NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY

(Ac.)

CODE 412

DEFINITION

A shaped or graded channel that is established with suitable vegetation to carry surface water at a non-erosive velocity to a stable outlet.

PURPOSE

- To convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding.
- To reduce gully erosion.
- To protect/improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

In areas where added water conveyance capacity and vegetative protection are needed to control erosion resulting from concentrated runoff.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct grassed waterways to comply with all Federal, State, and local laws and regulations.

Capacity. The minimum capacity shall convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Capacity shall be increased as needed to account for potential volume of sediment expected to accumulate in the waterway between planned maintenance activities. When the waterway slope is less than 1 percent, out-of-bank flow may be permitted if such flow will not cause excessive erosion. At a minimum, the design capacity shall remove the water before crops are damaged.

Stability. Determine the minimum depth and width requirements for stability of the grassed waterway using the procedures in the NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 7, Grassed Waterways; Agricultural Research Service (ARS) Agriculture Handbook 667, Stability Design of Grass-Lined Open Channels; or other equivalent method.

Width. Keep the bottom width of trapezoidal waterways less than 100 feet unless multiple or divided waterways or other means are provided to control meandering of low flows.

Side slopes. Keep the side slopes flatter than a ratio of two horizontal to one vertical. Accommodate the equipment anticipated to be used for maintenance and tillage/harvesting equipment that will cross the waterway in the designed width.

Depth. The capacity of the waterway must be large enough so that the water surface of the waterway is below the water surface of the tributary channel, terrace, or diversion that flows into the waterway at design flow.

Provide freeboard above the designed depth when flow must be contained to prevent damage. Provide freeboard above the designed depth when the vegetation has the maximum expected retardance.

Drainage. When needed to help or keep vegetation established on sites having prolonged flows, high water tables, or seepage problems, include Subsurface Drains (606), Underground Outlets (620), stone center waterways or other suitable measures in waterway designs.

Outlets. Provide a stable outlet with adequate capacity. The outlet can be another vegetated

channel, an earthen ditch, a grade-stabilization structure, filter strip or other suitable outlet.

Vegetative Establishment. Grassed waterways shall be vegetated according to NRCS Conservation Practice Standard Critical Area Planting (342). Species selected shall be suited to the current site conditions and intended uses. Selected species will have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the waterway.

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

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

All seed and planting materials shall be labeled and meet state seed quality law standards and use of certified seed, if available, will be encouraged,

Based on seed tags, adjust seeding rates to insure the required amount of pure live seed (PLS) is applied to site.

Fertilization, mulching, or other facilitating practices for plant growth shall be timed and applied to accelerate establishment of selected species.

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock, straw or hay bale dikes, fabric checks, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close growing crop, e.g. small grains or millet, on the contributing watershed prior to construction of the grassed waterway can also significantly reduce the flow through the waterway during establishment.

CONSIDERATIONS

Establish an appropriate width of vegetation on one or both sides of the waterway or add other sediment control measures above the waterway such as residue management to improve water quality and reduce sediment deposition in the waterway. Consider increasing the channel depth and/or designing areas of increased width or decreased slope to trap and store sediment to reduce the amount of sediment that leaves a field. Be sure to provide for regular cleaning out the waterway when trapping sediment in this manner.

Avoid areas where unsuitable subsurface, subsoil, substratum material that limits plant growth such as salts, acidity, root restrictions, etc., may be exposed during implementation of the practice. Where areas can not be avoided, seek recommendations from a soil scientist for ameliorating the condition or, if not feasible consider over-cutting the waterway and add topsoil over the cut area to facilitate vegetative establishment.

Avoid or protect if possible important wildlife habitat, such as woody cover or wetlands when determining the location of the grassed waterway. If trees and shrubs are incorporated, they should be retained or planted in the periphery of grassed waterways so they do not interfere with hydraulic functions. Medium or tall bunch grasses and perennial forbs may also be planted along waterway margins to improve wildlife habitat. Waterways with these wildlife features are more beneficial when connecting other habitat types; e.g., riparian areas, wooded tracts and wetlands. When possible, select species of vegetation that can serve multiple purposes, such as benefiting wildlife, while still meeting the basic criteria needed for providing a stable conveyance for runoff.

Water-tolerant vegetation may be an alternative to subsurface drains or stone center waterways on some wet sites.

Use irrigation in dry regions or supplemental irrigation as necessary to promote germination and vegetation establishment.

Provide livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation.

Add width of appropriate vegetation to the sides of the waterway for wildlife habitat.

Consider including diverse legumes or other forbs that provide pollen and nectar for native bees. In dry regions, these sites may be able to support flowering forbs with higher water requirements and thus provide bloom later in the summer

The construction of a grassed waterway can disturb large areas and potentially affect cultural resources. Be sure to follow state cultural resource protection policies before construction begins.

Cultural Resources

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

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

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

Endangered Species

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

PLANS AND SPECIFICATIONS

Prepare plans and specifications for grassed waterways that describe the requirements for applying the practice according to this standard. As a minimum the plans and specifications shall include:

- A plan view of the layout of the grassed waterway.
- Typical cross sections of the grassed waterway(s).
- Profile(s) of the grassed waterway(s).
- Disposal requirements for excess soil material.
- Site specific construction specifications that describe in writing the installation of the grassed waterway. Include specification for control of concentrated flow during construction and vegetative establishment.
- Vegetative establishment requirements.

OPERATION AND MAINTENANCE

Provide an operation and maintenance plan to review with the landowner. Include the following items and others as appropriate in the plan.

- Establish a maintenance program to maintain waterway capacity, vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.
- Protect waterway from concentrated flow by using diversion of runoff or mechanical means of stabilization such as silt fences, mulching, haybale barriers and etc. to stabilize grade during vegetation establishment.
- Minimize damage to vegetation by excluding livestock whenever possible, especially during wet periods. Permit grazing in the waterway only when a controlled grazing system is being implemented.

- Inspect grassed waterways regularly, especially following heavy rains. Fill, compact, and reseed damaged areas immediately. Remove sediment deposits to maintain capacity of grassed waterway.
- Avoid use of herbicides that would be harmful to the vegetation in and adjacent to the waterway area.
- Avoid using waterways as turn-rows during tillage and cultivation operations.
- Mow or periodically graze vegetation to maintain capacity and reduce sediment deposition. Mowing may be appropriate to enhance wildlife values, but must be conducted to avoid peak nesting seasons and reduced winter cover.
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the waterway.
- Control noxious weeds.
- Do not use waterways as a field road. Avoid crossing with heavy equipment when wet.

REFERENCES

USDA, ARS. 1987. Stability design of grass-lined open channels. Agriculture Handbook 667.

USDA, NRCS. 2007. National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 7, Grassed waterways.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

412 - GRASSED WATERWAY

I. SCOPE

The work shall consist of grading and shaping a natural or constructed waterway to the lines and grades as shown on the drawings, including furnishing of seed, fertilizer, and mulch required for planting vegetation within the waterway.

II. MATERIALS

Nylon Mat

The mat shall be of 3-dimensional structures of entangled nylon filament mat heat bonded at the intersections. The mat shall be black in color and be resistant to chemical and environmental degradation. The mat shall be at least 9 mm in thickness.

Staples

The staples shall be U,shaped or T,shaped with legs at least 10 inches in length and have a 2-inch crown or top and shall be made of 11 gauge or heavier wire.

Stakes

Stakes shall be cut from new 1-inch wood and be at least 12 inches in length and be wedge shaped with at least a 2-inch top.

Seed

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

Seed shall be of a quality which has a minimum pure live seed content of 80 percent (percent purity X percent germination) and weed seed shall not exceed 0.5 percent of the aggregate of pure live seed and other material.

Bag tag figures will be evidence of purity and germination. No seed will be accepted with a date of test of more than 9 months prior to the date of delivery to the site.

Sprigs

Bermuda Grass sprigs will be stolon or rhizome sprigs, 3- to 12-inches long containing 3 or more nodes. Sprigs shall be taken from healthy, vigorous, strong growing plants and when delivered to the site shall be in a live, moist and healthy condition. They shall not be harvested more than 24 hours prior to delivery, and may be held on site if kept cool and moist for a period not longer than 24 hours.

Plugs

Bermuda grass plugs shall be a minimum surface size of 3 inches X 3 inches and shall be not less than 2-1/2 inches thick. Plugs shall come from healthy, vigorous, established sod that has not been previously harvested for at least nine months. The plugs may be cut on-the-site from sod, or prepared at the place of harvest. They shall not be harvested more than 24 hours prior to delivery.

Plugs shall be kept moist and protected from the sun and drying winds, and aerated as necessary to prevent heating until planted. They may be held on site for a period not longer than 24 hours.

Fertilizer

Unless otherwise specified on the "Practice Requirements" sheet, fertilizer shall be Ammonium Phosphate and contain a minimum of 16 percent nitrogen, 20 percent available phosphoric acid and 0 percent water soluble potash, uniform in composition, dry and free flowing, pelleted, or granular.

All bagged fertilizer shall be delivered in unbroken or unopened containers, labeled in accordance with applicable state regulations and bearing the warranty of the producer for the grade furnished.

Inoculants

The inoculant for treating legume seeds shall be a pure culture of nitrogen-fixing bacteria prepared specifically for the plant species and shall not be used later than the date indicated on the container. A mixing medium, as recommended by the manufacturer, shall be used to bond the inoculant to the seed. For nonpellet

inoculated seed, two times the amount of the inoculant recommended by the manufacturer shall be used and seed shall be sown within 24 hours of treatment.

For pellet incoluated seed, the inoculation rate shall be at least 30 pounds per 1,000 pounds of raw seed and the seed shall be labeled to show the Lot Number, Expiration Date of the Rhizobia, and Percent Coat of the finished product.

Pellet inoculated seed shall be sown within 30 days of inoculation, shall be kept cool until sown, and shall achieve at least 80 percent nodulation.

Mulch

Straw mulch shall be new straw derived from rice, wheat, oats, or barley. The contractor, owner, or their representative shall furnish evidence that clearance has been obtained from the County Agricultural Commissioner, as required by law, before sprigs, plugs, and straw obtained from outside the county in which it is to be used is delivered to the site of the work.

III. SITE PREPARATION AND CHANNEL CONSTRUCTION

The foundation area shall be cleared by removing obstructions, trees (if necessary), stumps, roots, brush, boulders, debris, and other objectionable material. Removal shall be done in such manner as to avoid damage to other trees and property.

Any topsoil excavated to shape the channel shall be stockpiled until needed for spreading over areas that will be vegetated.

The channel shall be constructed to the cross-section, lines and grades as shown on the construction drawings. All spoil material shall be placed in areas as staked in the field and shaped to accommodate the vegetation operation. All fill areas within the cross-section of the waterway shall be compacted by a minimum of one passage of the equipment over the entire fill surface area of each lift. The final grading operation shall be made to accommodate seedbed preparation.

IV. SEEDING MIXTURE

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

The seeding rate(s) shall be the weight exclusive of any coating material. Any legume seed used shall be inoculated.

Planting shall be performed after final grading is completed and any protective armor work has been finished unless otherwise specified on the Practice Requirements sheet.

V. SEEDBED PREPARATION

The area to be planted shall be weed free and have a firm seedbed which has previously been roughened by scarifying, disking, harrowing, chiseling, or otherwise worked to a depth of 2 to 4 inches. No implement shall be used that will create an excessive amount of downward movement of clods on sloping areas. Seedbed may be prepared at time of completion of earthmoving work.

Rocks larger than 6 inches in diameter, trash, weeds, and other debris that will interfere with seeding or maintenance shall be removed. Seedbed preparation shall be suspended when soil moisture conditions are not suitable for the preparation of a satisfactory seedbed.

VI. SEEDING, SPRIGGING OR PLUGGING, FERTILIZING, MULCHING AND ANCHORING THE MULCH

Seeding

Seed shall be drilled or broadcast by hand, mechanical hand seeder, or power operated seeder. Seed shall be incorporated into the soil, but not more than 1 inch deep.

Fertilizing

Fertilizer shall be distributed uniformly over the seedbed at the rate of 500 pounds per acre unless a different amount is specified on the Practice Requirements sheet. Fertilizer shall be applied in any way that will result in uniform distribution. The fertilizer shall be incorporated into the soil. Fertilizing it shall not be accomplished more than 15 days prior to seeding.

Mulching

A mulch covering shall be distributed uniformly over the seeded area within 48 hours following seeding. Straw mulch shall be applied at a rate of 2 tons per acre unless a different amount is specified on the Practice

Requirements sheet. The mulch shall be applied by hand, blower, or other suitable equipment. If straw is applied by blower, it shall not be chopped in lengths less than 6 inches.

Anchoring the Mulch

The mulch shall be anchored in place. Anchoring process may include using hand tools, mulching rollers, disks, or similar types of suitable equipment and shall be performed in a satisfactory manner.

Sprigging or Plugging

Bermuda grass sprigs or plugs shall be planted in areas having adequate moisture throughout the summer. The sprigs or plugs shall be planted into moist soil beginning at the waterline and shall be planted in one or more rows as shown on the attached drawing with plants every 12 to 15 inches apart in a row. The adjacent row will be 12 to 15 inches apart and staggered with respect to the bottom row.

Sprigs will be planted in such a manner so that at least two or more nodes of the plant will be buried in the ground.

A planting hole for each plug shall be prepared with an appropriate hand tool. Planting techniques will be such that the soil is adequately firmed around each plug.

VII. IRRIGATION

When specified, irrigation water shall be applied at the times and rates as listed on the Practice Requirements sheet.

VIII. OTHER REQUIREMENTS

Other details for the establishment and maintenance of the plants including, but not limited to, the need for livestock and traffic control shall be applied as listed on the Practice Requirements sheet.

IX. SPECIAL MEASURES

Measures and construction methods shall be incorporated as needed and practical that enhances fish and wildlife values. Special attention shall be given to protecting visual resources and maintaining key shade, food and den trees.

X. CONSTRUCTION OPERATIONS

Construction operations shall be done in such a manner that erosion and air and water pollution are minimized and held within legal limits.

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

The completed job shall be workmanlike and present a good appearance.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

412 – GRASSED WATERWAY

OPERATION AND MAINTENANCE

Sponsor/Land user: _____ Date: _____

Address: _____

_____

Location GPS Coordinates Map Datum: _____ E _____ N _____

Quad Sheet Name _____ SEC _____ T _____ R _____

A properly operated and maintained grassed waterway is an asset to your farm. This grassed waterway was designed and constructed to safely convey runoff water. The estimated life span of this installation is at least 10 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic maintenance and may also require operational items to maintain waterway capacity, vegetative cover and outlet stability. Here are some recommendations to help you develop a good operation and maintenance program:

GENERAL RECOMMENDATIONS

- Inspect grassed waterways regularly, especially following heavy rains. Inspect grassed waterways annually for damage due to normal use. Repair and reseed eroded areas immediately. Remove sediment deposits to maintain capacity of grassed waterway.
- Seeding shall be protected from concentrated flow and grazing until vegetation is established.
- Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization and application of herbicides when necessary. Avoid areas where forbs have been established when applying herbicides. Avoid crossing the waterway during spray operations and if not possible cross only with the spray equipment shut off.
- Periodic mowing or grazing may also be needed to control height.
- Remove sediment/tillage furrows or ridges along the edge of the waterway that hinders runoff water from flowing into the waterway.
- Maintain all parts of the irrigation system used for vegetative establishment and maintenance. Promptly repair any damage.
- Maintain constructed width by lifting or disengaging equipment properly. Avoid farming operations along the waterway which would hinder water entry. Fill and seed all rills or small gullies that form in the waterway.

- Promptly repair all broken subsurface drain lines adjacent to or in the waterway.
- Maintain all sediment control measures in the contributing watershed to prevent sedimentation and the resulting loss of capacity.
- Limit the traffic and do not use as a roadway, especially when the waterway is wet. Use care when crossing the grassed waterway to prevent tillage marks or wheel tracks and promptly repair if necessary.
- Limit livestock usage to vegetative growth periods when they will not damage the vegetative root system or compact or trample the soil.
- Immediately repair any vandalism, vehicular, or livestock damage.
- Inspect for damage from rodents or burrowing animals. Repair any damage. Take appropriate corrective actions to alleviate further damage.
- Check all rock riprap sections or other grade control structures for accelerated weathering and displacement. Replace to original grades if necessary.
- Prescribed burning and mowing may be appropriate to enhance wildlife values, but must be conducted to avoid peak nesting seasons and reduced winter cover.

SPECIFIC RECOMMENDATIONS FOR YOUR GRASSED WATERWAY

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE PLAN FOR YOUR GRASSED WATERWAY.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
412 - GRASSED WATERWAY

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

Referral No._____Prepared By_____ Date_____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS TECHNICIAN.

1. Drawings, No._____ _____ _____

2. Practice Specifications 412_____,_____,_____

3. Seedbed Preparation:_____

4. Seed_____rate_____lbs/ac
   Seed_____rate_____lbs/ac
   Seed_____rate_____lbs/ac

5. Fertilizer_____rate_____lbs/ac

6. Mulch_____rate_____lbs/ac

7. Weed Control_____rate_____lbs/ac

8. Irrigation Water_____rate_____lbs/ac

9. Special Requirements:_____

_____

_____

_____

PRACTICE APPROVAL:

Job Classification:

Show the limiting elements for this job. This job is classified as, Class _____

Limiting elements:	Units
Design capacity _____	_____cfs
Drainage area _____	_____acres

Approved by:_____ Date:_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the drawings and specifications, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS technician.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date _____

STATEMENT OF WORK
Grassed Waterway (412)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documents that demonstrate criteria in practice standard have been met and are compatible with planned and applied practices
    a. Practice purpose(s) as identified in the conservation plan.
    b. List of required permits to be obtained by the client
    c. Compliance with NRCS national and state utility safety policy (NEM Part 503-Safety, Subpart A - Engineering Activities Affecting Utilities 503.00 through 503.06)
    d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Hydrology/hydraulics
        ii. Outlet capacity and stability
        iii. Seedbed preparation, soil amendments and vegetation requirements
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits. Plans and specification shall be developed in accordance with the requirements of conservation practice standard Grassed Waterway (Code 412).
3. Operation and maintenance plan
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03 (a) (3)).
5. Design modifications during installation as required

INSTALLATION

Deliverables

1. Pre-installation conference with client and contractor
2. Verification that client has obtained required permits
3. Staking and layout according to plans and specifications including applicable layout notes
4. Installation inspection
    a. Actual materials used
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation
7. Certification that the installation process and materials meets design and permit requirements

CHECK OUT

Deliverables

1. As-built documentation
    a. Extent of practice units applied
    b. Drawings
    c. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits (NEM Subpart A, 505.03 (c) (1)).
3. Progress reporting

REFERENCES

- Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard –Grassed Waterway, 412
- National Engineering Manual
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

423 – HILLSIDE DITCH

OPERATION AND MAINTENANCE

Sponsor/Land user: _____ Date: _____

Address: _____

_____

Location GPS Coordinates Map Datum: _____ E _____ N _____

A properly operated and maintained hillside ditch is an asset to the farm. This project was designed and installed to control the flow of water on steep slopes and intended to minimize erosion and runoff. The estimated life span of this installation is at least 10 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program:

GENERAL RECOMMENDATIONS

- Maintain hillside ditch capacity, storage, supporting ridge height and outlets.
- Redistribute sediment build up. If possible, correct sediment source.
- Repair or replace damaged hillside ditch components.
- Remove debris, liter, and excess vegetation accumulation from ditches and outlet facilities.
- Support ridges, especially those with steep back slopes, can be very hazardous to humans and livestock. Maintain good vegetation on all slopes to help control erosion and stabilize slope conditions.
- Control vegetation, trees and brush with grazing and use of approved herbicides, or mechanical means.
- Provide for periodic inspections, especially immediately following storms providing a 10 year frequency or greater runoff. Prompt repair or replacement of damaged components is necessary.

SPECIFIC RECOMMENDATIONS FOR YOUR HILLSIDE DITCH

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE FOR YOUR HILLSIDE DITCH.

NRCS, CA
November 2009

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

HILLSIDE DITCH

(Ft.)

CODE 423

DEFINITION

A channel that has a supporting ridge on the lower side, constructed across the slope at defined gradient and horizontal or vertical interval, with or without a vegetative barrier.

PURPOSE

To safely control the flow of water by diverting runoff from upland sloping areas to a stable outlet.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to steeply sloping sites where surface flow is damaging sloping upland, and there is sufficient soil depth for constructing a hillside ditch system. Hillside ditches shall not be used to provide protection to buildings, roads, or other improvements.

CRITERIA

Location. Locate hillside ditch systems to fit land conditions, soil texture, and field slope, and to drain to a stable outlet.

Outlets. Locate or establish adequate outlets prior to the construction of hillside ditches, with enough capacity to dispose of discharged water without creating an erosion hazard. An outlet may be a grade control structure, a natural or constructed waterway, a stable watercourse, or a stable disposal area such as a well-established pasture. Criteria for grassed waterways are found in NRCS Conservation Practice Standard, Grassed Waterway (412).

Length. The maximum allowable length of ditch draining in one direction is 400 feet, unless an extension is necessary to reach a stable outlet. In no case shall a ditch exceed 500 feet in length.

Permissible velocities. Design the ditch to be compatible with the erosion resistance characteristics of soils of the site.

Maximum channel velocities shall not exceed those recommended in NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 9, Diversions.

Horizontal spacing

Use Table 1 to determine the maximum horizontal spacing.

TABLE 1

Land Slope (percent)	Maximum Spacing (feet)
<12	40
12-25	35
25-40	25
>40	20

Capacity

At a minimum, hillside ditches shall safely carry the peak discharge from a 10-year frequency, 24-hour duration, rainfall event.

CONSIDERATIONS

When planning this practice, consider the following as applicable:

Effects upon components of the water budget, especially effects on volumes and rates of runoff, infiltration, evaporation, transpiration,

deep percolation, and ground water recharge.

Filtering effects of vegetation on movement of sediment and dissolved and sediment-attached substances.

Short-term and construction-related effects of this practice on the quality of downstream water.

Steep fields with sandy soils may benefit more from NRCS Conservation Practice Standard, Vegetative Barrier (601), than from hillside ditches.

Potential for development of saline seeps or other salinity problems resulting from increased infiltration in the presence of restrictive layers.

Potential to affect significant cultural resources.

Cultural Resources

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

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

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

Endangered Species

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

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

PLANS AND SPECIFICATIONS

Plans and specifications for constructing hillside ditches shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

The plan shall specify the locations, grades, dimensions, quantities, and materials requirements for the hillside ditch. Provisions must be made for necessary maintenance.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan shall be prepared for use by the landowner or operator. The plan shall include provisions to address the following, as a minimum:

Maintain hillside ditch capacity, ridge height, and the outlet capacity.

Remove vegetative growth or debris interfering with the proper functioning of the ditch, as necessary.

Remove debris interfering with the outlet operation, as necessary.

Maintain well-established vegetation in the outlet at all times, to provide stability.

Maintenance and repairs should be done on a routine basis with special emphasis on inspection as soon as possible after heavy rainfall events. Sediment accumulated in the ditches shall be removed and disposed of properly, as needed, to maintain the required minimum cross section and grade.

REFERENCES

Temple, D.M., K.M. Robinson, R.M. Ahring, A.G. Davis. 1987. Agriculture Handbook 667, Stability Design of Grass-Lined Open Channels. USDA-Agricultural Research Service.

STATEMENT OF WORK
HILLSIDE DITCH (423)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documentation that will demonstrate that the criteria in NRCS practice standard have been met and are compatible with other planned and applied practices.
    a. Practice purpose(s) as identified in the conservation plan
    b. List of required permits to be obtained by the client
    c. Compliance with NRCS national and state utility safety policy (NEM Part 503-Safety, Subpart A - Engineering Activities Affecting Utilities 503.00 through 503.06)
    d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Hydrology/Hydraulics
        ii. Ditch velocity (EFH Part 650, Chapter 14, Table 14-3.)
        iii. Outlet capacity and stability
        iv. Vegetation
        v. Environmental Considerations
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits...
3. Operation and Maintenance Plan
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03 (a) (3)).
5. Design modifications during installation as required.

INSTALLATION

Deliverables

1. Pre Installation conference with client and contractor.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Installation inspection (according to inspection plan as appropriate).
    a. Actual materials used
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the installation process and materials meets design and permit requirements.

CHECK OUT

Deliverables

1. As-Built documentation.
    a. Extent of practice units applied
    b. Drawings
    c. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits (NEM Subpart A, 505.03 (c) (1)).
3. Progress reporting.

STATEMENT OF WORK
HILLSIDE DITCH (423)

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard - Hillside Ditch, 423
- NRCS National Engineering Manual (NEM).
- NRCS Engineering Field Handbook (EFH), Part 650
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

600 – TERRACE

-OPERATION AND MAINTENANCE

Sponsor/Land user: _____ Date: _____

Address: _____

_____

Location GPS Coordinates Map Datum: _____ E _____ N _____

Quad Sheet Name _____ SEC _____ T _____ R _____

A properly operated and maintained terrace is an asset to the farm. The terrace system was designed and installed to adequately protect the field(s) from excessive erosion. The estimated life span of this installation is at least 10 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program:

GENERAL RECOMMENDATIONS

- Maintain terrace capacity, storage, ridge height and outlets. Remove sediment build-up in terraces to maintain terrace capacity.
- Each inlet for underground outlets must be kept clean and sediment build-up redistributed so the outlet is the lowest elevation. Inlets damaged or cutoff by farm machinery must be replaced or repaired immediately.
- Terrace ridges, especially those with steep back slopes, can be very hazardous. For this reason, some farmers prefer steep front slopes, thus keeping machinery away from the steep back slopes. All cut and fill slopes that are to be farmed must be no steeper than those on which farm machinery can operate safely. Any potential hazard must be brought to the attention of the responsible person in charge of equipment operation.
- Remove all foreign debris that hinders system operation.
- Inspect for damage from rodents or burrowing animals. Repair any damage. Take appropriate corrective actions to alleviate further damage.
- Maintain all vegetation by reseeding if necessary and remove all brush and trees by approved herbicides or mechanical means.
- Perform periodic inspections, especially after significant storm events and promptly repair any damage to the system.

- Avoid farm tillage operations such as cultivators that reduce the ridge height, resulting in reduced capacity of the terrace.
- Periodic plowing operations may be needed to maintain the constructed ridge height and capacity of terrace.
- Restrict livestock use of field with a terrace system when the ground is wet.

SPECIFIC RECOMMENDATIONS FOR YOUR TERRACE

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE PLAN FOR YOUR TERRACE.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

TERRACE

(Ft.)

CODE 600

DEFINITION

An earth embankment, or a combination ridge and channel, constructed across the field slope.

PURPOSE

This practice is applied as part of a resource management system for one or more of the following purposes:

- Reduce erosion by reducing slope length
- Retain runoff for moisture conservation

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Soil erosion caused by water and excessive slope length is a problem
- Excess runoff is a problem
- There is a need to conserve water
- The soils and topography are such that terraces can be constructed and reasonably farmed
- A suitable outlet can be provided

CRITERIA

General Criteria Applicable To All Purposes

Spacing. Space terraces at intervals across the slope to achieve the intended purpose. The maximum spacing of terraces for erosion control is that necessary to achieve soil loss tolerance (T). Include both the terrace system with planned as-built slopes and cultural practices such as residue management when determining soil loss. The slope length used when checking soil loss for a proposed terrace spacing is the distance from the terrace ridge to the next lower terrace channel measured along the natural flow direction. Maximum spacing for erosion control based on soil loss tolerance may be increased by as much as 10 percent to provide better location, alignment to accommodate farm machinery or to reach a satisfactory outlet.

The methods that may be used to determine terrace spacing include the current NRCS accepted erosion prediction technology, the Vertical Interval Equation or state developed methods that address unique soil, cropping or other farming practices that affect terrace spacing. Refer to the current NRCS accepted erosion prediction software and user guide to determine soil loss. Refer to the Engineering Field Handbook, Chapter 8, Terraces for use of the Vertical Interval Equation.

Alignment. To accommodate farm machinery and farming operations, design cropland terraces with long gentle curves. When multiple terraces are used in a field, design the terraces to be as parallel to one another as practicable.

Capacity. Design terraces to have enough capacity to control the runoff from a 10-year frequency, 24-hour storm without overtopping. For terrace systems designed to control excess runoff or to function with other structures, choose a larger design storm that is appropriate to the risk associated with the installation. For terraces with underground outlets, the capacity to contain the design storm can be a combination of storage and out flow through the underground outlet. Increase the capacity of terraces by the estimated 10-year sediment accumulation, unless the Operation and Maintenance Plan specifically

addresses the annual removal of sediment.

For terraces with open outlets, the capacity is based on the terrace channel size and stability. Base the capacity of the channel on a bare earth channel for crop fields or in the case of a permanently vegetated channel, the appropriate vegetation. For bare earth channels use a Manning's n value of 0.035 or greater to calculate capacity. For permanently vegetated channels refer to Conservation Practice Standard (412), Grassed Waterway for design criteria to determine capacity.

Design level terraces to contain the runoff from a 10-year 24-hour rainfall event, and the expected 10-year sediment accumulation, unless the Operation and Maintenance Plan specifically addresses the annual removal of sediment.

Terrace cross section. Proportion the terrace cross section to fit the land slope, the crops grown, and the farm machinery used. Add ridge height if necessary to provide for settlement, channel sediment deposits, ridge erosion, the effect of normal tillage operations, or safety. At the design elevation, the ridge shall have a minimum width of 3 ft. For terraces with open outlets, design the capacity of the outlet to be equal to or greater than the capacity of the terrace channel.

All farmable terrace slopes shall be no steeper than those on which farm equipment can be operated safely. For non-farmable terrace slopes, the steepest slopes allowable are 2 horizontal to 1 vertical unless an analysis of site specific soil conditions indicate that steeper slopes will be stable.

End closures. Level terraces may have open ends, partial end closures, or complete end closures. Use partial and complete end closures only on soils and slopes where stored water will be absorbed by the soil without appreciable crop damage or where underground outlets are provided.

If terraces with closed or partly closed ends are specified, install the end closures before the terraces are completed. End closures less than or equal to half the effective height of the terrace ridge are considered partial closures while those greater than half the height are considered complete closures. The cross sectional area of the end closure fill may be less than the terrace cross section. For level terraces that have end closures that are lower than the terrace ridge elevation, areas downstream from the end closure must be protected from flow that will exit from the closure before the design storm is reached.

Channel grade. Design the terrace channel to be stable with non-erosive velocities but with sufficient grade to prevent damage to crops or to prevent delay of farming activities from prolonged ponding.

For cultivated terraces, base the channel stability on a bare earth condition. The maximum velocity for erosion-resistant soils (clay textural classification) is 2.5 ft/s; for average soils (silt textural classification), 2.0 ft/s; and for easily erodible soils (sand textural classification), 1.5 ft/s. If Manning's equation is used to compute velocity, use a maximum n value of 0.035 to determine velocity for channel stability.

For permanently vegetated channels, base the channel stability on the appropriate vegetation. Refer to Conservation Practice Standard 412, Grassed Waterway for design criteria to determine stability.

For short distances in the upper reaches of a channel, grades may be increased to improve alignment. For terraces with an underground outlet, channel grades can be steeper for short distances within the impoundment area.

Level terrace length. The volume of water stored in level terraces is proportional to the length. To reduce the potential risk from failure, do not design level terraces with lengths that exceed 3,500 feet unless the channel is blocked at intervals not exceeding 3,500 feet.

Outlets. All terraces must have adequate outlets. The outlet must convey runoff water to a point where it will not cause damage.

Vegetated outlets are suitable for gradient or open-end level terraces. Grassed waterways or naturally vegetated drainage ways may be used as a vegetated outlet. Install and stabilize grassed waterways prior to the construction of the terrace so that the terrace will have a stable outlet when it is constructed. The capacity of the vegetated outlet must be large enough so that the water surface in the

outlet is below the water surface in the terrace at the design flow.

Underground outlets are suitable on gradient or level terraces. The outlet consists of an intake and an underground conduit. Refer to Conservation Practice Standard (620), Underground Outlet for design criteria for the underground outlet.

Design the intake structure for the underground outlet to control the flow out of the terrace and to prevent excessive pressure in the underground conduit. Design the outlet so that the flow release time does not exceed the inundation tolerance of the planned crops. If sediment retention is a primary design goal, adjust the release rate according to sediment particle size. Locate the inlet for the underground outlet to accommodate farming operations and to allow for sediment accumulation.

Soil infiltration may be used as the outlet for level terraces. Soil infiltration rates, under average rainfall conditions, must permit infiltration of the design storm from the terrace channel within the inundation tolerance of the planned crops.

Combinations of different outlet types may be used on the same terrace system to optimize water conservation, improve water quality, accommodate farming operations or to provide for economical installation.

Vegetation. Stabilize all areas planned for vegetation as soon as possible after construction. Refer to Conservation Practice Standard, 342, Critical Area Planting for seeding criteria.

Drainage. Install subsurface drainage to stabilize soils and improve terrace function as needed. Refer to Conservation Practice Standard, 606, Subsurface Drain for design and installation criteria.

Additional Criteria Applicable to Retaining Runoff for Moisture Control

For terraces installed to retain moisture, perform a water budget analysis to determine the volume of water that must be collected to meet the requirements of the water budget. As a minimum the terrace must still meet the design storm and sediment volume requirements in the Capacity section of this standard.

CONSIDERATIONS

One of the keys to a successful terrace system is to make sure that the terrace layout fits the farm equipment. This includes making curves long and gentle and spacing terraces so that the operator can make an even number of trips between terraces so that they end up on the same side of the field they started on.

Terrace ridges and cut slopes can introduce steep and potentially hazardous slopes into a crop field. Where slopes will be farmed, make sure they can be safely negotiated with the operator's equipment. Where steep slopes are unavoidable make sure the operator is aware of the location and potential danger of the slopes.

The soil survey can be a valuable resource when planning and designing terrace systems. The soil survey can identify potential problems such as the presence of limiting layers to plant growth in the soil profile. Field investigations can then identify problem areas to avoid such as shallow bedrock or dense, acid or saline layers that will adversely affect plant growth if construction brings them into the root zone.

Steep sided terraces that are in permanent vegetation can provide significant areas of habitat for wildlife. Consider planting native species that provide food and cover for wildlife. Do not mow these areas until after the nesting season to improve wildlife production.

Hillside seeps in a crop field can cause cropping problems. Consider aligning terraces and/or installing subsurface drainage to intercept and correct seepage problems.

Erosion can be a problem at the outfall of an underground outlet. To ensure an adequate outlet, protect the outfall of the underground outlet so that it is stable.

Outlets from terraces can provide a direct conduit to receiving waters for contaminated runoff from crop land. Terraces should be installed as part of a conservation system that addresses issues such as nutrient and pest management, residue management and filter areas.

Inlets for underground outlets can be easily damaged during cultivation, planting and harvesting operations. Using brightly colored inlets, barriers around the inlet or otherwise clearly marking the inlet will help prevent damage.

For terraces that will be farmed or otherwise revegetated, the stripping and stockpiling of topsoil from the construction area prior to excavation and then spreading the topsoil on the completed terrace will improve the growth of vegetation after construction.

Cultural Resources

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

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

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

Endangered Species

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

PLANS AND SPECIFICATIONS

Prepare plans and specifications for terraces that describe the requirements for applying the practice according to this standard. As a minimum the plans and specifications shall include:

1. A plan view of the layout of the terrace system.
2. Typical cross sections of the terrace(s).
3. Profile(s) or planned grade of the terrace(s).
4. Details of the outlet system
5. If underground outlets are used, details of the inlet and profile(s) of the underground outlet.
6. Seeding requirements if needed.
7. Site specific construction specifications that describe in writing the installation of the terrace system.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator. The minimum requirements to be addressed in a written operation and maintenance plan are:

1. Periodic inspections, especially immediately following significant runoff events.
2. Prompt repair or replacement of damaged components.
3. Maintenance of terrace ridge height, channel profile, terrace cross-sections and outlet elevations.
4. Removal of sediment that has accumulated in the terrace channel to maintain capacity and grade.
5. Regular cleaning of inlets for underground outlets. Repair or replacement of inlets damaged by farm equipment. Removal of sediment around inlets to ensure that the inlet remains the lowest spot in the terrace channel.

6. Where vegetation is specified, seasonal mowing and control of trees and brush.
7. Notification of hazards about steep slopes on the terrace.

REFERENCES

USDA, NRCS. 2004. Revised Universal Soil Loss Equation, Ver. 2 (RUSLE2).

USDA, NRCS. National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 8.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

620 – UNDERGROUND OUTLET

OPERATION AND MAINTENANCE

Sponsor/Land user: _____ Date: _____

Address: _____

_____

Location GPS Coordinates Map Datum: _____ E _____ N _____

Quad Sheet Name _____ SEC _____ T _____ R _____

A properly operated and maintained underground outlet is an asset to the farm. This outlet was designed and installed to pressurize and convey water in a pipeline where it can be released without causing erosion. The estimated life span of this installation is at least 20 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program:

GENERAL RECOMMENDATIONS

- Inspect all above ground connections, valves, gates, trash racks, rodent guards, inlets and outlets to make sure they are functioning properly. Remove any trash or debris and promptly repair if necessary.
- Maintain design depth of cover on all pipelines and structures.
- Avoid operation of tillage and subsoiling equipment that could damage any component of the system.
- Remove all foreign debris that hinders system operation.
- Limit traffic over pipeline to designated sections that were designed for traffic loads.
- Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization and application of herbicides when necessary. Periodic mowing may also be needed to control growth.
- Inspect for damage from rodents or burrowing animals. Repair any damage. Take appropriate corrective actions to alleviate further damage.
- Immediately repair any vandalism, vehicular or livestock damage.
- Repair leaks and broken or crushed pipes to insure proper functioning of the conduit.

SPECIFIC RECOMMENDATIONS FOR YOUR UNDERGROUND OUTLET

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE PLAN FOR YOUR UNDERGROUND OUTLET.

U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
620 - UNDERGROUND OUTLET

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

Referral No._____Prepared By_____ Date_____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS TECHNICIAN.

1. Drawings, No._____ _____ _____

2. Practice Specifications: 620 , _____,_____,_____

3. Type and size of pipe:_____

4. Type of outlet_____

5. Structure required_____

6. Special Requirements:_____

_____

_____

_____

_____

7. Special Maintenance Requirements:_____

_____

_____

PRACTICE APPROVAL:

Job Classification: (Ref: Section 501 NEM)

Show the limiting elements for this job. This job is classified as, Class _____

Limiting elements:	Units
Design capacity_____	_____cfs
_____	_____
_____	_____
_____	_____

Design Approved by:_____ Date:_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the drawings and specification, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS technician.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date _____

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

620 - UNDERGROUND OUTLET

I. SCOPE

The work shall consist of furnishing materials and installing underground outlet with appurtenances to the lines, grades, and elevations as shown on the drawings or as staked in the field.

II. EXCAVATION

Excavation shall be to the lines and grades shown on the drawings. Where trenches are excavated in soils containing rock or other hard material, or soils subject to appreciable swelling and shrinking, or when the trench bottom is unstable, the trenches shall be overexcavated and backfilled with selected materials to sufficient depth to provide a suitable base. If water is in the trench, that water shall be removed before placement of the pipe.

The width of the trench at any point below the top of the pipe shall be no wider than is necessary to, join, and backfill the pipe, and in no event be more than 24 inches wider than the nominal diameter of the pipe.

III. PLACEMENT

No pipe shall be laid which is cracked, checked, spalled, or damaged beyond ASTM specification tolerances; and all such sections of pipe shall be permanently removed from the work site.

Before final positioning of the pipe for jointing, the bedding for the pipe shall be made by tamping the pipe firmly into the bedding and not be by wedging or blocking.

The interior of the pipe shall be kept free of dirt and other foreign material as pipe installation progress.

IV. BACKFILLING

Initial Backfill

Hand, mechanical, or water packing methods are optional.

The initial backfill material shall be selected soil or sand free from rocks or stones larger than one inch in diameter. At the time of placement, the moisture content of the material shall be such that the required degree of compaction can be obtained with the backfill method to be used. The initial backfill material shall be so placed that the pipe will not be displaced, excessively deformed, or damaged.

Hand or Mechanical Backfill

Compaction shall be accomplished by means of hand tamping or manually directed power tamper, or plate vibrators, or as approved by the technician. Fill shall be placed in approximately horizontal layers. Hand compacted fill shall be placed in layers not more than 4 inches thick before compaction. Fill shall be placed in a manner that will prevent damage to the conduit. The height of the fill adjacent to the conduit shall be increased at approximately the same rate on all sides. Water shall be added to the fill material to obtain the proper moisture for compaction as directed by the technician.

Water Packing

When water packing is used, the pipeline first shall be filled with water. The initial backfill, before wetting shall be of sufficient depth to insure complete coverage of the pipe after consolidation has taken place. Water packing is accomplished by adding water to diked reaches of the trench in such quantity as to thoroughly saturate the initial backfill without excessive pooling of water. After saturation, the pipeline shall remain full until after final backfill is made. The wetted fill shall be allowed to dry until firm before final backfill is begun.

Final Backfill

Final backfill material shall be free of large rocks, frozen clods and other debris greater than three inches in diameter. The material shall be placed and spread in approximately uniform layers in such a manner that there will be no unfilled spaces in the backfill and the backfill will be level with the natural ground or at the design grade required to provide the minimum depth of cover after settlement has taken place. Rolling equipment shall not be used to consolidate the final backfill until a minimum depth of cover of 2 feet has been placed.

All special backfill requirements of the pipe manufacturer shall be complied with during the backfill operations.

V. MATERIALS

Pipe

The pipe shall be of the size and conform to the requirements of the Specification listed on the "Practice Requirement" sheet.

Appurtenances

All appurtenances shall conform to the specifications listed on the "Practice Requirement" sheet and to the sizes and dimensions as shown on the drawings.

Appurtenances shall include, but not be limited to, anti-seep collars, outlets, and energy dissipators. Backfill adjacent to appurtenances is critical, and shall be manually directed and to the same density the adjacent undistributed earth.

VI. BASIS OF ACCEPTANCE

The acceptability of the pipeline shall be determined by inspections to insure compliance with all the provisions of this specification with respect to the design of the line, the pipe and pipe markings, the appurtenances, and the minimum installation requirements.

VII. VEGETATIVE COVER

Unless otherwise specified, a protective cover of vegetation shall be established on the disturbed area. The planting of vegetative materials shall conform to the requirements of Practice Specification 342, Critical Area Planting.

VIII. SPECIAL MEASURES

Measures and construction methods shall be incorporated as needed and practical that enhance fish and wildlife values. Special attention shall be given to protecting visual resources and maintaining key shade, food and den trees.

IX. CONSTRUCTION OPERATIONS

Construction operations shall be done in such a manner that erosion and air and water pollution are minimized and held within legal limits. The owner, operator, Contractor or other persons will conduct all work and operations in accordance with proper safety codes for the type of construction being performed with due regards to the safety of all persons and property.

The completed job shall be workmanlike and present a good appearance.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

UNDERGROUND OUTLET

(Ft.)

CODE 620

DEFINITION

A conduit or system of conduits installed beneath the surface of the ground to convey surface water to a suitable outlet.

PURPOSE

To carry water to a suitable outlet from terraces, water and sediment control basins, diversions, waterways, surface drains or other similar practices without causing damage by erosion or flooding.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Disposal of surface water is necessary.
- An outlet is needed for a terrace, diversion, water and sediment control basin or similar practice but a surface outlet is impractical because of stability problems, topography, climatic conditions, land use or equipment traffic.
- The site is suitable for an underground outlet.

CRITERIA

Capacity. The design capacity of the underground outlet is based on requirements of the structure or practice it serves. The underground outlet can be designed to function as the only outlet for a structure or it can be designed to function with other types of outlets. The capacity of the underground outlet for natural or constructed basins shall be adequate for the intended purpose without causing inundation damage to crops, vegetation, or works of improvements.

Underground outlets may be designed for either pressure or gravity flow. If a pressure system is designed, all pipe and joints must be adequate to withstand the design pressure, including surges and vacuum. To fully utilize conduit capacity, design the inlet to provide maximum flow in the conduit. To prevent pressure flow or overloading of the conduit a flow restricting device such as an orifice or weir can be used to limit flow into the conduit.

If there are multiple structures flowing into an underground outlet, design the system so that upstream structures do not discharge into downstream structures unless the downstream structure is designed to accommodate the extra flow.

Pressure-relief wells may be used to allow excess flow to escape the conduit and flow over the surface. Only use pressure relief wells where there is a stable outlet for the flow from the relief well. Cover pressure relief wells with a grate or other appropriate covering to prevent the entry of small animals and debris.

Inlet. An inlet can be a collection box, a perforated riser, or other appropriate device. For perforated risers, use durable, structurally sound material that is resistant to damage by rodents or other animals. Use fire resistant materials for the inlet if fire is an expected hazard.

Inlets must have an appropriate trash guard to ensure that trash or other debris entering the inlet passes through the conduit without plugging.

Design collection boxes large enough to allow maintenance and cleaning operations. Use blind inlets where the installation of an open or

above ground structure is impractical. Design the blind inlet with a graded granular filter around the conduit. Design the filter based on the particle size of the surrounding soil and the desired flow rate. Refer to NEH Part 650, Engineering Field Handbook, Chapter 14 for the design of blind inlets.

Conduit. Underground outlets shall be conduits of tubing, tile or pipe. The minimum allowable conduit diameter is 4 inches. Design hydraulically smooth joints using materials and methods recommended by the manufacturer of the conduit.

The maximum design velocity must not exceed the safe velocity for the conduit materials and installation according to the conduit manufacturer's recommendation. To prevent sediment from collecting in the conduit, underground outlets should be designed with a minimum velocity of 1.4 ft/sec.

If junction boxes and other structures are needed, design them to allow cleaning and other maintenance activities. Maintain a downward grade towards the outlet in all sections of the underground outlet.

Materials. Plastic, concrete, aluminum, and steel pipe shall meet the requirements specified in the applicable ASTM standard. Materials must meet applicable site specific design requirements for leakage, external loading, internal pressure or vacuum.

Underground outlet conduits can be perforated or nonperforated, depending on the design requirements. Use a filter fabric wrap (sock) or appropriately designed granular filter if migration of soil particles into the conduit is anticipated. Design the filter based on the particle size of the surrounding soil to prevent rapid clogging of the filter. Protect all exposed plastic materials from degradation due to exposure to sunlight.

The pipe shall conform to or exceed the requirements of the appropriate specification listed below:

ASTM Specifications:

A 760 Corrugated Steel Pipe, Metallic Coated for Sewer and Drains
B 745 Corrugated Aluminum Pipe for Sewers and Drains
C 700 Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated

Specifications for C 700, Vitrified Clay Pipe, Standard Strength and Perforated, may be modified as follows:

Where clay pipe will not be subject to freezing and thawing hazards, before or during installation, and where the average frost depth is less than 18 inches, the freezing and thawing and absorption tests may be modified or waived.

C 412 Concrete Drain Tile
C 118 Concrete Pipe for Irrigation or Drainage
C 497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
C 14 Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
C 76 Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
D 2729 Poly(vinyl Chloride) (PVC) Sewer Pipe and Fittings
D 1527 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80
D 1785 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D 2104 Polyethylene (PE) Plastic Pipe, Schedule 40
D 2239 Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
D 2241 Poly(Vinyl Chloride) (PVC), Pressure-Rated Pipe (SDR Series)
D 2447 Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
D 2513 Thermoplastic Gas Pressure Pipe, Tubing and Fittings
D 2737 Polyethylene (PE) Plastic Tubing
D 2672 Joints for IPS PVC Pipes Using Solvent Cement
D 3035 Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
F 405 Corrugated Polyethylene (PE) Tubing and Fittings
F 667 Large Diameter Corrugated Polyethylene Pipe and Fittings
AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inches through 12 inches

AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inches

Filters and Filter Material. Filters will be used around conduits, as needed, to prevent movement of the surrounding soil material into the conduit. The need for a filter will be determined by the characteristics of the surrounding soil material, site conditions, and the velocity of flow in the conduit. A suitable filter should be specified if:

1. Local experience indicated a need.
2. Soil materials surrounding the conduit are dispersed clays, silts with a plasticity index less than 7, or fine sands with a plasticity index less than 7.
3. Deep soil cracking is expected, or
4. The method of installation may result in voids between the conduit and backfill material.

If a sand-gravel filter is specified, the filter gradation shall be designed in accordance with National Engineering Handbook (NEH) Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters.

Specified filter material must completely encase the conduit so that all openings are covered with at least 3 inches of filter material except that the top of the conduit and side filter material may be covered by a sheet of plastic or similar impervious material to reduce the quantity of filter material required. In all cases the resulting flow pattern through filter material shall be a minimum of 3 inches.

Artificial fabric or mat-type filter materials may be used, provided that the effective opening size, strength, durability, and permeability are adequate to prevent soil movement into the drain throughout the expected life of the system.

Envelopes and Envelope Material. Envelopes shall be used around subsurface drains if they are needed for proper bedding of the conduit or to improve the characteristics of flow of ground water into the conduit.

Materials used for envelopes do not need to meet the gradation requirements of filters, but they must not contain materials that will cause an accumulation of sediment in the conduit or that will render the envelope unsuitable for bedding of the conduit.

Envelope materials shall consist of sand-gravel, organic, or similar material. Sand-gravel envelope materials shall all pass a 1.5-inch sieve; not more than 30 percent shall pass a No. 60 sieve; and not more than 5 percent shall pass the No. 200 sieve. ASTM-C-33 fine aggregate for concrete has been satisfactorily used and is readily available.

Where organic or other compressible materials are used, they shall be used only around a rigid wall conduit and above the centerline of flexible tubing. All organic or other compressible material shall be of a type that will not readily decompose.

Anti-seep Collars. Consideration must be given to prevent piping in the backfill along the pipeline. Failure of the system can result if this is not considered. Piping is controlled at many sites by sloping of the trench banks and compacting the backfill (see figure 8-78, page 8-83 of the Engineering Field Manual). Moisture content of the backfill should be adjusted to aid compaction. Highly angular material which may bridge should not be used for backfill where piping is a concern. Protection can be provided by the use of anti-seep collars to increase the path of percolation.

Sufficient anti-seep collars shall be installed on an underground outlet to prevent the surface and subsurface waters from flowing into and adjacent to the pipe. Particular locations of weakness are below inlets, bends, transitions and areas where compaction is difficult. They should be placed on a maximum spacing of 100 feet.

Anti-seep collars of concrete, sheet metal, or rubber can be used. The collars are to extend beyond the pipe on all sides at least 1 foot or the diameter of the pipe whichever is greater.

Compaction around the anti-seep collars must be equal to or greater than the adjacent in-place material.

Outlet. The outlet must be stable for anticipated design flow conditions from the underground outlet. Design the underground outlet for water surface conditions at the outlet expected during the design flow conditions.

The outlet must consist of a continuous 10 foot section or longer of closed conduit or a headwall at the outlet. If a closed conduit is used, the material must be durable and strong enough to withstand anticipated loads, including those caused by ice. Do not design outlets to be placed in areas of active erosion. Use fire resistant materials if fire is an expected hazard. All outlets must have animal guards to prevent the entry of rodents or other animals. Design animal guards to allow passage of debris while blocking the entry of animals that cannot easily escape from the conduit.

Stabilization. Reshape and regrade all disturbed areas so that they blend with the surrounding land features and conditions. Revegetate or otherwise protect from erosion, disturbed areas that will not be farmed, as soon as possible after construction.

CONSIDERATIONS

Pressure relief wells, if not properly covered, can present a safe hazard for people or animals stepping into the well. In addition, pressure relief wells can be easily damaged by field equipment. To prevent accidents mark the location of pressure relief wells with a high visibility marker.

The rapid removal of water through an underground outlet will affect the water budget where it is installed. It can reduce infiltration. It can increase or decrease peak flows to receiving waters and reduce long term flows into the same waters. Consider these long term environmental, social, and economic effects when making design decisions for the underground outlet and the structure or practice it serves.

If perforated pipe is used for the subsurface conduit, locate the practice so that it has a minimal effect to the hydrology of wetlands.

Where perforated risers are used, often the risers are perforated below the surface of the ground to facilitate drainage. In this situation, if soil entry into the riser perforations is a problem, use an appropriately designed gravel or geotextile filter around the buried portion of the riser.

Seasonal water sources can be very important for migratory waterfowl and other wildlife. The use of a water control structure, on the inlet of an underground outlet during non-cropping times of the year, can allow water to pond in the structure to provide water for wildlife. Refer to Conservation Practice Standard (646) Shallow Water Development and Management for information on managing seasonal water sources for wildlife.

Underground outlets can provide a direct conduit to receiving waters for contaminated runoff from crop land. Underground outlets and the accompanying structure or practice should be installed as part of a conservation system that addresses issues such as nutrient and pest management, residue management and filter areas.

The construction of an underground outlet in a riparian corridor can have an adverse affect on the visual resources of the corridor. Consider the visual quality of the riparian area when designing the underground outlet.

The construction of an underground outlet can disturb large areas and potentially affect cultural resources. Be sure to follow state cultural resource protection policies before construction begins.

If an installation in a crop field is too shallow, tillage equipment can damage an underground outlet. Consider the type and depth of tillage that will likely occur when designing the depth of an underground outlet. A minimum of 2 feet of cover is recommended over all conduits.

Cultural Resources

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

http://www.nrcs.usda.gov/technical/cultural.html is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural

resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

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

Endangered Species

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

PLANS AND SPECIFICATIONS

Prepare plans and specifications for underground outlets that describe the requirements for applying this practice according to this standard. The plans and specifications for an underground outlet may be incorporated into the plans and specifications for the structure or practice it serves. As a minimum the plans and specifications shall include:

1. A plan view of the layout of the underground outlet.
2. Typical cross sections or bedding requirements for the underground outlet.
3. Profile of the underground outlet.
4. Details of the inlet and outlet.
5. Seeding requirements if needed.
6. Construction specifications that describe in writing the site specific installation requirements of the underground outlet.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator. The minimum requirements to be addressed in a written operation and maintenance plan are:

- Periodic inspections, especially immediately following significant runoff events, to keeping inlets, trash guards, and collection boxes and structures clean and free of materials that can reduce flow.
- Prompt repair or replacement of damaged components.
- Repair or replacement of inlets damaged by farm equipment.
- Repair of leaks and broken or crushed lines to insure proper functioning of the conduit.
- Periodic checking of the outlet and animal guards to ensure proper functioning.
- Repair of eroded areas at the pipe outlet.
- Maintenance of adequate backfill over the conduit.
- To maintain the permeability of surface materials on blind inlets, periodic scouring or removal and replacement of the surface soil layer may be necessary.

REFERENCES

USDA, NRCS. National Engineering Handbook, Part 650 Engineering Field Handbook, Chapters 6, 8, 14.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

635 – VEGETATED TREATMENT AREA

OPERATION AND MAINTENANCE

Sponsor/Land user: _____ Date: _____

Address: _____

_____

Location GPS Coordinates Map Datum: _____ E _____ N _____

Quad Sheet Name _____ SEC _____ T _____ R _____

A properly operated and maintained vegetated treatment area is an asset to your farm. This vegetated wastewater treatment strip was designed and installed to remove sediment and pollutants from agricultural wastewater and runoff. The estimated life span of this installation is at least 10 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program.

GENERAL RECOMMENDATIONS

- Remove all foreign debris that hinders system operation.
- Harvest treatment strip vegetation as appropriate to encourage dense growth, maintain an upright growth habit, and remove nutrients and other contaminants that are contained in the plant tissue.
- Control undesired weed species, especially state-listed noxious weeds.
- Inspect and repair treatment strips after storm events to fill in gullies, remove flow disrupting sediment accumulation, re-seed disturbed areas, and take other measures to prevent concentrated flow.
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of herbaceous vegetation.
- Maintain or restore the treatment strip as necessary by periodically grading when deposition jeopardizes its function, and then reestablishing to herbaceous vegetation.
- Routinely de-thatch and/or aerate treatment strips used for treating runoff from livestock holding areas in order to promote infiltration.
- Conduct maintenance activities only when the treatment strip is dry and moisture content in the surface soil layer will not allow compaction.

- Prevent grazing in treatment strips.
- Inspect filter strips regularly, especially following heavy rains. Inspect filter strips annually for damage due to normal use. Repair and reseed eroded areas immediately. Remove sediment deposits to maintain capacity of filter strip.
- Seeding shall be protected from concentrated flow and grazing until vegetation is established.
- Promptly repair all broken subsurface drain lines adjacent to or in the waterway.
- Maintain all sediment control measures in the contributing watershed to prevent sedimentation and the resulting loss of capacity.
- Filter strips in arid or semiarid regions that potentially could be affected by high salinity and/or sodicity (sodium content) should be monitored for excessive salt and sodium buildup. If found to be excessive, an appropriate corrective action shall be taken

SPECIFIC RECOMMENDATIONS FOR YOUR VEGETATED TREATMENT AREA

Provide application rates (seasonal rates may differ).

Provide filter resting time.

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE PLAN FOR YOUR VEGETATED TREATMENT AREA.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

VEGETATED TREATMENT AREA

(Ac.)

CODE 635

DEFINITION

An area of permanent vegetation used for agricultural wastewater treatment.

PURPOSE

To improve water quality by reducing loading of nutrients, organics, pathogens, and other contaminants associated with livestock, poultry, and other agricultural operations.

CONDITIONS WHERE PRACTICE APPLIES

Where a Vegetated Treatment Area (VTA) can be constructed, operated and maintained to treat contaminated runoff from such areas as feedlots, compost areas, barnyards, and other livestock holding areas; or to treat process wastewater from agricultural operations.

CRITERIA

Vegetated treatment areas shall comply with all applicable laws, rules, regulations, and permit requirements including those applicable to the discharges of waters to the state.

Base the total treatment area for the VTA on the soil's capacity to infiltrate and retain storm runoff and process water within the root zone and the vegetation's agronomic nutrient requirements. Use the soil's water holding capacity in the root zone, infiltration rate, permeability, and hydraulic conductivity to determine its ability to absorb and retain runoff. Base the runoff determination on the most restrictive soil layer within the root zone regardless of its thickness.

Divert uncontaminated water from the treatment area to the fullest extent possible unless additional moisture is needed to manage vegetation growth in the treatment area.

Design the VTA based on the need to treat the runoff volume from the 25-year, 24-hour storm event from the agricultural animal management facility. Infiltrate a portion or the entire volume of the design storm, based on management objectives. The portion of the design volume not infiltrated shall be stored for utilization or treatment unless discharge is permitted by applicable regulations.

The VTA design for processed water shall be based on the nutrient contents of the processed water and the VTA's ability to hold and uptake the nutrients.

Permanent vegetation consisting of a single species or a mixture of grasses, legumes and/or other forbs adapted to the soil and climate shall be established in the treatment area. Selected species shall be suited to current site conditions and intended use. Selected species will have the capacity to achieve adequate density, vigor and yield within an appropriate time frame to treat contaminated runoff. Site preparation and seeding shall be done at a time and in a manner that best ensures survival and growth of the selected species.

Vegetation shall be able to withstand anticipated wetting and/or submerged conditions. Harvest VTA as appropriate to encourage dense growth, maintain an upright growth habit, and remove nutrients and other contaminants that are contained in the plant tissue

Exclude livestock access to the vegetated treatment area.

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

Discharge into and through treatment areas shall be applied as sheet flow. Where sheet flow is planned, some means, such as a ditch, curb, gated pipe, level spreader or a sprinkler system, shall be provided to disperse concentrated flow and ensure sheet flow across the treatment area. Land grading and structural components necessary to maintain sheet flow throughout the treatment area shall be provided as necessary.

If site restrictions require location within a floodplain, the VTA shall be protected from inundation or damage from a 25-year flood event, or larger if required by regulation.

The water table shall be either naturally deep enough or artificially lowered so that the infiltrated runoff does not mingle with the ground water at the bottom of the root zone. Subsurface drainage shall not be provided within the VTA. Subsurface drainage may be used to lower the seasonal high water table to an acceptable level provided the subsurface drain lines are at least 10 feet away from the VTA and collected water is of suitable quality for discharge.

Infiltration areas shall not be planned where soil features such as cracking will result in preferential flow paths that transport untreated runoff from the surface to below the root zone, unless the soil moisture can be maintained to prevent drying and cracking.

Vegetated treatment areas must have a minimum flow length of 100 feet. The natural or constructed slope of the VTA shall be 0.3 to 6 percent. The entrance slope to the VTA shall not be flatter than 1 percent.

CONSIDERATIONS

Provide more than one treatment area to allow for resting, harvesting vegetation, maintenance, and to minimize the potential for overloading.

Use warm and cool season species in separate areas to ensure that plants are actively growing to maximize nutrient uptake during different times of the year.

Pre-treat influent with solid/liquid separation to reduce organic loading, odor generation, and nutrients to levels that will be tolerated by the VTA and to prevent excessive accumulation of solids in the treatment area.

Utilize inlet control structures to prevent undesirable debris from entering the VTA, to control the rate and timing of inflow during normal operations and to control inflow as necessary for operation and maintenance.

Supplement water as necessary to maintain plants in a condition suitable for the treatment purpose.

Store seasonal contaminated water upstream of the VTA during excessively wet or cold climatic conditions.

Consider suspension of application to treatment area when weather conditions are not favorable for aerobic activity or when soil temperatures are lower than 39^0 F. When soil temperatures are between 39^0 F and 50^0 F, consider reducing application rate and increasing application period while maintaining a constant hydraulic loading rate.

Manage the VTA to maintain effectiveness throughout the growing season. Time the harvest of the VTA plants so vegetation can regrow to a sufficient height to effectively filter effluent late in the growing season.

Effluent from the VTA may be stored for land application, recycled through the wastewater management system, or otherwise used in the agricultural operation.

Fences or other measures may be needed to exclude or minimize access of the VTA to humans or animals that would inhibit its function.

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard that describe the requirements for applying the practice to achieve its intended use. Include critical construction perimeters, necessary construction sequence, vegetation establishment requirements, and nutrient removal.

Plans and Specifications will include:

- A plan view showing the location of the VTA

- Details of the length, width, and slope of the treatment area to accomplish the planned purpose (length refers to flow length down the slope of the treatment area)
- Herbaceous species, seed selection, and seeding rates to accomplish the planned purpose
- Planting dates, care, and handling of the seed to ensure that planted materials have an acceptable rate of survival
- Site preparation sufficient to establish and grow selected species

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design.

The plan shall include the following as appropriate:

- Control undesired weed species, especially state-listed noxious weeds, and other pests that could inhibit proper functioning of the VTA
- Inspect and repair treatment areas after storm events to fill in gullies, remove flow disrupting sediment accumulation, re-seed disturbed areas, and take other measures to prevent concentrated flow
- Apply supplemental nutrients and soil amendments as needed to maintain the desired species composition and stand density of herbaceous vegetation
- Maintain or restore the treatment area as necessary by periodically grading when deposition jeopardizes its function, and then reestablishing to herbaceous vegetation
- Routinely de-thatch and/or aerate treatment areas used for treating runoff from livestock holding areas in order to promote infiltration
- Conduct maintenance activities only when the surface layer of the VTA is dry enough to prohibit compaction

Treatment areas in arid or semiarid regions that potentially could be affected by high salinity and/or sodium content should be monitored for excessive salt and sodium buildup. If excessive salt or sodium is found, an appropriate corrective action shall be taken.

REFERENCES

USDA/NRCS, National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook.1992, Last revised, June 1999.

Koelsch, R., B. Kintzer, and D. Meyer. (ed.) 2006. Vegetated Treatment Systems for Open Lot Runoff - A Collaborative Report. USDA, NRCS. http://www.heartlandwq.iastate.edu/ManureManagement/AlternativeTech/Avtsguidance/

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

638 – WATER AND SEDIMENT CONTROL BASIN

OPERATION AND MAINTENANCE

Sponsor/Land user: _____ Date: _____

Address: _____

_____

Location GPS Coordinates Map Datum: _____ E _____ N _____

Quad Sheet Name _____ SEC _____ T _____ R _____

A properly operated and maintained Water and Sediment Control Basin is an asset to your farm. This sediment basin was designed and installed to remove, collect and provide temporary storage of sediment and water. The estimated life span of this installation is at least 10 years. The life of this installation can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require you to perform periodic operation to maintain satisfactory performance. Additional permits may be required to perform this work. Here are some recommendations to help you develop a good operation and maintenance program.

GENERAL RECOMMENDATIONS

- Periodic removal of sediment is necessary to maintain the effectiveness of this installation. The cleanout intervals may vary depending upon the volume of sediment that has accumulated. As a general rule the basin will lose its effectiveness when about 50 percent of the design volume is filled with sediment.
- Periodically inspect the spillways and control gates for proper functioning for their ability to maintain the water level to design elevations. Immediately remove any blockage or obstructions in spillways.
- Maintain vigorous growth of vegetative coverings. This includes reseeding, fertilization, and application of herbicides when necessary. Periodic mowing may also be needed to control height.
- If fences are installed, they shall be maintained to prevent unauthorized or livestock entry.
- Immediately repair any vandalism, vehicular, or livestock damage to any earthfills, spillways, outlets or other appurtenance.
- Removal of debris that may accumulate at the pond and immediately upstream or downstream from the basin.
- Make sure all structure drains are functional and soil is not being transported through the drainage system. The screens and/or rodent guards shall also be kept in place.

- Repair spells, cracks and weathered areas in concrete surfaces.
- Repair or replace rusted or damaged metal and apply paint as a protective coating.
- Inspect for damage from rodents or burrowing animals. Repair any damage. Take appropriate corrective actions to alleviate further damage.
- Remove woody vegetation from embankments.
- Avoid excessive travel on any portion of the system that will harm or destroy the vegetative cover.

SPECIFIC RECOMMENDATIONS FOR WATER AND SEDIMENT CONTROL BASIN

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE FOR YOUR WATER AND SEDIMENT CONTROL BASIN.

U.S DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
CALIFORNIA

PRACTICE REQUIREMENTS
FOR
638 – WATER AND SEDIMENT CONTROL BASIN

For: Business Name_____

Job Location_____

County_____ RCD_____ Farm/Tract No._____

Referral No._____Prepared By_____ Date_____

IT SHALL BE THE RESPONSIBILITY OF THE OWNER TO OBTAIN ALL NECESSARY PERMITS AND/OR RIGHTS, AND TO COMPLY WITH ALL ORDINANCES AND LAWS PERTAINING TO THIS INSTALLATION.

Installation shall be in accordance with the following drawings, specifications and special requirements. NO CHANGES ARE TO BE MADE IN THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF THE NRCS TECHNICIAN.

1. Drawings, No._____ _____ _____

2. Practice Specifications_____,_____,_____

3. Earthfill Compaction by Method:_____

4. Special Requirements: _____

_____

_____

_____

_____

_____

_____

5. Special Maintenance Requirements:_____

_____

_____

PRACTICE APPROVAL:

Job Classification: (Ref: Section 501 NEM)

Show the limiting elements for this job. This job is classified as, Class _____

Limiting elements:	Units
Storage _____	_____ac-ft
Height of fill _____	_____ft
_____	_____
_____	_____
_____	_____

Design Approved by:_____ Date:_____

LANDOWNER'S/OPERATOR'S ACKNOWLEDGEMENT:

The landowner/operator acknowledges that:

a. He/she has received a copy of the construction drawings and specification, and that he/she has an understanding of the contents, and the requirements.

b. He/she has obtained all the necessary permits.

c. No changes will be made in the installation of the job without prior concurrence of the NRCS technician.

d. Maintenance of the installed work is necessary for proper performance during the project life.

Accepted by:_____ Date:_____

PRACTICE COMPLETION:

I have made an on site inspection of the site (or I am accepting owner/contractor documentation), and have determined that the job as installed does conform to the drawings and practice specifications.

Completion Certification by:

/s/_____ Date _____

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

638 – WATER AND SEDIMENT CONTROL BASIN

I. SCOPE

The work shall consist of constructing an earthfill embankment and appurtenances to the lines, grades, elevations and dimensions shown on the drawings or as staked in the field for the purpose to construct a pond.

II. FOUNDATION PREPARATION

The foundation area shall be cleared of trees, logs, stumps, roots, brush, boulders, sod, and rubbish, and shall be stripped to sufficient depth to remove all objectionable material. If needed to establish vegetation, the topsoil and sod shall be stockpiled and spread on the completed dam and spillways. Foundation surfaces shall be sloped no steeper than 1:1. The foundation area shall be thoroughly scarified before placement of the fill material. The surface shall have moisture added or it shall be compacted if necessary so that the first layer of fill material can be compacted and bonded to the foundation.

The cutoff trench and any other required excavation shall be excavated to the elevations and cross sections shown on the drawings or as staked in the field. Suitable excavated materials shall be used in the embankment fill. Compacted backfill shall not be placed in the trench until the engineer has inspected and approved the trench.

Existing stream channels in the foundation area shall be sloped no steeper than 1:1 and deepened and widened as necessary to remove all stones, gravel, sand, stumps, roots, and other objectionable material and to accommodate compaction equipment.

III. EARTHFILL PLACEMENT

Material

All fill materials shall be obtained from approved borrow pits and from excavations (if acceptable) required for other parts of the work. Fill materials shall contain no sod, brush, roots, or other perishable or unsuitable material. Cobbles and rock fragments having a maximum dimension of more than six inches shall be removed from the materials prior to compaction, and be disposed of or placed in areas designated by the Engineer.

Placement

Foundation areas shall be kept free of standing water when fill is being placed on them.

The placing and spreading of fill material shall be started at the lowest point of the foundation and the fill brought up in horizontal layers of such thickness that the required compaction can be obtained. The fill shall be constructed in continuous horizontal layers except where openings or sectionalized fills are required. In those cases, the slope of the bonding surfaced between the embankment in place and the embankment to be placed shall not be steeper than 3 horizontal to 1 vertical. The bonding surface shall be treated the same as that specified for the foundation so as to insure a good bond with the new fill.

The distribution and gradation of materials shall be such that there are no lenses, pockets, streaks, or layers of material. If it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the center and upstream parts of the fill. If zoned fills of substantially differing materials are specified, the zones shall be placed according to lines and grades shown on the drawings.

Selected backfill material shall be placed around structures, pipe conduits, and anti-seep collars at about the same rate on all sides of prevent damage from unequal loading.

Fill placed around structures will be brought up at approximately uniform height on all sides of the structure.

Moisture content of the fill material shall be adequate for obtaining the required compaction. Material that is too wet shall be dried to meet this requirement, or removed, and material that is too dry shall have water added and mixed until the requirement is met.

The proper moisture content for compaction will be determined by inspection during the placement operation. The material should maintain a ball shape when squeezed in the hand. When specified, the moisture shall be maintained within 2 percentage points of optimum as determined by ASTM D-698.

As far as practicable, the material shall be brought to the proper water content in the borrow pits before excavation. Supplemental water, when required, may be applied by sprinkling the materials on the fill. Uniform distribution of the moisture shall be obtained by discing, blading or other approved method prior to compaction.

Compaction

Construction equipment shall be operated over each layer of fill to insure that the required compaction is obtained. Special equipment shall be used if needed to obtain the required compaction.

Compaction shall meet the requirements of the method specified on the Practice Requirements sheet and as described below:

A. Sheepsfoot roller - the maximum layer thickness shall be 8 inches before compaction. The roller shall have staggered, uniformly spaced tamping feet and be equipped with suitable cleaners. The weight of the roller shall not be less than 2,500 pounds per foot of width. The maximum speed of the compaction equipment shall be 3 miles per hour. The entire surface of each layer placed should receive 6 passes of this equipment to attain the necessary compaction.

B. Pneumatically tired equipment - The maximum layer thickness before compaction shall be 6 inches. A loaded scraper may be considered a pneumatic roller. The wheels of this equipment must pass over 90 percent of the surface of each lift before a new lift is placed.

C. Track laying equipment (bulldozer) - The maximum layer thickness before compaction shall be 4 inches. The tracks of the equipment must pass over 90 percent of the surface of each lift before a new lift is placed.

D. Compaction shall result in densities equal to or greater than 95 percent of the maximum obtained by laboratory compaction at optimum moisture of like soils in accordance with the procedure given in ASTM D-698, Procedure A.

E. Compaction shall result in densities equal to or greater than 90 percent of the maximum obtained by laboratory compaction at optimum moisture of like soils in accordance with the procedure given in ASTM D-1557, Procedure A.

Heavy compaction equipment shall not be operated within 2 feet of any structure. Hand directed tampers or compactors shall be used on areas not accessible to heavy compaction equipment, and within 2 feet of any structure. Fills compacted in this manner shall be placed in layers not greater than 4 inches in thickness before compaction, and shall meet the same density requirement as for the adjacent area.

Compliance with compaction requirements will be determined by the procedure given in ASTM D-1556 or D-2167 for methods D and E and by observation of performance for methods A, B, and C.

Fill not meeting the specified requirements shall be reworked or removed and replaced with acceptable fill.

Fill adjacent to structures, pipe conduits, and anti-seep collars shall be compacted to a density equivalent to that of the surrounding fill by means of hand tamping or manually directed power tampers or plate vibrators.

The passage of heavy equipment will not be allowed (1) over cast-in-place conduits prior to seven days after placement of the concrete, or (2) over any type of conduit until the compacted backfill has been placed over the top surface of the structure equal to one-half the clear span width of the structure or pipe, or two feet whichever is greater.

Compaction of backfill adjacent to structures shall not be started until after the expiration of the following minimum time interval after placement of the concrete:

Walls and counterforts	10 days
Anti-seep collars, conduits, and cantilever outlet, bents	3 days

IV. PRINCIPAL SPILLWAY (WHEN SPECIFIED)

Corrugated metal pipe shall conform to the requirements of ASTM B-745 or ASTM A-760, as appropriate. Other pipe materials shall conform to specifications suitable for the intended purpose. Anti-seep collars shall be of materials compatible with the pipe and shall be installed so that they are watertight. The pipe shall be installed according to the manufacturer's instructions. The pipe shall be firmly and uniformly bedded throughout its length and shall be installed to the line and grade shown on the drawings.

V. CONCRETE (WHEN SPECIFIED)

Concrete shall conform to the requirement of Construction specification 901 - Concrete.

VI. FOUNDATION AND EMBANKMENT DRAINS (WHEN SPECIFIED)

Foundation and embankment drains shall be placed to the line and grade shown on the drawings. Detailed requirements for drain material and any required pipe shall be shown on the drawings and in the specifications.

Trenches for the filter or filter drains shall be excavated to lines, shapes, and dimensions shown on the drawings. Over excavation disturbing the compacted foundation will not be permitted, and any disturbed material shall be removed and replaced with compacted earth fill or filter material. The filter material shall be placed and tamped in place to the dimensions shown. When drain pipes are used, they will be installed on

line and grade, without displacement due to placement of filter material.

The filter material shall conform to the following gradation unless otherwise specified.

U.S. Standard Sieve Size	Percent Passing
2"	85-90
3/4"	50-90
#16	15-50
Less than #16	0-15

VII. EXCAVATED PONDS

Excavated material may be disposed of away from the job site or placed adjacent to the excavation at locations as shown on the drawings.

Where water storage will occur against fill material, only suitable material excavated from the pond shall be used, and compacted by one of the methods specified above.

The vegetative requirements shall apply to the waste fill area when such fill is within the area of work.

VIII. VEGETATIVE COVER

Unless otherwise specified, a protective cover of vegetative shall be established on the disturbed area. The planting of vegetative materials shall conform to the requirements of Practice Specifications 342, Critical Area Planting.

IX. FENCING (WHEN SPECIFIED)

The embankment, spillway, and other areas shall be fenced as shown on the drawings, and shall be installed in accordance with Practice Specifications 382, Fence.

X. SPECIAL MEASURES

Measures and construction methods shall be incorporated as needed and practical that enhance fish and wildlife values. Special attention shall be given to protecting visual resources and maintaining key shade, food and den trees.

XI. CONSTRUCTION OPERATIONS

Construction operations shall be done in such a manner that erosion and air and water pollution are minimized and held within legal limits. The owner, operator, Contractor or other persons will conduct all work and operations in accordance with proper safety codes for the type of construction being performed with due regards to the safety of all persons and property.

The completed job shall be workmanlike and present a good appearance.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WATER AND SEDIMENT CONTROL BASIN

(No.)

CODE 638

DEFINITION

An earth embankment or a combination ridge and channel constructed across the slope of minor watercourses to form a sediment trap and water detention basin with a stable outlet.

PURPOSE

This practice may be applied as part of a resource management system for one or more of the following purposes:

- To reduce watercourse and gully erosion
- To trap sediment
- To reduce and manage onsite and downstream runoff

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to sites where:

1. The topography is generally irregular.
2. Watercourse or gully erosion is a problem.
3. Sheet and rill erosion is controlled by other conservation practices.
4. Runoff and sediment damages land and works of improvements.

Adequate outlets can be provided. Do not use this standard in place of terraces. Where the ridge and/or channel extends beyond the detention basin or level embankment, use Conservation Practice Standard (600), Terrace or (362) Diversion as appropriate.

CRITERIA

General Criteria Applicable to All Purposes

Install Water and Sediment Control Basins as part of a conservation system that adequately addresses resource concerns both above and below the basin. Where land ownership or physical conditions preclude treatment of the upper portion of a slope, a Water and Sediment Control Basin may be used to separate this area from, and permit treatment of the lower slope.

Location. Locate Water and Sediment Control Basins to control erosion in drainage ways. Basins may be installed singly or in series as part of system. Adjust the location to fit the topography, maximize storage and accommodate farm equipment and farming operations.

Earth embankment. Minimum top widths are given in Table 1. Construct embankments at least 5% greater than design height to allow for settlement. Measured from natural ground at the centerline of the embankment, the maximum settled height of the embankment must be 15 feet or less. The minimum width for vehicular traffic should be 12 feet.

Table 1. Minimum Top Width of Embankments

Fill Height (feet)	Top Width (feet)
0 – 5	3
5 - 10	6
10 –15	8

Design embankment slopes no steeper than 2 horizontal to 1 vertical. The sum of the horizontal components of the upstream and downstream slopes of the embankment must be 5 or greater. Design all slopes to be farmed no steeper than those on which farm equipment can be operated safely.

Foundation cutoff and seepage control.

Portions of basin ridges designed to impound more than a 3-foot depth of water must include foundation cutoff and if conditions warrant, seepage control. Refer to Conservation Practice Standard (378), Pond for criteria for foundation cutoff and seepage control.

Capacity. As a minimum, design Water and Sediment Control Basins with sufficient capacity to control the runoff from a 10-year frequency, 24-hour duration storm using a combination of flood storage and discharge through the outlet. Where basins are used for flood control or to protect other works of improvement, if warranted, use larger design storms appropriate to the risk.

In addition to the above storage, Water and Sediment Control Basins must have the capacity to store at least the anticipated 10-year sediment accumulation, or periodic sediment removal is required in the Operation and Maintenance Plan to maintain the required capacity.

Outlets. A Water and Sediment Control Basin must have an adequate outlet. The outlet must convey runoff water to a point where it will not cause damage. Outlets can be underground outlets, pipe drop structures, soil infiltration, stabilized channels or a combination of outlet types.

If the basin is cropped, design the outlet so that the flow release time does not exceed the inundation tolerance of the planned crops. If sediment retention is a primary design goal, adjust the release rate according to sediment particle size so that sediment is retained in the basin. Refer to Conservation Practice Standard (620), Underground Outlet for design criteria for underground outlets.

Outlets can include auxiliary spillways above the primary storage to handle large storm flows. If an auxiliary spillway is used, add freeboard to the design height of the embankment to provide for the safe operation of the spillway. The freeboard shall be at least 0.5 ft. above the design flow depth through the auxiliary spillway. Auxiliary spillways must not contribute runoff to lower Water and Sediment Control Basins unless they are designed to handle the runoff. Refer to Conservation Practice Standard (378), Pond for criteria to design auxiliary spillways.

Topsoil. Where necessary to restore or maintain productivity, spread topsoil over areas disturbed by construction. Topsoil can be salvaged and stockpiled from the site of the Water and Sediment Control Basin prior to construction.

Vegetation. After construction of the Water and Sediment Control Basin, revegetate disturbed areas that will not be cropped as soon as possible. In non-cropland settings other erosion protection such as gravel or organic mulches can also be used.

Refer to Conservation Practice Standard (342), Critical Area Planting for criteria on seed selection, seedbed preparation, fertilizing and seeding.

Additional Criteria for when the effective height exceeds 6 feet.

For effective heights greater than six feet, the water and sediment control basin shall be designed to meet the requirements of standard (378) Pond, (410) Grade Stabilization or TR-60 according to the class and type of structure.

CONSIDERATIONS

Water and Sediment Control Basins can be spaced at intervals down a slope, similar to terraces, in order to control erosion. Refer to Conservation Practice Standard (600), Terraces for methods to determine spacing. Additional conservation measures may be needed in the water course between basins to prevent erosion.

When choosing the location of a Water and Sediment Control Basin be sure to consider the extent of ponding that will occur from the basin. If the basin will cause water to pond near or across property lines both land owners should agree in writing on the elevation and expected duration of ponding.

The soil survey can be a valuable resource when planning and designing water and sediment control basins. The soil survey can identify potential problems such as the presence of limiting layers to plant growth in the soil profile. Field investigations can then identify problem areas to avoid such as shallow bedrock or dense, acid or saline layers that will adversely affect plant growth if construction brings them into the root zone.

Sediment retention within the basin can be enhanced by using flow deflectors, inlet and outlet selection, and by increasing the length to width ratio of the basin.

For cropped fields, embankment orientation and crop row direction should be approximately perpendicular to the land slope to support contour farming. The design should support farmability by limiting short point rows or sharp curves. Field boundaries and row lengths should also be considered in planning basin location and row direction.

Underground outlets from Water and Sediment Control Basins can provide a direct conduit to receiving waters for contaminated runoff from crop land. To reduce the impact of this runoff, Water and Sediment Control Basins should be installed as part of a conservation system that includes such practices as grassed waterways, contouring, a conservation cropping system, conservation tillage, nutrient and pest management, crop residue management and filter areas to reduce or mitigate contaminated runoff.

Seasonal water sources can be very important for migratory waterfowl and other wildlife. Partially blocking the outlet of a basin during non-cropping times of the year will allow water to pond in the basin to provide water for wildlife. Refer to Conservation Practice Standard (646) Shallow Water Development and Management for information on managing seasonal water sources for wildlife.

The construction of a Water and Sediment Control Basin can disturb large areas and potentially affect cultural resources. Be sure to follow state cultural resource protection policies before construction begins.

The construction of Water and Sediment Control Basins can introduce steep and potentially dangerous slopes into crop fields. When designing Water and Sediment Control Basins that will be farmed, choose flat slopes that will be safe for operating farm equipment. Where steep slopes are unavoidable, make sure that the farmer is aware of the location of the basin and the potential danger.

Cultural Resources

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

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

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

Endangered Species

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

PLANS AND SPECIFICATIONS

Prepare plans and specifications for Water and Sediment Control Basins that describe the requirements for applying the practice according to this standard. As a minimum the plans and specifications shall include:

1. A plan view of the layout of the Water and Sediment Control Basin system.
2. Typical cross sections of the basin(s).
3. Profile(s) of the basin(s).

4. Details of the outlet system.
5. For underground outlets, details of the inlet and profile(s) of the underground outlet.
6. Seeding requirements if needed.
7. Construction specifications that describe in writing site specific installation requirements of the Water and Sediment Control Basin system.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator. The minimum requirements to be addressed in the operation and maintenance plan are:

1. Periodic inspections, especially immediately following significant runoff events.
2. Prompt repair or replacement of damaged components.
3. Maintenance of basin ridge height and outlet elevations.
4. Removal of sediment that has accumulated in the basin to maintain capacity and grade.
5. Regular cleaning of inlets for underground outlets. Repair or replacement of inlets damaged by farm equipment. Removal of sediment around inlets to ensure that the inlet remains the lowest spot in the basin.
6. Where vegetation is specified, regular mowing and control of trees and brush. Vegetative disturbance should be scheduled to avoid the peak nesting season.
7. Notification of hazards about steep slopes on the basin.

REFERENCES

USDA, NRCS. National Engineering Handbook, Part 650 Engineering Field Handbook, Chapters 6, 8, 14.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION CONSTRUCTION SPECIFICATION

900 – CONCRETE (3000 psi)

I. SCOPE

Concrete work shall consist of furnishing and placing concrete to the dimensions, lines and grades as shown on the drawings. Concrete strength, shall be a minimum of 3,000 psi at 28 days unless otherwise specified on the "Practice Requirements" sheet.

II. MATERIALS

Cement. Portland cement shall conform to the requirements of ASTM Designation of C-150 and shall be Type II or IIA unless otherwise specified in the "Practice Requirements" sheet. Cement shall be free of lumps and partially set masses.

Water. Water shall be potable and free from acid, alkali, oils or organic matter.

Aggregate. Shall be clean, hard, strong and durable, free from dirt and other substances deleterious to concrete. The fine and coarse aggregates shall be a well-graded mix approved by the Engineer. The maximum size of aggregate shall not exceed one and a half inches and conform to the requirements of ASTM C-33.

Entrained Air. Air entraining shall conform to ASTM C260.

Reinforcing Steel. Reinforcing steel shall be deformed bars conforming to the requirements of ASTM Designation A-615, Grade 40 or 60. Tie wires shall be 18-gage annealed steel.

Plain steel welded wire fabric reinforcement (flat sheets only, no rolled sheets) shall conform to ASTM Designation A-185.

Reinforcing steel shall conform to the grade, sizes, and shapes shown on the drawings.

Bar Supports. Bar supports and accessories shall be of the sizes required to provide the concrete cover specified. Where concrete surfaces are exposed to the weather, or liquid in hydraulic structures in finished work, galvanized or plastic-dipped metal bar supports shall not be used.

Precast concrete bar supports shall use the some class of concrete as specified for the concrete in the structure. The height of the block shall be the height required to provide the cover specified for reinforcing. The block shall contain wires for securing the block to the reinforcement.

Form Coating. Form coating must not bond with, stain, or adversely affect concrete surfaces and shall conform to ACI 347. Form coating must not impair subsequent treatment of concrete surfaces, including bonding agents, curing compounds, and waterproofing. Form coating must be non-toxic or become non-toxic within 30 days.

Curing Compound. Liquid curing compound shall meet the requirements of ASTM Specification C 309 and be type 2.

III. DESIGN MIX

The following proportions will be accepted as 3000 psi strength concrete. Concrete shall be proportioned to include not more than six gallons of water per sack of cement or less than five and one half sacks of cement per cubic yard of concrete. Consistency of the concrete shall allow it to be worked into place without segregation. The slump shall be as follows:

Slump for Mix Designs

Condition	Slump (in.)
Massive sections, pavements, footings, caissons, substructure walls	2 ± 1
Thick slabs, heavy beams, columns, reinforced walls (>12 inches)	3 ± 1
Columns, light beams, thin slabs, thin walls (12 inches or less)	4 ± 1

Entrained Air. Air entrainment may be used; however, it shall not exceed six percent.

Superplasticized concrete. A water-reducing admixture (ASTM C 494, Type F or G) and/or a plasticizing admixture (ASTM C 1017) may be used based on the manufactures recommendations with prior approval of the engineer. The contractor shall provide evidence acceptable to the engineer that the resulting concrete will meet the minimum strength requirements.

The slump shall not exceed 7.5 inches unless the contractor can demonstrate before placement that the job mix can be placed without segregation or excessive laitance at a slump greater than 7.5 inches. The concrete shall retain the increased slump for not less than 30 minutes.

Superplasticized concrete can be conveyed and placed when the temperature of the concrete is below 95 degrees Fahrenheit and the slump of the concrete remains within the allowable slump range.

When a superplasticized concrete mix is used, forms shall be coated according to the manufacturer's recommendations with a form release agent that is specifically formulated for plasticized concrete. Forms shall be designed to withstand the increased pressures of the superplasticized concrete and the increased impact forces resulting from larger drop heights used in placing the superplasticized concrete.

IV. READY-MIX CONCRETE

The 3000 psi design mix and testing results, from the batch plant will be supplied to the Engineer for approval upon request or as shown on the “Practice Requirements” sheet.

When ready-mixed concrete is furnished, the supplier will provide the owner a delivery ticket that shows: time of loading; quantity of materials used, including water and any admixtures; revolution counter reading at time of loading.

V. MIXING

For stationary mixers, the mixing time after all cement and aggregates are in the mixer drum shall be not less than 1-1/2 minutes. When concrete is mixed in a truck mixer, the number of revolutions of the drum or blades at mixing speed shall be not less than 70 or more than l00. Each batch shall be completely discharged before the mixer is recharged

VI. FORMS

Forms shall conform to the shapes, lines, and dimensions as shown on the drawings. They shall be braced and/or tied together so as to maintain position and shape and be sufficiently tight to prevent leakage of mortar. Forms shall be thoroughly covered with a form release agent or wetted and cleaned of debris prior to placement of concrete.

Forms shall not be removed without the approval of the Engineer.

VII. PLACEMENT

Concrete shall not be placed until the subgrade, forms, and reinforcing steel have been inspected by the Engineer.

Items to be embedded in the concrete shall be positioned accurately and firmly anchored to prevent displacement during placement of concrete.

All reinforcement at the time of placement shall be free from rust, oil, grease, paint or other deleterious matter.

The concrete shall be deposited as closely as possible to its final position and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. The deposition of concrete shall be regulated so that the concrete may be consolidated with a minimum of lateral movement.

Concrete shall not be dropped more than five feet vertically unless suitable equipment is used to prevent segregation. When a superplasticized concrete mix is used, concrete shall not be dropped more than 12 feet vertically unless suitable equipment is used to prevent segregation.

Consolidation of concrete may be accomplished by means of internal type mechanical vibrators, rodding, spading, or hand tamping.

VIII. CONSTRUCTION JOINTS

Construction joints shall be provided as shown in the drawings or as approved by the Engineer. Joints shall be thoroughly cleaned and laitance removed before a new placement is made. Each joint shall be wetted immediately before the placing of new concrete.

IX. FINISHING

After the concrete has been consolidated, the unformed surfaces shall be given a float finish.

Immediately after form removal, formed surfaces shall be cleaned of all fins and irregular projections from exposed surfaces. All defective concrete shall be removed and effectively repaired.

X. PROTECTION AND CURING

Concrete shall be prevented from drying for a curing period of at least seven days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period. Moisture shall be maintained by sprinkling, flooding, or fog spraying or by covering with continuously moistened canvas, burlap, cloth mats, straw earth or other approved material. For formed surfaces, the protection may be accomplished by leaving the forms in place and keeping them wet for the entire curing period. In lieu of water curing, the concrete shall be protected by spraying with an approved curing compound. The curing compounds shall be applied in an approved manner immediately after the concrete is finished. All surfaces shall be kept moist until the compound is applied.

The curing compound shall be applied at the rate of one gallon per 175 square feet.

XI. CONCRETING IN COLD WEATHER

Before any concrete is placed, all ice, snow, and frost shall be completely removed from all surfaces to be in contact with the new concrete, and the temperature of these surfaces shall be raised to as close as may be practical to the temperature of the new concrete that is to be placed thereon. No concrete shall be placed on a frozen subgrade or on one that contains frozen materials.

When the atmospheric temperature may be expected to drop below 40°F at the time concrete is placed, or at any time during the curing period, the following provisions also shall apply:

A. The temperature of the concrete at the time of placing shall not be less than 50° F or more than 90° F. The temperature of neither aggregates nor mixing water shall be more than 100° F just prior to mixing the cement.

B. When the daily minimum temperature is less than 40° F, mortar shall be insulated or housed and heated after placement. The temperature of the concrete and air adjacent to the mortar shall be maintained at not less than 50° F or more than 90° F for the duration of the curing period.

C. Methods of insulating, housing and heating the structure shall conform to "Recommended Practice for Cold Weather Concreting", ACI Standard 306.

D. The use of accelerators or antifreeze compounds will not be allowed.

E. When dry heat is used protect concrete, means of maintaining an ambient humidity of at least 40 percent shall be provided unless the concrete has been coated with a curing compound or is covered tightly with an approved impervious material.

XII. CONCRETING IN HOT WEATHER

When climatic or other conditions are such that the temperature of concrete may reasonably be expected to exceed 90° F at the time of placement, or during the first 24 hours after placement, the following provisions also shall apply:

The temperature of the concrete shall be maintained below 90° F during mixing, conveying, and placing. Methods used shall conform to "Recommended Practice for Hot Weather Concreting", ACI Standard 305.

Exposed concrete surfaces that tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or otherwise protected from drying immediately after placement.

Concrete surfaces exposed to the air shall be covered as soon as the concrete has hardened sufficiently and shall be kept continuously wet for at least the first 24 hours of the curing period, and for the entire curing period unless curing compound is applied as specified in Section X.

If moist curing is discontinued before the end of the curing period, curing compound shall be applied immediately.

XIII. STRUCTURE DRAINAGE

Graded sand and gravel filters or filter drains shall be constructed as shown on the drawings or as staked in the field.

Trenches for the filter drains shall be excavated to lines, shape and dimensions shown on the drawings. The sand and gravel shall be placed and tamped in place to the dimensions shown. When drainpipes are used, they will be installed on line and grade without displacement due to placement of filter material.

The filter material shall conform to the following gradation unless otherwise specified:

U.S. Standard Sieve Size	Percent Passing
2"	85-90
3/4"	50-90
No. 16	15-50
100	0-10
200	0-3

XIV. STRUCTURAL BACKFILL

The work shall consist of all earthfill adjacent to the structures.

Materials**.** The fill materials shall be the in place excavated materials unless otherwise stated in the “Practice Requirements” sheet and shown on the drawings.

Placement**.** The fill shall be placed so that the distribution of materials will be to the limits shown on the drawings and shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. No fill shall be placed upon a frozen surface nor shall snow, ice or frozen material be incorporated in the fill.

Fill shall not be placed until the following time has elapsed after concrete placement:

Walls or slabs	14 Days
Conduits, Precast, Cradles	2 Days
Conduits, Precast, Bedded	1 Day
Antiseep Collars	3 Days

The fill shall be placed in a manner adequate to prevent damage to the structure and allow the structure to gradually and uniformly assume the backfill loads. The maximum lift thickness prior to compaction shall be 6 inches.

Moisture Content. The soil moisture of the fill material shall be sufficient to hold a ball shape when squeezed in the hand, unless otherwise stated and shown on the drawings.

Compaction. The fill material shall be compacted to a density equal to that of the adjacent materials. Compaction shall be accomplished by hand tampers or other acceptable means excluding heavy equipment. Heavy equipment shall not be operated within two feet of any structure.

The passage of heavy equipment will not be allowed over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one half the clear span width of the structure or pipe or two feet, whichever is greatest.

XV. SURFACE DRAINAGE

After completion of the backfill operations, the surface area adjacent to and around the structures shall be graded to convey surface runoff away from the structure.

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION CONSTRUCTION SPECIFICATION

901 – CONCRETE (4000 psi)

I. SCOPE

Concrete work shall consist of furnishing and placing concrete to the dimensions, lines and grades as shown on the drawings. Concrete strength, shall be a minimum of 4,000 psi at 28 days as specified on the "Practice Requirements" sheet.

II. MATERIALS

Cement. Portland cement shall conform to the requirements of ASTM Designation of C-150 and shall be Type II or IIA, unless otherwise specified in the "Practice Requirements" sheet, and shall be free of lumps and partially set masses.

Water. Water shall be potable and free from acid, alkali, oils or organic matter.

Aggregate. Aggregates shall be clean, hard, strong and durable, free from dirt and other substances deleterious to concrete.

- Fine aggregates shall conform to ASTM C33.
- Coarse aggregates shall be crushed gravel and conform to ASTM C33, Size No. 57.

Flyash. Flyash shall conform to ASTM C260.

Entrained Air. Air entraining shall conform to ASTM C260.

Reinforcing Steel. Reinforcing steel shall be deformed bars conforming to the requirements of ASTM Designation A-615, Grade 40 or 60. Tie wires shall be 18-gage annealed steel.

Plain steel welded wire fabric reinforcement (flat sheets only, no rolled sheets) shall conform to ASTM Designation A-185.

Reinforcing steel shall conform to the grade, sizes, and shapes shown on the drawings.

Bar Supports. Bar supports and accessories shall be of the sizes required to provide the concrete cover specified. Where concrete surfaces are exposed to the weather, or liquid in hydraulic structures in finished work, galvanized or plastic-dipped metal bar supports shall not be used.

Precast concrete bar supports shall use the some class of concrete as specified for the concrete in the structure. The height of the block shall be the height required to provide the cover specified for reinforcing. The block shall contain wires for securing the block to the reinforcement.

Waterstops. Waterstops shall be PVC, center bulb type, 3/8 inch thick and 9 inches wide unless other specified. The waterstop shall be as shown on the drawings and installed in accordance with the manufacturer's specifications for water-tight joints. All angles and corners shall be prefabricated by the manufacturer.

Form Coating. Form coating must not bond with, stain, or adversely affect concrete surfaces and shall conform to ACI 347. Form coating must not impair subsequent treatment of concrete surfaces, including bonding agents, curing compounds, and waterproofing. Form coating must be non-toxic or become non-toxic within 30 days.

Curing Compound. Liquid curing compound shall meet the requirements of ASTM Specification C 309 and be type 2.

III. MIX DESIGN

The contractor is responsible for the design and proportioning of the concrete. Job mixes shall be prepared to meet the quality, consistency, and strength of concrete specified.

Submittals. At least 15 calendar days before the placement of any concrete, the contractor shall provide the engineer with full documentation to support the job mix and any admixtures to be used in the work. Job mixes are reviewed and accepted or rejected by the engineer within 8 calendar days following the date of submittal. After a job mix has been accepted, neither the source, character, or gradation of the aggregates nor the type or brand of cement or admixtures shall be changed without prior notice to the engineer. Revisions or changes in a job mix that are determined to be significant by the engineer shall follow the same submittal and acceptance process as that for the initial job mix.

Concrete mix shall provide proper workability, durability, strength, and appearance. Concrete shall work readily into corners and angles of forms and around reinforcement by methods of placing and consolidation employed on the project. Concrete mix shall not allow materials to segregate or allow excess

free water to collect on the surface.

Water/Cement Ratio. The maximum water-cement ratio shall be as shown on the "Practice Requirements sheet".

Minimum cementitious content is 564 pounds. Up to 25 percent by volume of fly ash can be substituted for cement.

Slump. Slump shall be as follows:

Slump for Mix Designs

Condition	Slump (in.)
Massive sections, pavements, footings, caissons, substructure walls	2 ± 1
Thick slabs, heavy beams, columns, reinforced walls (>12 inches)	3 ± 1
Columns, light beams, thin slabs, thin walls (12 inches or less)	4 ± 1

Admixtures. Proportion admixtures according to the manufacturer's recommendations.

Air Content. Air content shall be 6 ± 1percent.

Superplasticized concrete: A water-reducing admixture (ASTM C 494, Type F or G) and/or a plasticizing admixture (ASTM C 1017) may be used based on the manufactures recommendations with prior approval of the engineer. The contractor shall provide evidence acceptable to the engineer that the resulting concrete will meet the minimum strength requirements.

The slump shall not exceed 7.5 inches unless the contractor can demonstrate before placement that the job mix can be placed without segregation or excessive laitance at a slump greater than 7.5 inches. The concrete shall retain the increased slump for not less than 30 minutes.

Superplasticized concrete can be conveyed and placed when the temperature of the concrete is below 95 degrees Fahrenheit and the slump of the concrete remains within the allowable slump range.

When a superplasticized concrete mix is used, forms shall be coated according to the manufacturer's recommendations with a form release agent that is specifically formulated for plasticized concrete. Forms shall be designed to withstand the increased pressures of the superplasticized concrete and the increased impact forces resulting from larger drop heights used in placing the superplasticized concrete.

IV. READY-MIX CONCRETE

When ready-mixed concrete is furnished, the supplier will provide the owner a delivery ticket that shows: time of loading; quantity of materials used, including water and any admixtures; revolution counter reading at time of loading.

When concrete is mixed in a truck mixer, the number of revolutions of the drum or blades at mixing speed shall be not less than 70 or more than l00. Each batch shall be completely discharged before the mixer is recharged

V. FORMS

Forms shall conform to the shapes, lines, and dimensions as shown on the drawings. They shall be braced and/or tied together so as to maintain position and shape and be sufficiently tight to prevent leakage of mortar. Forms shall be thoroughly covered with a form release agent or wetted and cleaned of debris prior to placement of concrete.

Forms shall not be removed without the approval of the Engineer.

VI. CONVEYANCE

Concrete shall be delivered to the site and discharged completely into the forms within 1.5 hours or before the drum of truck has revolved a total of 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees Fahrenheit or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.

The engineer can allow an appropriate extension of time when the setting time of the concrete is increased a corresponding amount by the addition of an approved admixture. In any case concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods that prevent segregation of the aggregates or loss of mortar.

VII. PLACEMENT

Concrete shall not be placed until the subgrade, forms, and reinforcing steel have been inspected by the Engineer.

Items to be embedded in the concrete shall be positioned accurately and firmly anchored to prevent displacement during placement of concrete.

All reinforcement at the time of placement shall be free from rust, oil, grease, paint or other deleterious matter.

The concrete shall be deposited as closely as possible to its final position and shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates or excessive laitance. The deposition of concrete shall be regulated so that the concrete may be consolidated with a minimum of lateral movement.

Concrete shall not be dropped more than five feet vertically unless suitable equipment is used to prevent segregation. When a superplasticized concrete mix is used, shall not be dropped more than 12 feet vertically unless suitable equipment is used to prevent segregation.

Consolidation of concrete may be accomplished by means of internal type mechanical vibrators, rodding, spading, or hand tamping.

VIII. CONSTRUCTION JOINTS

Construction joints shall be provided as shown in the drawings or as approved by the Engineer. Joints shall be thoroughly cleaned and laitance removed before a new placement is made. Each joint shall be wetted immediately before the placing of new concrete.

IX. FINISHING

After the concrete has been consolidated, the unformed surfaces shall be given a float finish.

Immediately after form removal, formed surfaces shall be cleaned of all fins and irregular projections from exposed surfaces. All defective concrete shall be removed and effectively repaired.

X. PROTECTION AND CURING

Concrete shall be prevented from drying for a curing period of at least seven days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period. Moisture shall be maintained by sprinkling, flooding, or fog spraying or by covering with continuously moistened canvas, burlap, cloth mats, straw earth or other approved material. For formed surfaces, the protection may be accomplished by leaving the forms in place and keeping them wet for the entire curing period. In lieu of water curing, the concrete shall be protected by spraying with an approved curing compound. The curing compounds shall be applied in an approved manner immediately after the concrete is finished. All surfaces shall be kept moist until the compound is applied.

The curing compound shall be applied at the rate of one gallon per 175 square feet.

XI. CONCRETING IN COLD WEATHER

Before any concrete is placed, all ice, snow, and frost shall be completely removed from all surfaces to be in contact with the new concrete, and the temperature of these surfaces shall be raised to as close as may be practical to the temperature of the new concrete that is to be placed thereon. No concrete shall be placed on a frozen subgrade or on one that contains frozen materials.

When the atmospheric temperature may be expected to drop below 40°F at the time concrete is placed, or at any time during the curing period, the following provisions also shall apply:

A. The temperature of the concrete at the time of placing shall not be less than 50° F or more than 90° F. The temperature of neither aggregates nor mixing water shall be more than 100° F just prior to mixing the cement.

B. When the daily minimum temperature is less than 40° F, mortar shall be insulated or housed and heated after placement. The temperature of the concrete and air adjacent to the mortar shall be maintained at not less than 50° F or more than 90° F for the duration of the curing period.

C. Methods of insulating, housing and heating the structure shall conform to "Recommended Practice for Cold Weather Concreting", ACI Standard 306.

D. The use of accelerators or antifreeze compounds will not be allowed.

E. When dry heat is used protect concrete, means of maintaining an ambient humidity of at least 40 percent shall be provided unless the concrete has been coated with a curing compound or is covered tightly with an approved impervious material.

XII. CONCRETING IN HOT WEATHER

When climatic or other conditions are such that the temperature of concrete may reasonably be expected to exceed 90° F at the time of placement, or during the first 24 hours after placement, the following provisions also shall apply:

The temperature of the concrete shall be maintained below 90° F during mixing, conveying, and placing. Methods used shall conform to "Recommended Practice for Hot Weather Concreting", ACI Standard 305.

Exposed concrete surfaces that tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or otherwise protected from drying immediately after placement.

Concrete surfaces exposed to the air shall be covered as soon as the concrete has hardened sufficiently and shall

be kept continuously wet for at least the first 24 hours of the curing period, and for the entire curing period unless curing compound is applied as specified in Section X.

If moist curing is discontinued before the end of the curing period, curing compound shall be applied immediately.

XIII. STRUCTURE DRAINAGE

Graded sand and gravel drainfill or geotextile and gravel drain rock shall be as shown on the drawings.

Trenches for the filter drains shall be excavated to lines, shape and dimensions shown on the drawings. The sand and gravel shall be placed and tamped in place to the dimensions shown. When drain pipes are used, they will be installed on line and grade without displacement due to placement of filter material.

XIV. STRUCTURAL BACKFILL

The work shall consist of all earthfill adjacent to the structures.

Materials. The fill materials shall be the in-place excavated materials unless otherwise stated in the "Practice Requirements" sheet and shown on the drawings.

Placement. The fill shall be placed so that the distribution of materials will be to the limits shown on the drawings and shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. No fill shall be placed upon a frozen surface nor shall snow, ice or frozen material be incorporated in the fill.

Fill shall not be placed until the following time has elapsed after concrete placement:

Walls or slabs	14 Days
Conduits, Precast, Cradles	2 Days
Conduits, Precast, Bedded	1 Day
Antiseep Collars	3 Days

The fill shall be placed in a manner adequate to prevent damage to the structure and allow the structure to gradually and uniformly assume the backfill loads. The maximum lift thickness prior to compaction shall be 6 inches.

Moisture Content. The soil moisture of the fill material shall be sufficient to hold a ball shape when squeezed in the hand, unless otherwise stated and shown on the drawings.

Compaction. The fill material shall be compacted to a density equal to that of the adjacent materials. Compaction shall be accomplished by hand tampers or other acceptable means excluding heavy equipment.

Heavy equipment shall not be operated within two feet of any structure.

The passage of heavy equipment will not be allowed over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one half the clear span width of the structure or pipe or two feet, whichever is greatest.

XV. SURFACE DRAINAGE

After completion of the backfill operations, the surface area adjacent to and around the structures shall be graded to convey surface runoff away from the structure.

STATEMENT OF WORK
Terrace (600)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documents that demonstrate criteria in practice standard have been met and are compatible with planned and applied practices
    a. Practice purpose(s) as identified in the conservation plan.
    b. List of required permits to be obtained by the client
    c. Compliance with NRCS national and state utility safety policy (NEM part 503-Safety, Section 503.00 through 503.22)
    d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Hydrology/Hydraulics
        ii. Interval/Spacing
        iii. Outlet Capacity and Stability
        iv. Erosion Control
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Operation and maintenance plan
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03(b)(2)).
5. Design modifications during installation as required

INSTALLATION

Deliverables

1. Pre-installation conference with client and contractor
2. Verification that client has obtained required permits
3. Staking and layout according to plans and specifications including applicable layout notes
4. Installation inspection
    a. Actual materials used
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation
7. Certification that the installation process and materials meets design and permit requirements (NEM Subpart A, 505.03(c) (1)).

CHECK OUT

Deliverables

1. As-built documentation
    a. Extent of practice units applied
    b. Drawings
    c. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits
3. Progress reporting

REFERENCES

- Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard - Terrace, 600.
- National Engineering Manual
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

STATEMENT OF WORK
Underground Outlet (620)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documents that demonstrate criteria in practice standard have been met and are compatible with planned and applied practices
    a. Practice purpose(s) as identified in the conservation plan.
    b. List of required permits to be obtained by the client
    c. Compliance with NRCS national and state utility safety policy (NEM part 503-Safety, Section 503.00 through 503.06)
    d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Inlet Type
        ii. Hydraulics
        iii. Materials
        iv. Outlet Capacity and Stability
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Operation and maintenance plan
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03(b) (2)).
5. Design modifications during installation as required

INSTALLATION

Deliverables

1. Pre-installation conference with client and contractor
2. Verification that client has obtained required permits
3. Staking and layout according to plans and specifications including applicable layout notes
4. Installation inspection
    a. Actual materials used
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation
7. Certification that the installation process and materials meets design and permit requirements (NEM Subpart A, 505.03(c) (1)).

CHECK OUT

Deliverables

1. As-built documentation
    a. Extent of practice units applied
    b. Drawings
    c. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits
3. Progress reporting

REFERENCES

- Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard – Underground Outlet, 620.
- National Engineering Manual
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

STATEMENT OF WORK
Vegetated Treatment Area (635)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documentation that will demonstrate that the criteria in NRCS practice standard have been met and are compatible with other planned and applied practices.
    a. Practice purpose(s) as identified in the conservation plan.
    b. List of required permits to be obtained by the client.
    c. Compliance with NRCS national and state utility safety policy (NEM Part 503-Safety, Subpart A - Engineering Activities Affecting Utilities 503.00 through 503.06).
    d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Geology and Soil Mechanics (NEM Subpart 531a).
        ii. Maximize Clean Water Diversion.
        iii. Hydraulic Loading Rate.
        iv. Environmental Considerations (e.g. location, air and water quality).
        v. Vegetation.
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Design Report and Inspection Plan as appropriate (NEM Part 511, Subpart B Documentation, 511.11 and Part 512, Subpart D Quality Assurance Activities, 512.30 through 512.32).
4. Operation and Maintenance Plan
5. Certifications that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03(b) (2)).
6. Design modifications during installation as required.

INSTALLATION

Deliverables

1. Pre Installation conference with client and contractor.
2. Verification that client has obtained required permits.
3. Staking and layout according to plans and specifications including applicable layout notes.
4. Installation inspection (according to inspection plan as appropriate).
    a. Actual materials used.
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer.
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation.
7. Certification that the installation process and materials meets design and permit requirements.

CHECK OUT

Deliverables

1. As-Built documentation.
    a. Extent of practice units applied
    b. Drawings
    c. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits (NEM Subpart A, 505.03(c) (1)).
3. Progress reporting.

STATEMENT OF WORK
Wastewater Treatment Strip (635)

REFERENCES

- NRCS Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard – Vegetated Treatment Area - 635.
- NRCS National Engineering Manual (NEM).
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook

STATEMENT OF WORK
Water and Sediment Control Basin (638)

These deliverables apply to this individual practice. For other planned practice deliverables refer to those specific Statements of Work.

DESIGN

Deliverables:

1. Design documents that demonstrate criteria in practice standard have been met and are compatible with planned and applied practices
    a. Practice purpose(s) as identified in the conservation plan.
    b. List of required permits to be obtained by the client
    c. Compliance with NRCS national and state utility safety policy (NEM part 503-Safety, Section 503.00 through 503.22)
    d. Practice standard criteria related computations and analyses to develop plans and specifications including but not limited to:
        i. Hydrology/Hydraulics
        ii. Interval/Spacing
        iii. Outlet Capacity and Stability
        iv. Erosion Control
2. Written plans and specifications including sketches and drawings shall be provided to the client that adequately describes the requirements to install the practice and obtain necessary permits.
3. Operation and maintenance plan
4. Certification that the design meets practice standard criteria and comply with applicable laws and regulations (NEM Subpart A, 505.03(b) (2)).
5. Design modifications during installation as required

INSTALLATION

Deliverables

1. Pre-installation conference with client and contractor
2. Verification that client has obtained required permits
3. Staking and layout according to plans and specifications including applicable layout notes
4. Installation inspection
    a. Actual materials used
    b. Inspection records
5. Facilitate and implement required design modifications with client and original designer
6. Advise client/NRCS on compliance issues with all federal, state, tribal, and local laws, regulations and NRCS policies during installation
7. Certification that the installation process and materials meets design and permit requirements (NEM Subpart A, 505.03(c) (1)).

CHECK OUT

Deliverables

1. As-built documentation
    a. Extent of practice units applied
    b. Drawings
    c. Final quantities
2. Certification that the installation meets NRCS standards and specifications and is in compliance with permits
3. Progress reporting

STATEMENT OF WORK
Water and Sediment Control Basin (638)

REFERENCES

- Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard - Water and Sediment Control Basin, 638.
- National Engineering Manual
- NRCS National Environmental Compliance Handbook
- NRCS Cultural Resources Handbook