shaped so that the banks can be stabilized with vegetation.

Identification of existing stable channels in the area is a good guide for shaping and layout of new channels.

Maintaining fisheries within stream channels should be a high priority and irrigation diversions should be designed to maintain an instream flow that will support fish requirements.

METHODS AND MATERIALS

Native meadowland irrigation management is defined, in effect, as a system of physical facilities for water control; therefore, it is necessary that the facilities be designed and constructed properly. A principal objective is the control of the water quality in the downstream receiving waters. The methods suggested in this section for achieving water quality control involve the use of appropriate elements of the system. The design considerations for these elements are discussed in the Appendix F - Agriculture - Farming.

MAINTENANCE

Snag and debris removal from creek beds and ditches is usually an annual project which helps to maintain water in the channels and alleviate uncontrolled surface flow and soil erosion. Snag and debris removal must be conducted in a manner which does not impact the fisheries and wildlife values of the creek. Please refer to BMP 6-3 for additional information.

EFFECTIVENESS

Irrigation management will maintain meadow production, control soil erosion and improve water quality.

CHEMICAL HANDLING, STORAGE, & DISPOSAL:

SAFETY DATA SHEET (SDS)

DEFINITION

An SDS (formerly known as MSDS) includes information such as the properties of each chemical; the physical, health, and environmental health hazards; protective measures; and safety precautions for handling, storing, and transporting the chemical.

PURPOSE

The purpose of a Safety Data Sheet (SDS) is to provide information on the hazards of working with a chemical and procedures that should be used to ensure safety. SDSs are a primary source of information regarding chemical hazards and handling.

CONDITIONS WHERE PRACTICE APPLIES

State and Federal law require that employers obtain an SDS for each hazardous substance they use or store and make the SDS available to employees.

CRITERIA

All employees must be trained on how to read, understand, and access Safety Data Sheets. If the lab employs both a primary means of SDS access and a back-up secondary means of access, both methods should be covered during training.

- SDSs can be stored electronically or as paper copies.
- SDSs must be stored in a location that all staff can access during work hours (not behind a locked door or on a password-protected device to which they do not have the password).
- SDSs must be stored in the work area (not far away or in another building).
- If electronic copies are used, SDSs must still be available if the area loses electricity or internet access.
    - Back-up options include:
        - A laptop with PDFs (or any electronic file type) on the local hard drive.
        - PDFs downloaded onto a USB stick.
        - A computer with PDFs on the local hard drive that is hooked up to a battery back-up or plugged into an outlet on a back-up generator (red outlets).

SPILL CONTINGENCY PLAN

DEFINITION

A contingency plan, also called an emergency response plan or a spill response plan is a set of procedures to be followed to minimize the effects of an abnormal event, such as a spill.

PURPOSE

An emergency, such as a spill, is often a stressful situation. Under such conditions, important steps of the response can be overlooked or forgotten. Following a plan helps to ensure all necessary concerns are addressed, i.e. life is protected, injuries are minimized, resources are used effectively, environmental impact is kept to a minimum and essential reporting is completed.

CONDITIONS WHERE PRACTICE APPLIES

The provisions of any plan will be carried out immediately whenever there is a fire, explosion, or release of hazardous waste or hazardous waste constituents which could threaten human health or the environment.

OPERATION AND MAINTENANCE

Emergency Hazardous Material Spill - Emergency chemical spills are spills of any hazardous material in a quantity or location that the employee has not been trained to handle. These spills are generally more than a liter in volume and involve a highly toxic or reactive compound, present an immediate fire or environmental hazard, or require additional PPE (e.g., respirator) and specialized training to properly clean.

Non-Emergency Hazardous Material Spill - Spills involving a material, a quantity and in a location that the employee has been trained to handle and for which the employee has appropriate PPE and spill response materials. For example, a small spill of a routinely handled chemical reagent on a fumehood benchtop.

CHEMICAL APPLICATION DRIFT

DEFINITION

Pesticide spray or chemical drift is the movement of pesticide dust or droplets through the air at the time of application or soon after, to any site other than the area intended. Pesticide droplets are produced by spray nozzles used in application equipment for spraying pesticides on crops, forests, turf and home gardens. Some other pesticides are formulated as very fine dry particles (commonly referred to as dust formulations).

EFFECTS AND RISKS

Pesticide drift of sprays and dusts can affect people's health and the environment, and damage nearby crops.

Health and Environmental Risks

Pesticide drift can pose health risks when sprays and dusts are carried by the wind and deposited on other areas:

- Nearby homes, schools, and playgrounds.
- Farm workers in adjacent fields.
- Wildlife, plants, and streams and other water bodies.

Economic Effects

Pesticide drift can cause economic loss:

- Drift of herbicides can injure some crops. Crops on nearby farms can become unsellable if the drifting pesticide is not registered for use on the crop.
- State and local agencies receive thousands of complaints about drifting pesticides each year and spend substantial resources investigating drift complaints.

ACTIONS TO REDUCE SPRAY DRIFT AND RUNOFF

When applying pesticides around your home, follow these good stewardship practices to protect water resources by reducing runoff and spray drift.

- Only apply the pesticide directly to the treatment area.
- Be mindful of the location of storm drains, drainage ditches, gutters, or surface waters during a pesticide application. Apply the pesticide in a manner that does not allow the product to enter these areas.
- Applying pesticides during calm weather conditions, when rain is not predicted for the next 24 hours, will help to ensure that wind or rain does not blow or wash pesticide off the treatment area.
- Rinsing application equipment, such as watering cans, low pressure hand wands, backpack sprayers, etc. over the treated area will help avoid runoff to water bodies or drainage systems.

- When applying granular products, sweeping any product that lands on a driveway, sidewalk, street, or other hard impervious surface, back onto the treated area of the lawn or garden will help to prevent runoff to water bodies or drainage systems.
- When watering treated areas, refer to the watering-in instructions on the label, and ensure you do not water the treated area to the point of runoff.

AGRICHEMICAL HANDLING FACILITY

DEFINITION

A facility with an impervious surface to provide an environmentally safe area for the handling of on farm agrichemicals.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce pollution to surface and ground water, including potential drinking water sources.
- Reduce impacts to air quality.
- Prevent the concentration of agrichemicals in the soil.

CONDITION WHERE PRACTICE APPLIES

This practice applies where:

- An area or structure is needed to properly manage and handle agrichemicals (e.g., store, mix, load, and readily clean-up agrichemicals that are spilled or leaked).
- Water is available for filling application equipment tanks, rinsing application equipment, and chemical containers, as needed for the operation.
- This standard does not apply to the handling or storage of fuels. This standard does not apply to commercial or multi-landowner agrichemical handling operations.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct agrichemical handling facilities to meet all Federal, Tribal, State, and local regulations. Ensure that soils and topography are suitable for the agrichemical facility. Base the size of the agrichemical storage on the maximum agrichemical use on the farm for a single growing season from any of the last 5 years.

Ensure the chemical compatibility of materials in the pad, hoses, pipes, valves, seals, connectors, filters, tanks, and related plumbing are compatible with the agrichemicals being handled and capable of withstanding the intended use. Do not include outlet drains in the agrichemical collection, storage, or handling areas. Design containment volumes to be leakproof (watertight and chemical-tight, as pertinent). Do not construct posts, pipes, hoses, discharge valves, or other features that pass through the floor, containment storage walls, or the sumps.

Provide secondary containment to collect any drips or spills where the agrichemical handling facility (AHF) is separated from the mixing/loading area and where transfer of agrichemicals occurs to load application equipment. Install a shutoff valve or dry-break hose connection where the liquid fertilizer tank discharge is at a higher elevation than the handling pad. When a combined volume of more than 60 gallons of Class I, II, or III flammable or combustible liquids,

or a single storage container larger than 5 gallons of Class I, II, or III flammable or combustible liquids are stored in an agrichemical handling facility, follow National Fire Protection Association (NFPA) 30, "Flammable and Combustible Liquids Code," Chapter 4, "Storage of Liquids." Storage cabinets or other remedies are required. Provide adequate storage areas for agrichemicals. Provide appropriate barriers and safeguards between the mixing, handling, and storage areas.

CONSIDERATIONS

Determine and list all agrichemicals scheduled for use in the facility. Acquire official chemical labels, compile the associated design concerns pertinent to all scheduled agrichemicals (e.g., flammability, corrosive action, volatility, toxicity, and incompatibilities), and establish easy access to the chemical label information for personnel use while working at the facility.

Consider posting emergency contact phone numbers for the facility and the appropriate address for directing first responders. For permanent facilities, design the agrichemical handling facility for corresponding increases in water use at the site from the mixing of agrichemicals and rinsing of agrichemical sprayers, containers, and agrichemical handling pad.

Install rinsing devices so that residual contents of agrichemical containers can be adequately evacuated from agrichemical containers. The rinse system may be designed to operate from the nurse tank discharge pump or a separate pump that provides adequate pressure. Verify with the manufacturer of the facility that any pump to be used in pressure rinsing is compatible with the rinse device. Dispose of clean, empty agrichemical containers in accordance with local and State requirements. Provide a roof over permanent facilities.

Minimize sediment transport onto the pad by installing an apron at the facility entrance. Inform users about procedures to minimize and remove sediment from equipment and other sources from entering the facility. For conditions that do not allow for independent sediment removal from tractors and equipment prior to entrance, design appropriate systems to capture sediments separately for proper disposal. Provide a mixing platform for filling agrichemical sprayers.

For ventilation of enclosed buildings, apply NRCS CPS Air Filtration and Scrubbing (Code 371) to reduce pollutant emissions. For portable handling facilities, consider using a top or bottom-loading valve with built-in check valve in the hose from the nurse tank to the spray tank. This enables the operator to remain on the ground while filling the sprayer.

OPERATION AND MAINTENANCE

Develop an operation and maintenance (O&M) plan that is consistent with the purpose of the practice, the intended design life, safety requirements, design criteria, and all local, State, and Federal laws and regulations.

As a minimum the O&M Plan will include, where appropriate:

- Brief description of the facility. Define parameters used to size and design the facility such as storage tank and equipment sizes.
- The facility will not be used for purposes other than the storing, mixing, loading, cleaning, and maintenance of materials and equipment used for agrichemical application.
- Provide an updated inventory of agrichemicals to be stored or handled at the facility.
- Maintain safety data sheets (SDS) for all scheduled agrichemicals available onsite.
- Identify chemical incompatibilities to properly store agrichemicals until disposal.
- The proposed method of handling and disposing of rinsate, washwater, and spills according to the agrichemical label within 72 hours following the rain or spill event.
- The process for handling accumulated rainfall.
- The process for handling accumulated sediment.
- The strategy for cleaning surfaces between different agrichemical mixing operations.
- An inspection plan of structural components such as the condition of concrete, curbing, sump(s), access roads, building structure, etc. Note the timing of inspections, conditions that would cause concern, and required actions as appropriate.
- Any weekly, monthly, or annual maintenance that may be necessary for the proper functioning of the system components including, but not limited to, concrete surfaces, sumps, pumps, hoses, pipelines, building materials, electrical equipment, and other materials and equipment.
- A schedule of any required written inspection and maintenance reports.
- Proper guidance for seasonal shutdown of the facility.
- Safety signage.
- Maintain personnel training for up-to-date safety procedures and corresponding certificates.
- Limit facility access to required personnel only.
- Maintain barriers to keep animals away from the facility.
- An emergency response plan with safety procedures in the event of an accidental spill, exposure, fire, or other hazardous incident. Provide a list of safety equipment, contact names, and phone numbers.
- Require personnel to possess a functioning charged cell phone or other communication device for emergency contact in the event the facility has no phone for this purpose.

INTEGRATED PEST MANAGEMENT: (SEE NON-CHEMICAL PEST MANAGEMENT SECTION)

BIOLOGICAL CONTROL

DEFINITION

Biological control involves the reduction of pest populations through the use of natural enemies such as parasitoids, predators, pathogens, antagonists, or competitors to suppress pest populations.

PURPOSE

Natural enemies of insects play an important role in limiting the densities of potential pests. These natural enemies include predators, parasitoids, and pathogens. Biological control of potential pest insects can be increased by: 1) conservation of existing natural enemies, 2) introducing new natural enemies and establishing a permanent population, and 3) mass rearing and periodic release of natural enemies, either on a seasonal basis or inundatively.

PLANNING CRITERIA & IMPLEMENTATION

Biological control can be classified into three basic categories namely conservation, classical and augmentation. First, conservation biological control involves the deliberate practice aimed at promoting the survival and activity of natural enemies at the expense of pest populations. For example, ecological strips consisting of selected non-crop plants can be deliberately created to provide food sources and overwintering shelters as well as protect local natural enemies from pesticide disturbances thereby enhancing classical biological control as successfully shown in cereals, cabbages, and fruit orchards.

Second, classical biological control involves collection of natural enemies from their area of origin and releasing them in the new area where their host was introduced accidentally. This is of particular importance when the introduced pest species has no known alternative parasitoids indigenous to the area. However, the efficacy of a classical biological will depend on the newly released parasitoids to successfully establish populations that can compete in the new environment.

Last, augmentative biological control is the periodic release of large numbers of mass-reared natural enemies with the aim of supplementing natural enemy populations or flooding (i.e., inundating) pest populations with natural enemies. It is commercially deployed in various cropping systems worldwide and two forms of control are distinguished namely the inundative approach and the seasonal inoculative method. In the inundative release method, the biological control agent is collected, mass-reared and released periodically in large numbers as for example a biotic insecticide to achieve immediate pest control in crops where

viable breeding populations of the natural enemy are not possible.

The seasonal inoculative approach differs from inundative method in that it is deployed in short-term crops, the production season of which is not longer than one year and where multiple pest generations occur. The aim of the method is to obtain both immediate pest control as well as a build-up of the biological control agent population over the entire duration of the same production season.

MAINTENANCE & CONSIDERATIONS

Biological control is a practical option for suppressing pest populations because:

- It is easy and safe to use.
- It is a very cost effective and environmentally sound method of pest control, especially compared to the broad-spectrum pesticides often used.
- It reduces the use of conventional pesticides.
- It can be implemented as part of an Integrated Pest Management (IPM) program.
- Once established, populations are typically self-sustaining.
- It is target specific.

WEED MANAGEMENT

MULCH

DEFINITION

Applying plant residues or other suitable materials to the land surface.

PURPOSE

This practice is applied to achieve the following purpose(s):

- Improve the efficiency of moisture management.
- Reduce irrigation energy used in farming/ranching practices and field operations.
- Improve the efficient use of irrigation water.
- Prevent excessive bank erosion from water conveyance channels.
- Reduce concentrated flow erosion.
- Reduce sheet, rill, & wind erosion.
- Improve plant productivity and health.
- Maintain or increase organic matter content.
- Reduce emissions of particulate matter.

CONDITION WHERE PRACTICE APPLIES

This practice applies to all lands where mulches are needed.

CRITERIA

General Criteria Applicable to All Purposes

The selection of mulching materials will depend primarily on the purpose(s) for the mulch application, site conditions, and the material's availability. The mulch materials may consist of natural or artificial materials of sufficient dimension (depth or thickness) and durability to achieve the intended purpose for the required time period.

Prepare the soil surface to achieve its desired purpose prior to mulching. Apply the mulch material evenly. Use tackifiers, emulsions, pinning, netting, crimping or other methods of anchoring, if needed, to hold the mulch in place for specified periods. In cases where furrow erosion may occur due to concentrated flows from mulches (e.g., plastic mulches on beds), take appropriate measures to protect the furrows and the furrow outlets.

Apply manufactured mulches according to the manufacturer's specifications. Remove synthetic mulches from the field prior to the next crop. Do not incorporate (e.g., disk) synthetic mulches into the soil. When mulching with wood products such as wood chips, bark, or shavings or other wood materials, apply a minimum 2-inch thickness of particles that will remain in place during

heavy rainfall or strong wind events, or both if applicable. The minimum size of mulching material consisting of gravel or other inorganic mulching is 0.75 inches and applied to a minimum depth of 2 inches.

When mulching with cereal grain straw or grass hay, apply at a rate to achieve a minimum 70-percent ground cover. Determine the mulch rate using the current erosion prediction technology for the intended purpose. Do not apply plant-based mulch materials with a carbon (C) to nitrogen (N) ratio less than 20:1 to watercourses.

Additional Criteria to Improve the Efficiency of Moisture Management, to Reduce Irrigation Energy Used in Farming/Ranching Practices, and Field Operations or to Improve the Efficient Use of Irrigation Water

Apply mulch materials to cover at least 90 percent of the soil surface to reduce potential evaporation. Fine-textured mulches (e.g., rice hulls) that allow less oxygen penetration than coarser materials should not be thicker than 2 inches.

Additional Criteria to Improve Plant Productivity and Health

When establishing vegetative cover, apply mulch at a rate that achieves a minimum of 70-percent ground cover to provide protection from erosion and runoff and yet allow adequate light and air penetration to the seedbed to ensure proper germination and emergence.

Additional Criteria to Increase Organic Matter Content

Use plant-based mulching materials of suitable quantity and quality to add organic matter, provide food and shelter for soil biota, and protect the soil surface from raindrop impact and crusting, while allowing for adequate soil aeration. An evaluation of the system using the current approved soil conditioning index (SCI) procedure results in zero or higher.

CONSIDERATIONS

Evaluate the effects of mulching on evaporation, infiltration, and runoff. Mulch material may affect microbial activity in the soil surface, increase infiltration, and decrease runoff, erosion, and evaporation. The temperature of the surface runoff may also be lowered.

Mulch materials with low permeability may adversely affect the water needs of plants.

Avoid excessively thick or tightly packed mulches that can result in soggy, anaerobic conditions at the soil surface during wet weather; or prevent rainfall or overhead irrigation from reaching the soil during times of moisture deficit. Organic materials with C:N ratios of less than 20:1 will release nitrate-nitrogen that could cause water quality impairments.

Finely divided plant residues (e.g., sawdust) and those rich in soluble carbohydrates (e.g., fresh greenchopped sorghum-sudangrass, corn, or other grasses) that have a C:N ratio greater than 30 can tie up soil N and necessitate supplemental N applications on crops. Coarser materials such as grain straw and chipped brush usually do not reduce crop-available soil N levels unless and until they are incorporated into the soil by tillage or cultivation.

Mulching may also provide habitat for beneficial organisms and provide pest suppression. In attempting to provide habitat for ground beetles, spiders, and other predators of weed seeds and crop pests, use mulch of sufficient ground cover and suitable thickness and texture for the target species. Avoid excessively thick or tightly packed mulches, which can interfere with the movement of ground beetles and other beneficial organisms, and may increase the incidence of crop pests and diseases.

Consider mulching crops only if the selected mulching materials, and rates of application do not contribute to pest problems. During the period when weed seed predation is desired and predators are most active, avoid pesticide applications or pesticide exposures that could adversely affect weed seed consumers. Low permeability mulches (e.g., plastic) may increase concentrated flow and erosion on the non-mulched areas.

Light-reflecting mulches such as white or aluminized plastic film or bright straw can repel some pests. Consider potential beneficial or detrimental effects of mulching materials on the biotic community surrounding the crop, including beneficial soil micro- and macro-organisms, as well as plant pathogens and plant pests. These effects are specific to site, mulch, and crop, and may include enhanced soil microbial activity, increased or reduced levels of crop diseases, and toxic (allelopathic) activity against the crop, weeds, or other beneficial or pest organisms.

Keep mulch 3 to 6 inches away from plant stems and crowns to prevent disease and pest problems. Additional weed control may be needed around the plant base area. Deep mulch provides nesting habitat for ground-burrowing rodents that can chew extensively on tree trunks and tree roots. Light mulch applied after the first cold weather may prevent rodents from nesting. Some mulch material may adversely affect aquatic environments through changes in water chemistry or as waterborne debris. Consider placing mulch in locations that minimize these risks.

Consider potential effects of soil physical, chemical, and biological properties. Refer to soil survey data as a preliminary planning tool for assessment of areas. Consult a resource soil scientist or the Web Soil Survey at: http://websoilsurvey.nrcs.usda.gov/app/ to obtain soil properties and qualities information. For all organic or transitioning to organic operations, follow all National Organic Program rules.

PLANS AND SPECIFICATIONS

Prepare specifications for each site and purpose on the implementation requirements document. Documentation must include:

- Purpose of the mulch.
- Type of mulch material used.
- Percent cover or thickness of mulch material, as applicable.
- Timing of application.
- Site preparation.
- Listing of netting, tackifiers, or method of anchoring.
- Operation and maintenance.

OPERATION AND MAINTENANCE

Periodically inspect the mulched areas and reinstall mulch or repair as needed to accomplish the intended purpose. Evaluate the effectiveness of the mulch (application, amount of cover provided, durability, etc.) and adjust the management or type of mulch to better meet the intended purpose(s).

Remove or incorporate mulch materials to be consistent with the intended purpose and site conditions. Do not operate equipment near the mulched site that would compromise the intended purpose of the mulch. Prevent or repair any fire damage to the mulch material. Properly collect and dispose of synthetic mulch material after intended use. Monitor and control undesirable weeds in mulched areas.

NEVADA COVER CROP GUIDANCE:

- **Cover Crop Scenarios**
  - Irrigation – Cover crop planting capable of being irrigated during irrigation season, irrigation applied after seeding to wet top 2-4 inches of soil profile for establishing cover crop. Additional irrigation applications may be used to benefit cover crop growth. Cover crop seed mix must contain a minimum of 2 species with growth patterns that meet the resource concern being addressed.
  - Dryland – Site conditions or field does not allow for application of irrigation water. Planting should coincide with seasonal moisture to increase success of establishment. During periods of drought where irrigation water is uncertain, cover crop should be seeded as if being planted on dryland acres. Cover crop seed mix must contain a minimum of 2 species with growth patterns that meet the resource concern being addressed.
  - Drought/Unknown Irrigation - Cover Crop may be used to address resource concern "reduce erosion from wind and water" when irrigation water is not guaranteed. In this scenario planting should coincide with seasonal moisture to increase success of establishment. Single species cover crop may be utilized. Residue and material must remain in field until preparation of following crop planting. Grazing is not allowed when sole resource concern is, reduce erosion from wind and water. WEPS runs required to document reduction of soil erosion, run WEPS with and without cover crop showing year of fallow ground vs a year under cover crop.

- **Cover Crop Species Selection –**
  Cover Crop species selection should be based on the season of planting, probability of moisture and localized climate. See Nevada Cover Crop Guidance Tables for Cover Crop Species and Mix Information.

- **Certification and Payment Requirements**
  - Irrigated Cover Crop – Certification and payment upon Cover Crop Establishment
    - Completed IR
    - Seed bag tag and seed invoice
    - Photo documentation of established cover crop
  - Dryland Cover Crop/ Drought-Unknown Irrigation – Certification and payment upon completion of seeding (establishment if possible).
    - Completed IR
    - Seed Bag Tag and seed invoice
    - Photo Documentation of seed bed that has been planted.

- **Grazing of Cover Crop** –
  - Grazing for Biomass - Grazing of a cover crop as biomass would be acceptable when cover crop is being utilized to improve soil health. Grazing of a cover crop must be documented and recorded utilizing 528 Prescribed Grazing plan. Stubble height upon the completion of grazing shall be no less than 4 inches.
  - Grazing to Terminate - To terminate cover crop by grazing, timing and cover growth patterns need to be considered and a high intensity grazing plan is required. In scenarios where the following crop will not be planted within 35 days of grazing termination, residue levels need to be maintained to meet cover crop resource concern being addressed. If grazing is utilized for termination, select the payment scenario that best fits the overall cover crop planting and resource concern. (Ex… Cover crop winter kill scenario, does not include funding for chemical or mechanical termination.)

- **Termination of a Cover Crop** –
  - Irrigated Cover Crop – Terminate cover crop in a manner and timing that allows for successful implementation and planting of following crop. Termination of cover crops in an irrigated cropping system will be based on the crop system, water availability, and the conservation purpose, but before the planted crop emerges.
  - Dryland/ Drought-Unknown Irrigation – Non-irrigated crop, RMA termination guidance for Zone 1 reads "*cover crop to be terminated 35 days prior to planting of late spring to fall seeded crops."* Spring seeded crop terminate cover crops as soon as practical prior to planting. Utilize best management practices to maintain soil coverage during the Nevada windy season (February – June).

  See NRCS Cover Crop Termination Guidelines Version 4 for further information and guidance.

- **Range Planting vs Cover Crop** –

  Perennial vegetation establishment and long-term success (Range Planting) vs annual cover establishment (Cover Crop). The intent of cover crop planting is to cover a field with residue and is not based on long term survivability and establishment of a plant community.

WEED FABRIC

DEFINITION

Pest control fabric or netting is an important (Integrated Pest Management) IPM tool. The fabric is well suited for use on net houses, greenhouses, pollination cages and hoop houses/quonsets.

PURPOSE

These nets block the entry of pests into crop environments and reduce the need to apply pesticides.

PLANNING CRITERIA & IMPLEMENTATION

Insect barriers are made of porous fabric with a mesh sufficiently small to exclude certain insects, preventing them from damaging or otherwise interfering with a crop, without excluding light and rainfall.

MAINTENANCE

- Inspect for and immediately repair fabric and netting material failures.

GRAZING

DEFINITION

A livestock/wildlife grazing system in which two or more grazing units are alternately deferred or rested from grazing in a planned sequence over a period of years. The rest period may vary in duration given the specifics of the grazing area (i.e. season, year, etc.).

PURPOSE

1. To maintain or improve plant cover, plant composition and forage production while properly using the forage on all grazing units.

2. To improve efficiency of grazing by uniform use of all parts of each grazing unit.

3. To provide a supply of forage throughout the grazing season.

4. To improve the quality of forage available to animals during specific seasons.

5. To protect watersheds, reduce runoff and sedimentation for the improvement of surface and ground water quality.

6. To improve wildlife habitat.

APPLICABILITY

Applies to native grazing lands, including those treated by spraying, seeding, etc., grazable woodlands and grazed wildlife lands. Grazing management may be applied to a single grazing unit and may be adequate to meet water quality objectives where proper grazing use and uniform distribution can be obtained.

PLANNING CRITERIA

The grazing system plan should:

1. Consider the climate, soils, range sites, present vegetative conditions, topography and other ecological conditions.

2. Allow forage use allocation for livestock and wildlife.

3. Be coordinated among all effected interests and natural resources. A "watershed" view should be established to identify all of the resources and interests. The coordinated approach should include federal land management agencies, state agencies, private land owners, other grazing users and applicable special interest groups. A variety of Resource Management and/or grazing systems are available given the specifics of the site including Holistic Resource Management, Coordinated Resource Management, and Savory Grazing Systems, to mention a few.

4. Consider specific management measures to alleviate livestock distribution problems such as concentrated use of riparian areas or other critical areas.

5. Should consider the kinds of livestock and the operator's objectives in conjunction with the federal land management objectives if the plan involves public lands.

6. Allow for practical application of the system and be flexible enough to meet the needs of key plant species and communities in relation to climatic fluctuations.

7. Consider the facilities needed for proper distribution and uniform use of grazing units such as fences, stock water developments, stock trails, access roads, salt, and supplemental feeding stations.

8. Provide for prolonged drought or other unusual circumstances. A monitoring plan should be included which monitors plant species use and condition with respect to the desired condition.

9. Consider economic costs in relation to the benefits expected from the entire system.

METHODS AND MATERIALS

1. **Grazing Management Systems** - Appropriate grazing management systems ensure proper grazing use by adjusting grazing intensity and duration to reflect the availability of forage and feed designated for livestock uses, and by controlling animal movement through the operating unit of range or pasture. Practices that accomplish this include:

   A. Deferred grazing - usually is defined as the postponing or resting of livestock grazing on an area for a prescribed period to provide for plant reproduction, establishment of new plants, or restoration of vigor to existing plants.

   B. Deferred-rotation grazing - Provides for a systematic rotation of deferment among two or more units.

   C. Rest-rotation grazing - Provides for adequate rest to restore and maintain plant vigor, reduced trampling of mature seeds after plant maturity, and establishment of seedlings.

Grazing and rest are systematically rotated until all pastures within the system have received treatment. Rest periods may be throughout the year, during the growing season of key plant species or may include one full year of rest.

2. **Livestock Distribution** - Proper distribution of livestock is needed for the efficient and uniform use of each grazing unit. A livestock operator can implement the management practice of herding or moving livestock when the desired plant use has been attained in a given area:

A. Fencing - Fences are usually required for livestock control and to divide ranges into grazing units of near equal capacity. Fences are also needed to exclude livestock from sensitive or critical areas. (See Appendix G-5 for fencing guidelines and specifications)

B. Stockwater Developments - It is essential to provide adequate water for livestock within reasonable distance of the grazing areas. Implementation of an improved grazing system often concentrates livestock requiring development of new or higher capacity watering facilities. In some applications water alone can be controlled to move livestock from one area to another.

There are several methods of developing stock water, including:

(1) Spring developments - Improving springs and seeps by excavating, cleaning, capping or providing collection and storage facilities.

(2) Wells - Constructed or improved to meet the needs of livestock and wildlife.

(3) Stockwater ponds and dugouts - A water impoundment made by constructing a dam or an embankment, or by excavation of a pit or dugout.

(4) Pipelines, trough or tank - Pipeline to convey water to areas with no water source and a trough or tank for storage.

(5) Photovoltaic pumping systems.

(6) Ram pumps.

(7) Windmills.

C. Stock Trails - May be needed where natural or man-made barriers limit access and movement of grazing animals. (See Appendix G-4 for guidelines and specifications for stock trails)

D. Salt, Mineral and Feed Supplement Locations - These need to be properly placed for good distribution of grazing animals throughout each grazing unit. They may be placed in light use areas away from water.

3. **Access** - It is necessary to have good access to all grazing areas for livestock management and to service and maintain facilities. Refer to NRS.535.010 on permit requirements for stock watering ponds and dams.

MAINTENANCE

Proper grazing use will maintain enough live vegetation and litter cover to protect the soil from erosion; will achieve riparian and other resource objectives; and will maintain or improve the quality, quantity and age distribution of desirable vegetation. Maintain fences and other facilities for efficient operations. Follow proper grazing use, that is, grazing at an intensity that will maintain plant cover and maintain or improve the quantity and quality of desirable vegetation. Adjust system plans based on inspection and records of utilization.

EFFECTIVENESS

A properly operated grazing system provides for efficient use of forage and is an effective means of maintaining a plant cover that will reduce runoff and sediment delivery. How effective grazing management will be is dependent upon both the quality of the design in relation to the land and the skill utilized to implement, monitor and adjust management to meet objectives.