

NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD

**IRRIGATION WATER CONVEYANCE**  
**DITCH AND CANAL LINING, FLEXIBLE MEMBRANE**  
(Ft.)  
**CODE 428B**

**DEFINITION**

A fixed lining of impervious material installed in an existing or newly constructed irrigation field ditch or irrigation canal or lateral.

**PURPOSE**

- Prevent waterlogging of land
- Maintain water quality
- Reduce water loss
- Improve management of irrigation water

**CONDITIONS WHERE PRACTICE APPLIES**

Ditches and canals to be lined shall serve as an integral part of an irrigation water distribution or conveyance system designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

Water supplies and irrigation deliveries for the area served shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Lined ditches and canals shall either be located where they are not susceptible to damage from side drainage flooding or they shall be protected from such damage, e.g., flooding.

**CRITERIA**

**Capacity.** A lined ditch or canal shall have enough capacity to meet its requirement as part of the planned irrigation water distribution system without danger of overtopping. Design capacity shall be based on the following, whichever is greater:

1. The capacity shall be enough to deliver the water needed for irrigation to meet the design peak consumptive use of the crops in the area served.

2. Capacity shall be sufficient to provide an adequate irrigation stream for all methods of irrigation, for existing and potential irrigated crops planned, for use in the area served.

Canals and laterals lined with flexible membranes must be designed with sufficient capacity to carry the required flows at the velocity that will be developed under the maximum probable retardance conditions.

For capacity design, the value "*n*" shall be selected according to the material in which the canal or lateral is constructed, taking into account alignment, hydraulic radius, and potential weed and moss hazard or other retardances.

**Velocity.** The velocity in ditch reaches from which water is to be delivered onto the field through turn-outs, siphon tubes, or similar means shall be sufficiently low to permit operation of the planned take-out structure or device.

When soil material is used as a protective cover over a liner, the velocity in canals or ditches shall not exceed the nonerosive velocity for the soil material or the material through which the canal or ditch passes, whichever is less. Local information on velocity limits for specific soils may be used if available. If such information is not available, stability limits shall be based on the tractive stress design approach as discussed in USDA - ARS (Agricultural Research Service) Agriculture Handbook Number 667 - "Stability Design of Grassed-Lined Open Channels" or other comparable channel stability criteria.

A Manning's "*n*" no greater than 0.025 shall be used when evaluating designs with a protective cover in order that velocities do not exceed permissible values in erodible soils.

**Freeboard.** The required freeboard varies according to the size of the ditch or canal, the velocity of the water, the horizontal and vertical alignment, the amount of storm or waste water that may be inter-

cepted, and the change in the water surface elevation that may occur when any control structure is operating. The minimum freeboard for any lined ditch or canal shall provide 3 inches (in.) of lining above the designed water surface. This minimum freeboard requirement is based on the assumption that the finished channel bottom elevations will vary no more than 0.1 foot (ft) from the design elevations. If a construction deviation greater than 0.1 ft is permitted, the minimum freeboard shall be increased.

**Side slopes.** Canals and ditches with buried membrane linings must be constructed with stable side slopes. Slope requirements vary according to the type of cover material, but the side slopes shall not be steeper than 3:1.

**Subgrade.** Flexible membranes shall be placed on a relatively smooth and firm surface. The top 6 in. of the subgrade shall be free of organic material, particles larger than 3/8-inch in size, angular particles, other sharp objects, or anything else that could damage the liner. If the subgrade does not meet these criteria, a 6 in. layer of soil free of particles larger than 3/8-in., angular particles, and other sharp objects or 8 ounce non-woven geotextile material shall be used as padding beneath the liner.

**Protective cover.** Flexible membrane liners shall be protected by an earth or an earth and gravel cov-

ering not less than 6 in. thick and must extend not less than 6 in. above the top edge of the lining unless recommended by manufacturer to leave uncovered. In areas subject to traffic by livestock, the minimum thickness of the protective cover shall be 9 in. and be free of particles larger than 3/8-in., angular particles, and other sharp objects. Any manufactured material shall have sufficient ultraviolet protection to prevent deterioration.

The material in the bottom 3 in. of cover shall be soil free of particles larger than 3/8-in., angular particles, and other sharp objects. Lining in bottom of ditch or canal may need to be thicker, as recommended by manufacturer.

Covered liners require cutoffs and anchor trenches to secure the liner to the subgrade.

**Exposed liners.** Exposed liners require cutoffs and anchor trenches to secure the liner from uplift or tearing away from the bottom and sides if the seams release.

**Membrane thickness.** The required flexible membrane thickness depends on the expected subgrade conditions, the hydrostatic forces that will be acting on the flexible membrane and the susceptibility of the lining to damage during or after installation. Protect the liner from external water pressures.

The minimum nominal thickness of flexible membrane liners shall be:

Material	Covered Condition	Exposed Condition
	Minimum thickness (mil)	Minimum thickness (mil)
PVC	20	N/A
GCL	0.75 lb/sq ft <sup>‡</sup> of sodium bentonite	NA
EPDM	45	45
EPDM (reinforced)	45	45
Polyurethane/geotextile composite	45	45
HDPE	40	40
LLDPE	40	40
PP (reinforced)	36	36
Bituminous geomembrane	120	120

<sup>‡</sup>Minimum cover thickness – 12 inches of soil

**Key:**

PVC - poly-vinyl chloride

GCL – geosynthetic clay liner

EPDM - ethylene propylene diene monomer (synthetic rubber)

HDPE – high-density polyethylene

LLDPE - linear low-density polyethylene

PP - polypropylene

**Water surface elevations.** All lined ditches and canals shall be designed so that the water surface elevations at field takeout points are high enough to provide the required flow onto the field surface. If ditch checks or other control structures are to provide the necessary head, the backwater effect must be considered in computing freeboard requirements. The required elevation of the water surface above the field surface varies according to the type of takeout structure or device used and the amount of water to be delivered. A minimum head of 4 in. shall be provided.

**Related structures.** Plans for ditch or canal lining installations shall provide for adequate inlets, outlets, turnouts, checks, crossings, and other related structures needed for successful conservation irrigation. These structures can be installed before, during, or after the lining placement. They must be constructed or installed in such a way as to not damage or impair the effectiveness of the lining.

**Materials.** Flexible membrane liners shall equal or exceed the physical requirements indicated for materials under “Plans and Specifications”.

## CONSIDERATIONS

Abrasive effects of sediment on the liner itself or the erosive effects on the protective cover over the liner may create an operation and maintenance need.

### **Cultural Resources Considerations**

NRCS's objective is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice will have any effect on any cultural resources.

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

GM 420, Part 401, the California Environmental Handbook and the California Environmental Assessment Worksheet provide guidance on how the NRCS must account for cultural resources. The Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

### **Endangered Species Considerations**

Determine if installation of this practice with any others proposed will have any effect on any federal or state listed Rare, Threatened or Endangered species or their habitat. NRCS's objective is to benefit these species and others of concern or at least not have any adverse effect on a listed species. If the Environmental Evaluation indicates the action may adversely affect a listed species or result in adverse modification of habitat of listed species which has been determined to be critical habitat, NRCS will advise the land user 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 landowner selects one of the alternative conservation treatments for installation; or at the request of the landowners, NRCS may initiate consultation with the Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game. If the Environmental Evaluation indicates the action will not affect a listed species or result in adverse modification of critical habitat, consultation generally will not apply and usually would not be initiated. Document any special con-

siderations for endangered species in the Practice Requirements Worksheet.

### **Water Quantity**

1. Effects on the water budget, especially effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
2. Effects on downstream flows or aquifers that would affect other water uses or users.
3. Potential changes in growth and transpiration of vegetation located next to the conveyance because of the elimination of leakage from the system.

### **Water Quality**

1. Effects of the practice on the movement of dissolved substances to ground water.
2. Effects of wetlands or water-related wildlife habitats.
3. Effects on the visual quality of water resources.

## PLANS AND SPECIFICATIONS

Plans and specifications for installing flexible membrane irrigation ditch and canal lining shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purposes.

## OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan shall be developed for flexible membrane ditch and canal linings. The plan should document needed actions to ensure that practices perform adequately throughout their expected life.

O&M requirements shall be determined as part of the design. Any requirements should be documented as brief statements in the plans, specifications, the conservation plan narrative, or as a separate O&M plan. Typical O&M may include sediment/debris removal, patching of tears, replacement of deteriorated linings, re-anchoring edges or re-sealing seams.

UNITED STATES DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE

**428B – IRRIGATION WATER CONVEYANCE  
FLEXIBLE MEMBRANE DITCH AND CANAL LINING**

**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 lined irrigation ditch or canal is an asset to the farm. This lining was designed and installed to reduce water loss in the irrigation delivery and/or head ditches. 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 adequate drainage of foundations.
- Maintain widths of soil berms or banks. Avoid use of tillage equipment that accelerates soil removal.
- Drain all lined ditches and canals when not being used. Immediately repair any cracks or breaks in the lining, and if settlement is present, investigate cause before repair.
- If livestock are present, prevent their access to linings and provide other drinking water facilities.
- Remove any blockage (sediments, debris, foreign material etc.) that restrict flow capacity.
- Immediately repair any vandalism, vehicular or livestock damage.
- Inspect embankments for damage from rodents or burrowing animals. Repair any damage. Take appropriate corrective actions to alleviate further damage.
- Remove woody vegetation from areas adjacent to lining,
- Equipment is permitted only on liners with a minimum soil cover of 12 inches. If equipment is allowed on a liner covered with a minimum 12 inches of soil, avoid excessive speeds and sharp turns.

- Prevent all livestock from using any area of the pond which was sealed by artificial liners.
- Fences shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.
- Settlement or cracks in the soil weaken earthen sections and may accelerate the development of flow paths that may result in structure failure. This should be investigated to determine the cause and immediately repaired.
- Inspect for damage from rodents or burrowing animals. Repair any damage. Take appropriate corrective actions to alleviate further damage.
- Immediately remove any debris that may harm or reduce the effectiveness of sealants.
- Immediately repair any vandalism, vehicular, or livestock damage to any earthfills, spillways, or outlets or other apparatuses.

**SPECIFIC RECOMMENDATIONS FOR YOUR LINED IRRIGATION CANAL OR DITCH**



**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 LINED IRRIGATION CANAL OR DITCH.**

NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD

**STREAM CROSSING**

(No.)  
**CODE 578**

**DEFINITION**

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

**PURPOSE**

- Improve water quality by reducing sediment, nutrient, organic, and inorganic loading of the stream.
- Reduce streambank and streambed erosion.
- Provide crossing for access to another land unit.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies to all land uses where an ephemeral, intermittent or perennial watercourse exists and a ford, bridge, or culvert type crossing is desired for livestock, people, and /or equipment.

**CRITERIA**

**General Criteria Applicable to all Purposes.**

All federal, state and local requirements shall be addressed in the design.

Location and overall design of stream crossings shall be compatible with local conditions and stream geomorphology.

Watercourse crossings associated with timber harvesting or anadromous fish streams shall be designed to accommodate the estimated 100 year, 24 hour storm, including debris and sediment.

Location. Stream crossings shall be located in areas where the streambed is stable or where grade control can be provided to create a stable condition. Avoid sites where channel grade or alignment changes abruptly, excessive seepage or channel aggradation, degradation or lateral instability is evident, overfalls exist, or large tributaries enter the stream. Wetland areas shall be avoided if at all possible.

Crossings shall be installed perpendicular to the direction of flow of the stream. Skews should be

avoided.

Locate crossings, where possible, out of shady riparian areas to discourage cattle loafing time in the stream.

Stream crossings shall provide a way for normal passage of water, fish and other aquatic animals within the channel during all seasons of the year.

Access Roads. Where high rates of erosion of the adjacent roadways that slope towards the crossing threaten to deliver an excessive amount of sediment to the drainage, install measures to minimize erosion of the roadside ditch, road surface, and/or cut slopes. Where the stream crossing is installed as part of a roadway, the crossing shall be in accordance with NRCS Conservation Practice Standard, 560, Access Road.

Width. The stream crossing shall provide an adequate travel-way width for the intended use. A multi-use stream crossing shall have a travel-way no less than 10 feet wide. "Livestock only" crossings shall be no less than 6 feet wide. Width shall be measured from the upstream end to the downstream end of the stream crossing and shall not include the side slopes.

Side Slopes. All cuts and fills for the stream crossing shall have side slopes that are stable for the soil involved. Side slopes of earth cuts or fills shall be no steeper than 2 horizontal to 1 vertical. Rock cuts or fills shall be no steeper than 1.5 horizontal to 1 vertical.

Stream Approaches. Approaches to the stream crossing shall blend with existing site conditions where possible, and shall not be steeper than 4 horizontal to 1 vertical. Unless the foundation geology is otherwise acceptable, the approaches shall be stable, have a gradual ascent or descent grade, and be underlain with suitable material, as necessary, to withstand repeated and long term use. The minimum width of the approaches shall be equal to the width of the crossing surface.

Surface runoff shall be diverted around the approaches to prevent erosion of the approaches. Roadside ditches shall be directed into a diversion

or away from the crossing surface. Where high rates of erosion of the adjacent roadways that slope towards the crossing threaten to deliver an excessive amount of sediment to the drainage, install measures to minimize erosion of the roadside ditch, road surface, and/or cutslopes.

**Materials.** Materials selected for stream crossings shall be non-toxic to fish and other aquatic life. Asphalt and other petroleum products shall not be used.

Rock shall be chosen to withstand exposure to air, water, freezing and thawing. When rock is used, it shall be sufficiently large and dense so that it is not mobilized by design flood flows. Avoid rock with excessive fines that will impact the fisheries resource.

**Fencing.** Areas adjacent to the stream crossing shall be permanently fenced or otherwise excluded as needed to manage livestock access to the crossing.

Cross-stream fencing at fords shall be accomplished with breakaway wire, swinging floodgates, hanging electrified chain or other devices to allow the passage of floodwater debris during high flows.

All fencing shall be designed and constructed in accordance with NRCS Conservation Practice Standard 382, Fence.

**Vegetation.** All areas to be vegetated shall be planted as soon as practical after construction. When necessary, use of NRCS Conservation Practice Standard 342, Critical Area Planting shall be considered where vegetation is unlikely to become established by natural regeneration, or acceleration of the recovery of vegetation is desired.

**Safety.** Evaluate the need for safety measures such as guardrails at culvert or bridge crossing, or water depth signage at ford crossings.

### **Criteria for Culvert and Bridge Crossings**

Culverts or bridges are used where deeper flows preclude a safe low-water crossing, on high-traffic roads, and where year-round access is required.

Design of culverts and bridges shall be consistent with sound engineering principles and shall be adequate for the use, type of road, or class of vehicle. Culverts and bridges shall have sufficient capacity to convey the design flow without appreciably altering the stream flow characteristics.

Culverts shall be sized to accommodate at least the 10 year, 24 hour storm, and shall be a minimum of 18 inches in diameter and include adequate capacity to pass the anticipated woody debris load. Culverts or bridges shall also have adequate capacity so that the 25 year, 24 hour storm doesn't erode channel beds and energy dissipaters are not needed.

Crossings shall be adequately protected so that out-of-bank flows safely bypass without structure or streambank damage, or erosion of the crossing fill. Additional culverts may be used at various elevations to maintain terrace or floodplain hydraulics.

The length of the culvert shall be adequate to extend the full width of the crossing, including side slopes. At least one culvert pipe shall be placed on or below grade with the existing stream bottom.

Acceptable culvert materials include concrete, corrugated metal, corrugated plastic, new or used high quality steel and other materials approved by the engineer.

Acceptable bridge materials include concrete, steel, and wood.

### **Criteria for Ford Crossings**

A ford is an alternative way to cross a watercourse under the following circumstances:

1. The streambed has a firm rock or coarse gravel bottom, or a firm base can be established;
2. The approaches are low and stable enough to support traffic;
3. Traffic is limited to livestock or to low volumes of light vehicles; and
4. Water depth is less than 3 feet.

Unvented fords are structures that pass all water over the ford surface. They're commonly used on intermittent streams or perennial streams with low flows. Unvented fords do not allow for fish passage.

Vented fords are constructed with single or multiple culverts that pass low flows. Flood flows are intended to overtop the structure. They're commonly used in low to moderate flow perennial streams or where the normal flow would exceed a fordable depth.

When ford crossings are used, the cross-sectional area of the crossing shall not be less than the natural channel cross-sectional area. A portion of

the crossing shall be depressed at or below the average stream bottom elevation when needed to keep base flows or low flows concentrated.

Cutoff walls shall be provided at the upstream and downstream edges of ford-type stream crossings when needed to protect against undercutting. Protect the structure from piping.

The finished top surface of the ford type stream crossing in the bottom of the watercourse shall be no higher than the original stream bottom at the upstream edge of the ford crossing. If the downstream edge of the ford crossing is above the original stream bottom, the ford crossing shall be stabilized in accordance with NRCS Conservation Practice Standard 584, Stream Channel Stabilization.

Where rock is used for-ford type stream crossings for livestock, use a hoof contact zone or alternative surfacing method over the surfacing rock.

#### Concrete Fords

Concrete ford crossings shall be used only where the foundation of the stream crossing is determined to have adequate bearing strength.

Concrete shall have a minimum compressive strength of 3,000 psi at 28 days. Concrete ford crossings shall have a minimum thickness of placed concrete of 5 inches with minimum reinforcement of 6-inch by 6-inch, 6 gauge welded wire fabric. The concrete slab shall be poured on a minimum 4-inch thick rock base, unless the foundation is otherwise acceptable.

Precast concrete panels may be used in lieu of cast-in-place concrete slabs. Precast concrete units shall comply with ACI 525 or 533, or as otherwise acceptable for local conditions.

When heavy equipment loads are anticipated, the concrete slab shall be designed using an appropriate procedure as described in American Concrete Institute, ACI 360, Design of Slabs on Grade.

#### Geocell and/or Rock Ford Crossings

Rock ford crossings with geotextile shall be used when the site has a soft or unstable subgrade and the velocities do not exceed 5 fps. Ford crossings made of stabilizing material such as rock riprap are often used in steep areas subject to flash flooding, where normal flow is shallow or intermittent.

The bed of the channel shall be excavated to the necessary depth and width and covered with geotextile material. The geotextile material shall be

installed on the excavated surface of the ford and shall extend across the bottom of the stream and at least up to the 10-year, 24-hour peak discharge elevation.

The geotextile material shall be covered with at least 6 inches of crushed rock. If using geocells, the cells shall be at least 6 inches deep. All geosynthetic material shall be suitably durable and shall be installed in accordance with the manufacturer's recommendations, including the use of staples, clips and anchor pins.

At minimum, all rock ford stream crossings shall be designed to remain stable during the 10-year, 24-hour peak discharge.

#### **CONSIDERATIONS**

Avoid or minimize stream crossings, when possible, through evaluation of alternative trail or travel-way locations. Consider alternative practices to keep cattle out of the stream, e.g., (614) Watering Facility, (574) Spring Development or pasture pumps.

Ford crossings have the least detrimental impact on water quality when crossing is infrequent. Ford crossings are adapted for crossing wide, shallow watercourses with firm streambeds.

Stream crossings should be located where adverse environmental impacts will be minimized and considering the following:

- Effects on upstream and downstream flow conditions that could result in increases in erosion, deposition, or flooding.
- Short term and construction-related effects on water quality.
- Effects on fish passage and wildlife habitats.
- Effects on cultural resources.
- Overall effect on erosion and sedimentation that will be caused by the installation of the crossing and any necessary stream diversion.
- Long-term goals of riparian vegetation.

#### Cultural Resource Considerations

NRCS' objective is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice will have any effect on any cultural resources.

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GM 420, Part 401, the California Environmental Handbook and the California Environmental Assessment Worksheet provide guidance on how the NRCS must account for cultural resources. The Field Office Technical Guide, Section II contains general information, with internet sites for additional information.

### **Endangered Species Considerations**

Determine if installation of this practice with any others proposed will have any effect on any federal or state listed Rare, Threatened, or Endangered species or their habitat. NRCS' objective is to benefit these species and others of concern, or at least not have any adverse effect on a listed species. If the Environmental Evaluation indicated the action may adversely affect a listed species or result in adverse modification of habitat of listed species which has been determined to be critical habitat, NRCS will advise the land user of the requirements of the Endangered Species Act and recommend alternative conservation treatments for installation; or at the request of the landowners, the NRCS may initiate consultation with the U.S. Fish and Wildlife Service, NOAA Fisheries (National Marine Fisheries Service), and/or California Department of Fish and Game. If the Environmental Evaluation indicates the action will not affect a listed species or result in adverse modification of critical habitat, consultation generally will not apply and usually would not be initiated. Document any special considerations for endangered species in the Practice Requirements Worksheet.

Some species are year-round residents in some streams, such as freshwater shrimp. Other species, such as steelhead and salmon, utilize streams during various seasons. Be aware that during critical periods, such as spawning, eggs in gravels, and rearing of young, may preclude activities in the stream that may directly affect the stream habitat during those periods. For example, there should be no disturbance of stream gravel beds that may have eggs in them. That could include any equipment in the stream or even walking in the stream or work upstream that may result in sediment depositing in the gravel beds. Document any special considerations for endangered species in the Practice Requirements Worksheet.

## **PLANS AND SPECIFICATIONS**

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

## **OPERATION AND MAINTENANCE**

An operation and maintenance plan shall be developed and implemented for the life of the practice.

The stream crossing, appurtenances, and associated fence should be inspected after each major storm event, with repairs made as needed.

## **REFERENCES**

Guidelines for Salmonid Passage at Stream Crossings, National Marine Fisheries Service, September 2001,

<http://swr.nmfs.noaa.gov/hcd/NMFSSCG.PDF>

Designing Watercourse Crossings for Passage of 100-year Flood Flows, Wood and Sediment, California Forestry Report No. 1, Peter Cafferata, Thomas Spittler, Michael Wopat, Greg Bundros and Sam Flanagan, February 2004

<http://www.fire.ca.gov/ResourceManagement/PDF/100yr32links.pdf>

Best Management Practices for Stream Crossings, Florida Division of Forestry,

[http://www.fl-dof.com/Conservation/hydrology/page\\_28.html](http://www.fl-dof.com/Conservation/hydrology/page_28.html)

South Carolina Forestry Commission Best Management Practices,

<http://www.state.sc.us/forest/rbsc.htm>

Low Water Stream Crossings: Design and Construction Recommendations, Final Report, R.A. Lohnes et al., December 2001,

<http://www.ctre.iastate.edu/reports/LWSC.pdf>

Journal of Range Management, Volume 54:648–652, "Influence of off-stream supplements on streambanks of riparian pastures", Michael L. McInnis and James McIver, November 2001,

<http://uvalde.tamu.edu/jrm/nov01/MCINNIS.HTM>

Journal of Range Management, November 1996, Volume 49:482-488, "Cattle distribution, habitats, and diets in the Sierra Nevada of California", John G. Kie and Brian B. Boroski, November 1996,

[http://jrm.library.arizona.edu/data/1996/496/482-488\\_kie.pdf](http://jrm.library.arizona.edu/data/1996/496/482-488_kie.pdf)

Wiest, R.L., July 1998, A Landowner's Guide to Building Forest Access Roads: USFS (Northeast Area), Report TP-NA -06-98 Radnor PA, Pertinent chapters include Stream Crossings and Fish Protection.

Warhol, T., and Pyles, M.R., 1989, Low-Water Fords- An Alternative to Culverts on Forest Roads: Presented at the 12<sup>th</sup> Annual Council on Forest Engineering Meeting, Coeur d'Alene, ID, Aug. 27-30, 1989, 10 p.

Weaver, W.E., and Hagans, D.K., June 1994, Handbook for Forest and Ranch Roads: A Guide for planning, designing, constructing, reconstructing, maintaining, and closing wildland roads: Report prepared for the Mendocino County Resource Conservation District, in cooperation with the California Dept. of Forestry and Fire Protection and the USDA-SCS, 161 p. plus

UNITED STATES DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE

**578 – STREAM CROSSING**  
**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 stream crossing is an asset to your farm. This structure was designed and installed to safely cross a stream with livestock, equipment or vehicles with minimum disturbance to the stream ecosystem. The estimated life span of this system is at least 10 years. The life of this system can be assured and usually increased by developing and carrying out a good operation and maintenance program.

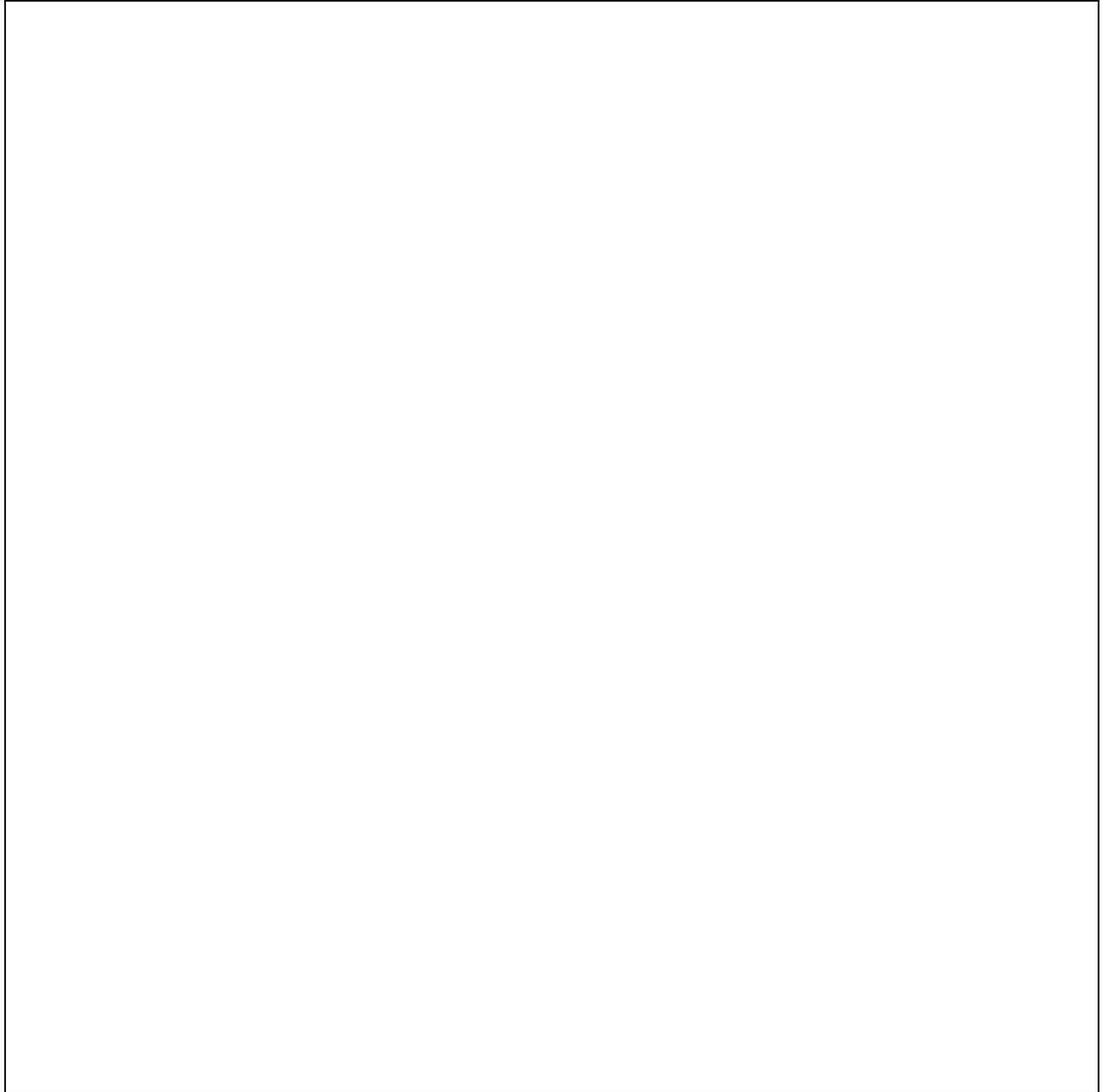
This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. Additional permits may be required to perform this work. Here are some recommendations to help you develop a good operation and maintenance program.

**GENERAL RECOMMENDATIONS**

- All fences, railings, and/or warning signs shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.
- Check all stream crossings after all major storms and at least twice per year—in spring and fall. Remove any debris that may accumulate on or in the immediate area of the structure.
- Make sure that all culverts are functional. Immediately remove any debris that blocks the culverts.
- Maintain vigorous growth of desirable vegetative coverings. This includes reseeding, fertilization, and controlled application of herbicides when necessary. Periodic mowing may also be needed to control height.
- Determine and eliminate causes of settlement or cracks in the earthen sections and repair damage.
- Repair spalls, cracks and weathered areas in concrete surfaces.
- Replace weathered or displaced rock.
- 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 to the stream crossing or associated practices, e.g., fences.

**SPECIFIC RECOMMENDATIONS FOR YOUR STREAM CROSSING**



**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 STREAM CROSSING.**

NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD

**STRUCTURE FOR WATER CONTROL**

(No.)  
**CODE 587**

**DEFINITION**

A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation or measures water.

**PURPOSE**

The practice may be applied as a management component to control the stage, discharge, distribution, delivery or direction of water flow.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies wherever a permanent structure is needed as an integral part of a water-control system to serve one or more of the following functions:

- Convey water from one elevation to a lower elevation within, to or from a water conveyance system such as a ditch, channel, canal or pipeline designed to operate under open channel conditions. Typical structures: drops, chutes, turnouts, surface water inlets, head gates, pump boxes and stilling basins.
- Control the elevation of water in drainage or irrigation ditches. Typical structures: checks, flashboard risers and check dams.
- Control the division or measurement of irrigation water. Typical structures: division boxes and water measurement devices.
- Keep trash, debris or weed seeds from entering pipelines. Typical structure: debris screen and fish screen.
- Control the direction of channel flow resulting from tides and high water or back-flow from flooding. Typical structures: tide and water management gates.
- Control the water table level, remove surface or subsurface water from adjoining land, flood land for frost protection or manage water

levels for wildlife or recreation. Typical structures: water level control structures, flashboard risers, pipe drop inlets and box inlets.

- Convey water over, under or along a ditch, canal, road, railroad or other barriers. Typical structures: bridges, culverts, flumes, inverted siphons and long span pipes.
- Modify water flow to provide habitat for fish, wildlife and other aquatic animals. Typical structures: chutes, cold water release structures and flashboard risers.
- Provide silt management in ditches or canals. Typical structure: sluice.
- Supplement a resource management system on land where organic waste or commercial fertilizer is applied.
- Create, restore or enhance wetland hydrology.

**CRITERIA**

**General Criteria Applicable to All Purposes**

If soil and climatic conditions permit, a protective cover of vegetation shall be established on all disturbed earth surfaces. If soil or climatic conditions preclude the use of vegetation and protection is needed, non-vegetative means, such as mulches or gravel, may be used. In some places, temporary vegetation may be used until permanent vegetation can be established. Seedbed preparation, weeding, fertilizing, and mulching shall comply with the instructions in technical guides.

Fencing can be provided, if necessary, to protect the vegetation.

Structures shall not be installed that have an adverse effect on septic filter fields.

The water level upstream of water control structures shall not be raised on adjacent properties without permission from the adjacent landowner.

Provide design features to facilitate continuation of fish migrations, where appropriate.

### **Additional Criteria for Fish Screens**

Fish screens shall be designed on an individual job basis to meet site conditions and functional requirements. Fish screen designs must meet the requirements of the current version of the State of California, Fish Screening Criteria and the National Marine Fisheries Service, Southwest Region, Fish Screening Criteria for Anadromous Salmonids.

Provisions of gravity flow fish screens will include return of the fish to the point of diversion in a manner which insures their survival. Provisions for fish trapping need to be considered and incorporated into the design if necessary.

Fish screens should be designed for easy removal from the river for ease of operations and maintenance.

Fish screen designs shall include a pump safety shutoff mechanism, or bypass, with instrumentation to determine the status of the system.

Water backwash systems should incorporate appropriate water filtration devices.

### **CONSIDERATIONS**

When planning, designing, and installing this practice, the following items should be considered:

#### **Water Quantity**

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
2. Potential for a change in the rate of plant growth and transpiration because of changes in the volume of soil water.
3. Effects on downstream flows or aquifers that would affect other water uses or users.
4. Effects on the volume of downstream flow that might cause environmental, social or economic effects.
5. The effect on the water table of the field to ensure that it will provide a suitable rooting depth for the anticipated crop.
6. Potential use for irrigation management to conserve water.

#### **Water Quality**

1. Effects on stream system channel morphology and stability as it relates to erosion and the movement of sediment, solutes, and sediment-attached substances carried by runoff
2. Effects on the movement of dissolved substances below the root zone and to ground water.
3. Effects of field water table on salt content in the root zone.
4. Effects on the turbidity of downstream water resources.
5. Short term and construction-related effects of this practice on the quality of downstream water.
6. Effects of water level control on the temperatures of downstream waters for their effects on aquatic and wildlife communities.
7. Effects on wetlands or water-related wildlife habitats.
8. Effects on the visual quality of downstream water resources.

Design alternatives presented to the client should address economics, ecological concerns, and acceptable level of risk for design criteria as it relates to hazards to life or property.

#### **Cultural Resources Considerations**

NRCS's objective is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice will have any effect on any cultural resources.

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

GM 420, Part 401, the California Environmental Handbook and the California Environmental Assessment Worksheet provide guidance on how the NRCS must account for cultural resources. The Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

### Endangered Species Considerations

Determine if installation of this practice with any others proposed will have any effect on any federal or state listed Rare, Threatened or Endangered species or their habitat. NRCS's objective is to benefit these species and others of concern or at least not have any adverse effect on a listed species. If the Environmental Evaluation indicates the action may adversely affect a listed species or result in adverse modification of habitat of listed species which has been determined to be critical habitat, NRCS will advise the land user 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 landowner selects one of the alternative conservation treatments for installation; or at the request of the landowners, NRCS may initiate consultation with the Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game. If the Environmental Evaluation indicates the action will not affect a listed species or result in adverse modification of critical habitat, consultation generally will not apply and usually would not be initiated. Document any special considerations for endangered species in the Practice Requirements Worksheet.

Some species are year-round residents in some streams, such as, freshwater shrimp. Other species, such as steelhead and salmon, utilize streams during various seasons. Be aware that during critical periods, such as spawning, eggs in gravel's and rearing of young may preclude activities in the stream that may directly affect the stream habitat during those periods. For example there should be no disturbance of stream gravel beds that may have eggs in them. That could include any equipment in the stream or even walking in the stream or work upstream that may result in sediment depositing in the gravel beds. Document any special considerations for endangered species in the Practice Requirements Worksheet.

### PLANS AND SPECIFICATIONS

Plans and specifications for installing structures for water control 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 location, grades, quantities, dimensions, materials, and hydraulic and structural requirements for the individual structure.

### OPERATION AND MAINTENANCE

An operation and management plan shall be provided to and reviewed with the land manager. The plan shall be site specific and include but not be limited to the following:

- Structures will be checked and necessary maintenance, including removal of debris, shall be performed after major storms and at least semi-annually.
- Water level management and timing shall be adequately described wherever applicable.

### REFERENCES

1. California Department of Fish and Game, June 19, 2000, Fish Screen Criteria, <http://iep.water.ca.gov/cvffrt/DFGCriteria2.htm>
2. National Marine Fisheries Service, January 1997, Fish Screening Criteria for Anadromous Salmonids, <http://swr.nmfs.noaa.gov/hcd/fishscrn.pdf>
3. National Marine Fisheries Service, May 9, 1996, Addendum to Fish Screening Criteria for Pumped Water Intakes. <http://swr.nmfs.noaa.gov/hcd/pumpcrit.pdf>
4. California NRCS, September 2003, Technical Notice TN-Engineering-CA-14, NRCS California, Planning and Design Guide for Stream Corridor Restoration

NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE SPECIFICATION

**587A - STRUCTURE FOR WATER CONTROL  
CORRUGATED METAL PIPE**

**I. SCOPE**

The work will consist of furnishing and placing of circular, arched or elliptical corrugated metal pipe and the necessary fittings to the lines, grades, and elevations as shown on the drawings.

**II. MATERIALS**

Pipe and fittings shall be of the size, shape, and kind of material shown on the drawings. Zinc-coated steel corrugated pipe and fittings and coatings shall conform to the requirements of ASTM Specification A-760 for the specified classes and shapes of pipe. Aluminum corrugated pipe and fittings and coatings shall conform to the requirements of ASTM B-745 for the specified classes and shapes of pipe.

**III. EXCAVATION**

Excavation for the conduit shall conform to the lines and grades shown on the drawings or as staked in the field, and as necessary for safe installation.

**IV. INSTALLATION**

The pipe shall be installed in accordance with the manufacturer's recommendations unless otherwise specified. Field welding of corrugated steel pipe will not be permitted. The pipe sections shall be joined with standard coupling bands unless otherwise specified. The pipe shall be firmly and uniformly bedded throughout its entire length. Backfill shall be accomplished in a manner that will not displace the pipe from the design grade or elevations shown on the drawings. Damaged coatings shall be repaired by acceptable methods.

**V. WATER CONTROL GATES**

Water control gates, when required, shall conform to the details shown on the drawings and shall be installed according to the manufacturer's recommendation.

**VI. CONCRETE HEADWALLS OR OTHER  
CONCRETE APPURTENANT STRUCTURES.**

Concrete headwalls or other concrete appurtenant structures shall conform to the details shown on the drawings and installed in accordance with Conservation Practice Specification 901, Concrete.

**VII. BACKFILL**

Backfill material shall contain no rocks greater than 2 inches. Compaction shall be accomplished by means of hand tamping or manually directed power tamper, or plate vibrators. Fill shall be placed in approximately horizontal layers. Fill shall be placed in layers not more than 4 inches thick before compaction, and in a manner which 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, if necessary, to obtain the proper moisture for compaction; the material shall retain a ball shape when squeezed in the hand.

**VIII. 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.

**IX. 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.

## **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 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.

## **XI. OPERATION AND MAINTENANCE ITEMS**

A properly operated and maintained structure for water control is an asset to your farm. This structure was designed and installed to safely convey water at a condition that will prevent erosion. The estimated life span of this system is at least 10 years. The life of this system 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 operations and maintenance program.

All fences, railings, and/or warning signs shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.

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.

Remove any debris that may accumulate on or in the immediate area of the structure.

Make sure that all structural drains are functional.

Settlement or cracks in the soil weaken earthen sections and may accelerate the development of flow paths which may result in structure failure. This should be investigated to determine the cause and immediately repaired.

Check concrete surfaces for accelerated weathering, spalling, settlement, alignment or cracks.

Check metal surfaces for rust and other damage, especially sections in contact with earthfill and with other materials. Repair or replace damaged section and apply paint as protective covering.

Inspect the structure and immediate vicinity 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 to the structure, and any appurtenances.

Other items specific to your project are listed on the "Practice Requirement" sheet.

U.S DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE  
CALIFORNIA

**PRACTICE REQUIREMENTS**  
**for**  
**587A - STRUCTURE FOR WATER CONTROL**  
**CORRUGATED METAL PIPE**

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 \_\_\_\_\_ 587A \_\_\_\_\_
3. Special Requirements: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. 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 Approved by: \_\_\_\_\_ Date: \_\_\_\_\_

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**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: \_\_\_\_\_

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**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: \_\_\_\_\_

UNITED STATES DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE

**587 – STRUCTURE FOR WATER CONTROL**

**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 control structure is an asset to your farm. This structure was designed and installed to safely convey water at condition that will prevent erosion. The estimated life span of this system is at least 10 years. The life of this system can be assured and usually increased by developing and carrying out a good operation and maintenance program.

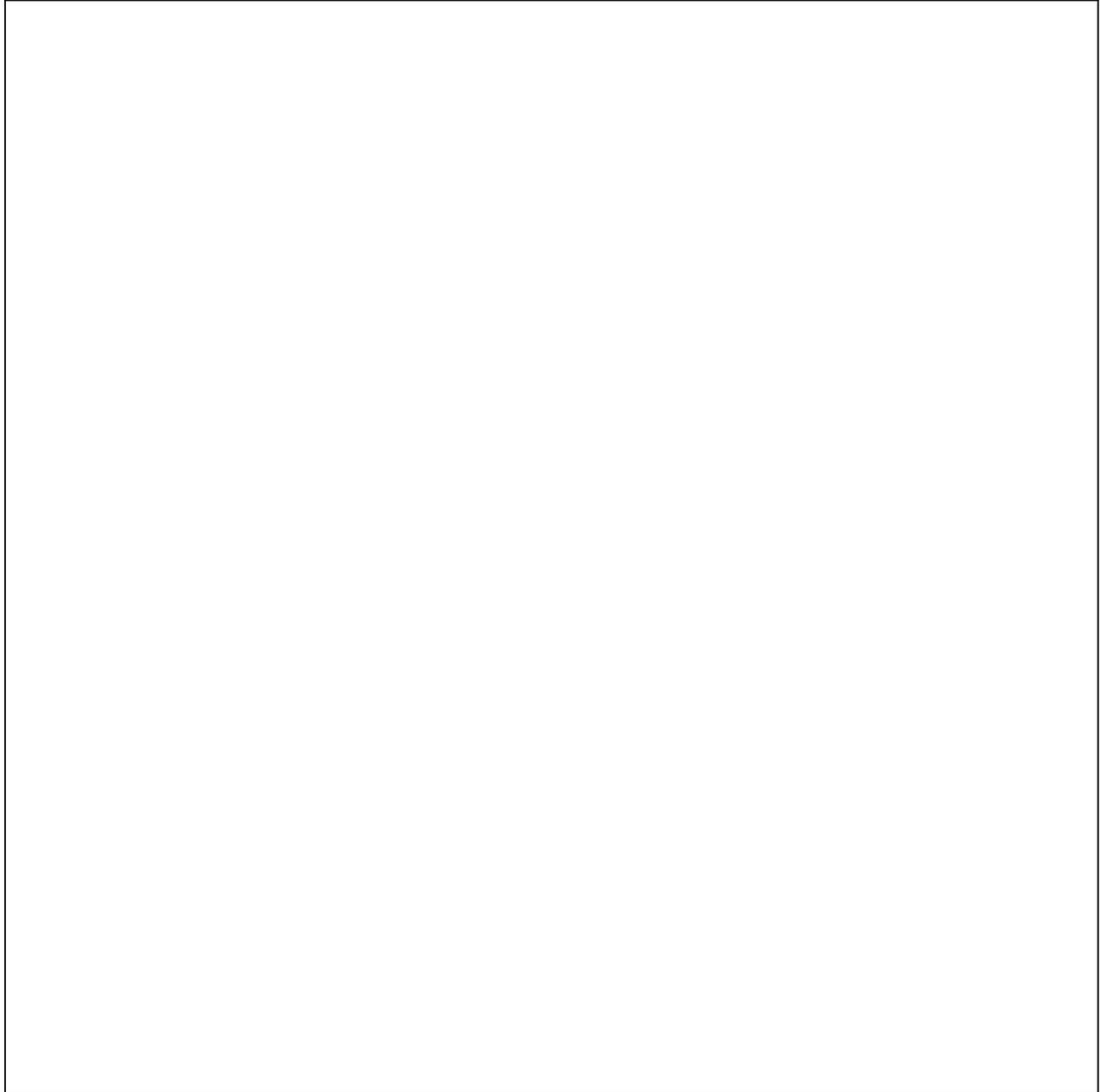
This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. Additional permits may be required to perform this work. Here are some recommendations to help you develop a good operation and maintenance program.

**GENERAL RECOMMENDATIONS**

- All fences, railings, and/or warning signs shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.
- Maintain vigorous growth of desirable vegetative coverings. This includes reseeding, fertilization, and controlled application of herbicides when necessary. Periodic mowing may also be needed to control height.
- Remove any debris that may accumulate on or in the immediate area of the structure.
- Make sure that all structural drains are functional.
- Determine and eliminate causes of settlement or cracks in the earthen sections and repair damage.
- Repair spalls, cracks and weathered areas in concrete surfaces.
- Repair or replace rusted or damaged metal and apply paint as a protective coating.
- Check all valves, gates and other appurtenances for proper functioning. If worn or damaged, repair or replace following the manufacturer's recommendations.
- Replace weathered or displaced rock riprap to constructed grade.
- Check all timber or lumber sections for decay and other damage, especially sections in contact with earth or other materials. Repair damaged sections and apply protective coatings as needed.

- 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 to any earthfills, spillways, or outlets or other apparatuses.

**SPECIFIC RECOMMENDATIONS FOR YOUR STRUCTURE**



**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 STRUCTURE FOR WATER CONTROL.**

NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE SPECIFICATION

**587B - STRUCTURE FOR WATER CONTROL  
PLASTIC PIPE CULVERTS**

**I. SCOPE**

The work will consist of furnishing and placing plastic pipe for culverts, with the necessary fittings at the location, and to the lines and grades as shown on the drawings, and shall include any necessary excavation and the required structural support.

**II. GENERAL**

Pipe and fittings shall be of the size, shape, and kind of material as shown on the drawings.

The Installer shall provide the Engineer with a Certificate of Compliance from the manufacturer for each type of plastic pipe furnished. Said certificate shall certify that the plastic pipe complies with the requirements of the specifications, and shall include the resin material cell classification, unit weight of pipe, average pipe stiffness and the date of manufacture.

The dimensions given for the pipe are nominal inside diameters from which the average inside diameter shall not vary more than the amount specified for in the ASTM or ASSHTO specification for the different types of pipe

**III. MATERIALS**

The pipe used shall be listed on the "Practice Requirements" sheet. Prior to purchase of the pipe, the owner should provide the Engineer with the name of the pipe manufacturer and the markings on the pipe for the Engineer's determination of acceptance. The quality of the pipe shall conform to the requirements of one of the following type of pipe:

ASSHTO M 294-01, Corrugated Polyethylene Pipe. The pipe shall be Type C (full circular cross section, with a corrugated surface both inside and outside; or Type S, (full circular cross section, with an outer corrugated pipe wall and a smooth inner liner). Corrugations shall be annular.

ASTM F949, Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe and fittings. The pipe shall be full circular cross section, with an outer corrugated pipe wall and a smooth inner liner. Pipe stiffness shall be 46 psi.

ASTM F679, Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings. The pipe shall conform to all the requirements of ASTM Designation F 679. Pipe stiffness shall be 46 psi

ASTM F794, Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based On Controlled Inside Diameter. The pipe shall conform to all the requirements of ASTM Designation F 794. Pipe stiffness shall be 46 psi

**IV. CONTROL OF WATER**

Do not lay or embed pipe in standing or running water. At all times prevent runoff and surface water from entering the trench. Maintain water level below pipe bedding and foundation to provide a stable trench bottom.

De-watering shall meet the requirements of 909 Control of Water. De-watering should continue through-out the pipe laying operation until sufficient cover is placed over the pipe so that it will not float.

**V. TRENCH EXCAVATION**

All necessary excavation shall be to the limits required to place the pipe to grade. Any trench excavations greater than 4 feet in depth shall be supported as necessary to safeguard the work and workmen.

Where trench walls are stable or supported, provide a minimum trench width sufficient, but no greater than necessary, to ensure working room to properly and safely compact haunching and other embedment materials. The space between the pipe and the trench wall must be larger than the compaction equipment used in the pipe zone. The minimum trench width shall be not less than 1.25 times the outer diameter plus 12 inches.

**LAYING AND BEDDING THE PIPE**

The installer shall furnish such equipment as is necessary to place the pipe without damaging the pipe. The pipe shall be transported and handled in such a manner as to prevent bending or crushing.

Unless otherwise specified, the pipe shall be installed and the pipe sections shall be joined in accordance with the manufacturer's recommendations.

The pipe shall be firmly and uniformly bedded throughout its entire length to the depth specified on the drawings. Provide a minimum of 4 inches of bedding unless otherwise specified. When rock or unyielding material is present in the trench bottom, install a minimum of 6 inches of bedding below the bottom of the pipe. Where the trench bottom is unstable or shows a "quick" tendency, excavate to a depth as required by the engineer and replace with Class IB or Class II material. If the trench sidewalls slough off during excavation or pipe installation, remove all sloughed or loose material from the trench.

After the grade line has been checked for proper elevation, the pipe shall be loaded sufficiently to prevent its being lifted from the bedding during backfilling.

Deflection of pipe diameter (in the vertical direction) shall be controlled by strutting or other methods. Pipe with bell and spigot shall be placed with the bell upstream. Bell holes shall be excavated to allow the pipe to rest firmly on the bedding. All work shall be carried out in the dry and stable conditions.

Pressure testing: When specified, the pipeline shall be tested for leakage by subjecting the pipeline to a water pressure equal to the design working head. All locations of joints and connections shall be open from backfill during testing. However, some backfill may be placed in the mid-sections of the pipe for the purpose of holding the pipe in place while testing. After testing any leaks shall be repaired, and the line tested again. After the leaks have been satisfied, the backfill can be completed.

## VI. STRUCTURAL BACKFILL

All necessary excavation shall be to the limits required to place the pipe to grade. Any trench excavations greater than 4 feet in depth shall be supported as necessary to safeguard the work and workmen.

Structural backfill shall consist of one of the following classes of backfill (ASTM D2321) which is as shown on the drawings:

Class 1B - The material shall conform to the following gradation:

Sieve Size	Percent Passing Sieve Size
1 1/2 inch	100
No. 4	≤ 50
No. 200	≤ 5

The material is to be placed in layers of not more than 6 inches and the relative density of each layer shall not be less than 85 percent of the maximum laboratory compaction at optimum moisture in accordance with ASTM D-698.

Class II - On-site material (GW, GP, SW, and SP) - Backfill material shall be of the material from on-site excavation and shall be compacted to a minimum density 85 percent of the maximum laboratory compaction at optimum moisture in accordance with ASTM D-698.

Class III - On-site material (GM, GC, SM, and SC) - Backfill material shall be of the material from on-site excavation and shall be compacted to 90 percent of the maximum laboratory compaction at optimum moisture in accordance with ASTM D-698.

Cement Slurry Backfill may consist of a fluid, workable mixture of aggregate, cement and water. The aggregate shall be Class II backfill material.

The mixture shall contain a minimum of 2 bags of Portland cement per cubic yard of slurry, and only sufficient water to produce a workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

The slurry is to be allowed to cure in place for 12 hours before proceeding with other construction operations.

Backfill material shall contain no rocks greater than 1 1/2 inches. Compaction shall be accomplished by means of hand tamping or manually directed power tamper, or plate vibrators. Fill shall be placed in approximately horizontal layers not more than 6 inches thick before compaction, and in a manner which 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, if necessary, to obtain the proper moisture for compaction; the material shall retain a ball shape when squeezed in the hand.

The initial backfill shall extend to a minimum of 12 inches above the top of the pipe before using mechanical compactors. The final backfill shall be placed in layers, not exceeding 8 inches and compacted, and is to extend upward to the natural ground surface or the limits as shown on the drawings. Heavy motorized equipment shall not be permitted for compacting backfill.

## VIII. MINIMUM COVER

To prevent damage to the pipe and disturbance to the embedment, a minimum depth of cover should be installed before allowing vehicles or heavy equipment to cross the pipe trench. Provide a minimum cover of 24 inches or one pipe diameter (whichever is larger) over Class IB embedment and 36 inches for Class II and III embedment.

## 1X CONCRETE HEADWALLS OR OTHER CONCRETE APPURTENANT STRUCTURES.

Concrete headwalls or other concrete appurtenant structures shall conform to the details shown on the drawings and installed in accordance with Conservation Practice Specification 901, Concrete.

## **X WATER CONTROL GATES**

Water control gates, when required, shall conform to the details shown on the drawings and shall be installed according to the manufacturer's recommendation.

## **XI 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.

## **XII 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.

## **XIII 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.

## **OPERATION AND MAINTENANCE ITEMS**

A properly operated and maintained structure for water control is an asset to your farm. This structure was designed and installed to safely convey water at a condition that will prevent erosion. The estimated life span of this system is at least 10 years. The life of this system 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 operations and maintenance program.

All fences, railings, and/or warning signs shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.

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.

Remove any debris that may accumulate on or in the immediate area of the structure.

Settlement or cracks in the soil weaken earthen sections and may accelerate the development of flow paths that may result in structure failure. This should be investigated to determine the cause and immediately repaired.

Check metal surfaces for rust and other damage, especially sections in contact with earthfill and with other materials. Repair or replace damaged section and apply paint as protective covering.

Inspect the structure and immediate vicinity 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 to the structure, and any appurtenances.

Other items specific to your project are listed on the "Practice Requirement" sheet.

U.S DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE  
CALIFORNIA

**PRACTICE REQUIREMENTS**  
**for**  
**587B - STRUCTURE FOR WATER CONTROL**  
**PLASTIC PIPE CULVERTS**

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 \_\_\_\_\_ 587B \_\_\_\_\_
3. Special Requirements: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. 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 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

**587C - STRUCTURE FOR WATER CONTROL  
FISH SCREEN**

**I. SCOPE**

The work will consist of furnishing and installing a fish screening system to prevent fish, trash and debris from entering the irrigation delivery system. The work will include all the necessary work and fittings installed to the lines, grades and elevations as shown on the drawings.

**II. MATERIALS**

Pipe and fittings shall conform to the Practice Standard 430 appropriate to the pipe material.

Concrete used in the installation shall conform to the NRCS Construction Specification 901 Concrete.

Earthfill shall conform to the NRCS Construction Specification 903 Earthfill.

Rock riprap shall conform to the NRCS Construction Specification 907 Rock Riprap.

Grouted Rock Riprap shall conform to NRCS Construction Specification 908 Rock Riprap (Grouted).

Geotextile Fabrics shall conform to NRCS Construction Specification 905 Geotextile Fabric.

**III. EXCAVATION**

Excavation for the installation shall conform to the lines and grades shown on the drawings or as staked in the field, and as necessary for safe installation.

**IV. INSTALLATION**

Pumped diversions, which are screened using manufactured, self-contained screens, shall be installed in accordance with the manufacturer's recommendations unless otherwise specified. Minimum clearance of one screen diameter from the channel invert and minimum submergence of one screen diameter from the water surface is required. Installation of all other screens shall be as shown on the drawings.

Pipe shall be shop or field fabricated as needed. Field welding of galvanized corrugated metal pipe will not be permitted. Pipe sections shall be joined with

flanged fittings or coupling bands unless otherwise specified. Pipe shall be bedded or supported as shown on the drawings.

**V. WATER CONTROL GATES**

Water control gates, when required, shall conform to the details shown on the drawings and shall be installed according to the manufacturer's recommendation.

**VI. BACKFILL**

Backfill material shall contain no rocks greater than 2 inches. Compaction shall be accomplished by means of hand tamping or manually directed power tamper, or plate vibrators. Fill shall be placed in approximately horizontal layers. Fill shall be placed in layers not more than 4 inches thick before compaction, and in a manner which 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, if necessary, to obtain the proper moisture for compaction; the material shall retain a ball shape when squeezed in the hand.

**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 while minimizing disturbances to instream and riparian habitats. Special attention shall be given to protecting visual resources as well as the physical characteristics of the streambank, streambed and surrounding vegetation.

**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.

### **OPERATION AND MAINTENANCE ITEMS**

A properly operated and maintained fish screen is an asset to your farm. This structure was designed and installed to safely convey water in a manner that will prevent entraining anadromous fish in your irrigation system. Lack of attention to operation and maintenance details has the potential to kill significant numbers of fish that the screen has been designed to protect.

The estimated life span of this system is at least 10 years. The life of this system 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 operations and maintenance program.

#### **Pumped diversions:**

Before start of irrigation season, remove, clean and inspect screens for damage, corrosion, and service rotating components as recommended by the manufacturer. Repair or replace damaged screens or hardware components.

Inspect backwash pump system and pressure gauge for proper operation. Pressure shall be within the specified pressure range. Spray nozzles shall be inspected for plugging or debris and replaced if excessive wear is noted. Check to see that the interlock with the main pumping plant is functional so that the backwash pump cannot be inadvertently turned off. Replace pressure gauges if non-functional.

Inspect inline filters or sand separators. Repair and/or replace if non-functional

Remove any debris and silt bars that may have accumulated and check depth of water below screen to assure one screen diameter clearance from the bottom.

Remove any aquatic weeds that may interfere with rotation of screens or cause debris to accumulate.

Install and maintain fish screen warning signs to notify boaters and fisherman of submerged obstacle.

Inspect all working platforms, fences and railings for safety and post warning signs to prevent unauthorized

entry.

During pump operation monitor backwash pressure or install automatic pump safety shutoff switch.

If variations in irrigation pump supply or debris accumulation on screen are noted, discontinue pumping. Do not resume pumping until the difficulty has been located and corrected.

#### **Non-pumped Diversions:**

The screen should be visited as frequently as environmental conditions dictate. If the river level or diversion flow changes, steps must be taken to ensure that the screen is properly submerged for the amount of flow being diverted. Bypass flows may also need to be adjusted.

Dealing with debris at a screen site needs to be addressed on a frequent basis as debris accumulation can cause significant injury to fish. Debris type and quantity vary seasonally so a suitable schedule should be developed.

Remove any debris that may accumulate on or in the immediate area of the structure. Remove debris from bypass downwells, bypass entrances and exits, trash racks and along the screen face.

Components must be greased (with environmentally benign grease) on a regular basis. Screen seals must be checked frequently for wear and replaced as needed. Sediment should be removed before it starts passing through the seals.

#### **All screens:**

All fences, railings, and/or warning signs shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.

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.

Compacted earthfill shall be inspected for destructive rodent holes, and repaired as necessary.

Make sure that all structural drains are functional.

Settlement or cracks in the soil weaken earthen sections and may accelerate the development of flow paths that may result in structure failure. This should be investigated to determine the cause and immediately repaired.

Check concrete surfaces for accelerated weathering, spalling, settlement, alignment or cracks.

Check metal surfaces for rust and other damage, especially sections in contact with earthfill and with

other materials. Repair or replace damaged section and apply paint as protective covering.

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 to the structure, and any appurtenances.

Other items specific to your project are listed on the "Practice Requirement" sheet.

NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE SPECIFICATION

**587C - STRUCTURE FOR WATER CONTROL  
FISH SCREEN**

**I. SCOPE**

The work will consist of furnishing and installing a fish screening system to prevent fish, trash and debris from entering the irrigation delivery system. The work will include all the necessary work and fittings installed to the lines, grades and elevations as shown on the drawings.

**II. MATERIALS**

Pipe and fittings shall conform to the Practice Standard 430 appropriate to the pipe material.

Concrete used in the installation shall conform to the NRCS Construction Specification 901 Concrete.

Earthfill shall conform to the NRCS Construction Specification 903 Earthfill.

Rock riprap shall conform to the NRCS Construction Specification 907 Rock Riprap.

Grouted Rock Riprap shall conform to NRCS Construction Specification 908 Rock Riprap (Grouted).

Geotextile Fabrics shall conform to NRCS Construction Specification 905 Geotextile Fabric.

**III. EXCAVATION**

Excavation for the installation shall conform to the lines and grades shown on the drawings or as staked in the field, and as necessary for safe installation.

**IV. INSTALLATION**

Pumped diversions, which are screened using manufactured, self-contained screens, shall be installed in accordance with the manufacturer's recommendations unless otherwise specified. Minimum clearance of one screen diameter from the channel invert and minimum submergence of one screen diameter from the water surface is required. Installation of all other screens shall be as shown on the drawings.

Pipe shall be shop or field fabricated as needed. Field welding of galvanized corrugated metal pipe will not be permitted. Pipe sections shall be joined with

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**V. WATER CONTROL GATES**

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**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,

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

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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 operations and maintenance program.

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entry.

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Dealing with debris at a screen site needs to be addressed on a frequent basis as debris accumulation can cause significant injury to fish. Debris type and quantity vary seasonally so a suitable schedule should be developed.

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#### **All screens:**

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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.

Compacted earthfill shall be inspected for destructive rodent holes, and repaired as necessary.

Make sure that all structural drains are functional.

Settlement or cracks in the soil weaken earthen sections and may accelerate the development of flow paths that may result in structure failure. This should be investigated to determine the cause and immediately repaired.

Check concrete surfaces for accelerated weathering, spalling, settlement, alignment or cracks.

Check metal surfaces for rust and other damage, especially sections in contact with earthfill and with

other materials. Repair or replace damaged section and apply paint as protective covering.

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 to the structure, and any appurtenances.

Other items specific to your project are listed on the "Practice Requirement" sheet.

U.S DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE  
CALIFORNIA

**PRACTICE REQUIREMENTS**  
**for**  
**587C - STRUCTURE FOR WATER CONTROL**  
**FISH SCREEN**

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 \_\_\_\_\_ 587C \_\_\_\_\_
3. Special Requirements: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. 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 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: \_\_\_\_\_

U.S DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE  
CALIFORNIA

**PRACTICE REQUIREMENTS**  
**for**  
**587C - STRUCTURE FOR WATER CONTROL**  
**FISH SCREEN**

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 \_\_\_\_\_ 587C \_\_\_\_\_
3. Special Requirements: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. 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 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 STANDARD

**VERTICAL DRAIN**

(No.)

**CODE 630**

**DEFINITION**

A well, pipe, pit, or bore in porous, underground strata into which drainage water can be discharged.

**PURPOSE**

Provide an outlet for drainage water from a surface or subsurface drainage system.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice is applicable in locations where the underlying strata can receive, transmit or store the design drainage flow and other drainage outlets are not available and cannot be provided at a reasonable cost. This practice is also applicable where natural “sinkholes” are the vertical drain, and where erosion control or treatment of surface runoff is a concern.

This practice is applicable only in locations where a determination has been made that it is not contrary to state laws or regulations, and that it will not cause pollution of underground waters.

**CRITERIA**

The number, size and location of vertical drains shall be adequate to discharge the design drainage flow into the underlying stratum or strata, and shall be based on a field determination of the depth, permeability, porosity, thickness and extent of the strata.

The minimum diameter of shallow uncased wells shall be 6 in. and of deep cased wells, 4 in.

A suitable filter system, desilting basin or other means necessary for removing sediment from the water shall be provided before it enters the well.

Well casings shall be of adequate strength and longevity to serve planned needs.

**CONSIDERATIONS**

Significant diversions into underground storage areas may have an effect on the peak discharge rate from a watershed. Planners should consider this, and take steps to mitigate any potential negative

effects this may have on riparian habitat downstream from the structure.

Significant additions to subsurface water sources may raise local water tables or cause undesirable surface discharges down gradient from the vertical drain.

**Cultural Resources Considerations**

NRCS’s objective is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice will have any effect on any cultural resources.

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

GM 420, Part 401, the California Environmental Handbook and the California Environmental Assessment Worksheet provide guidance on how the NRCS must account for cultural resources. The Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

**Endangered Species Considerations**

Determine if installation of this practice with any others proposed will have any effect on any federal or state listed Rare, Threatened or Endangered species or their habitat. NRCS's objective is to benefit these species and others of concern or at least not have any adverse effect on a listed species. If the Environmental Evaluation indicates the action may adversely affect a listed species or result in adverse modification of habitat of listed species which has been determined to be critical habitat, NRCS will advise the land user 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 landowner selects one of the alternative conservation treatments for installation; or at the request of the landowners, NRCS may initiate consultation with the Fish and Wildlife Service, National Marine Fisheries Service and/or California

Department of Fish and Game. If the Environmental Evaluation indicates the action will not affect a listed species or result in adverse modification of critical habitat, consultation generally will not apply and usually would not be initiated. Document any special considerations for endangered species in the Practice Requirements Worksheet.

Some species are year-round residents in some streams, such as, freshwater shrimp. Other species, such as steelhead and salmon, utilize streams during various seasons. Be aware that during critical periods, such as spawning, eggs in gravel's and rearing of young may preclude activities in the stream that may directly affect the stream habitat during those periods. For example there should be no disturbance of stream gravel beds that may have eggs in them. That could include any equipment in the stream or even walking in the stream or work upstream that may result in sediment depositing in the gravel beds. Document any special considerations for endangered species in the Practice Requirements Worksheet.

#### **Water Quantity**

1. Effect on the aquifer recharge.
2. Effect on the water table.
3. Effect on the volume of downstream flow to downstream users and uses.

#### **Water Quality**

1. Potential hazard to ground water quality from the discharge of drainage water containing dissolved substances.
2. Potential for land use changes that may impair aquifer quality.

#### **PLANS AND SPECIFICATIONS**

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

#### **OPERATION AND MAINTENANCE**

An operation and maintenance plan must be prepared by the Designer for use by the owner or other responsible for operating this practice. The plan should provide specific instructions for operating and maintaining the system to insure that it functions properly. It should also provide for

periodic inspections and prompt repair or replacement of damage components. The plan shall be site specific and include but not be limited to the following:

- Periodic inspection of the inlets to vertical drains to ensure that they are not plugged or damaged.
- Vegetative filters, sediment basins and other filters shall be maintained as per Operation and Maintenance requirements for each of the respective practice standards.

UNITED STATES DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE

**630 – VERTICAL DRAIN**

**OPERATION AND MAINTENANCE**

Sponsor/Land user: \_\_\_\_\_ Date: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

Location GPS Coordinates Map Datum: \_\_\_\_\_ E \_\_\_\_\_ N \_\_\_\_\_

Quad Sheet Name \_\_\_\_\_ SEC \_\_\_\_\_ T \_\_\_\_\_ R \_\_\_\_\_

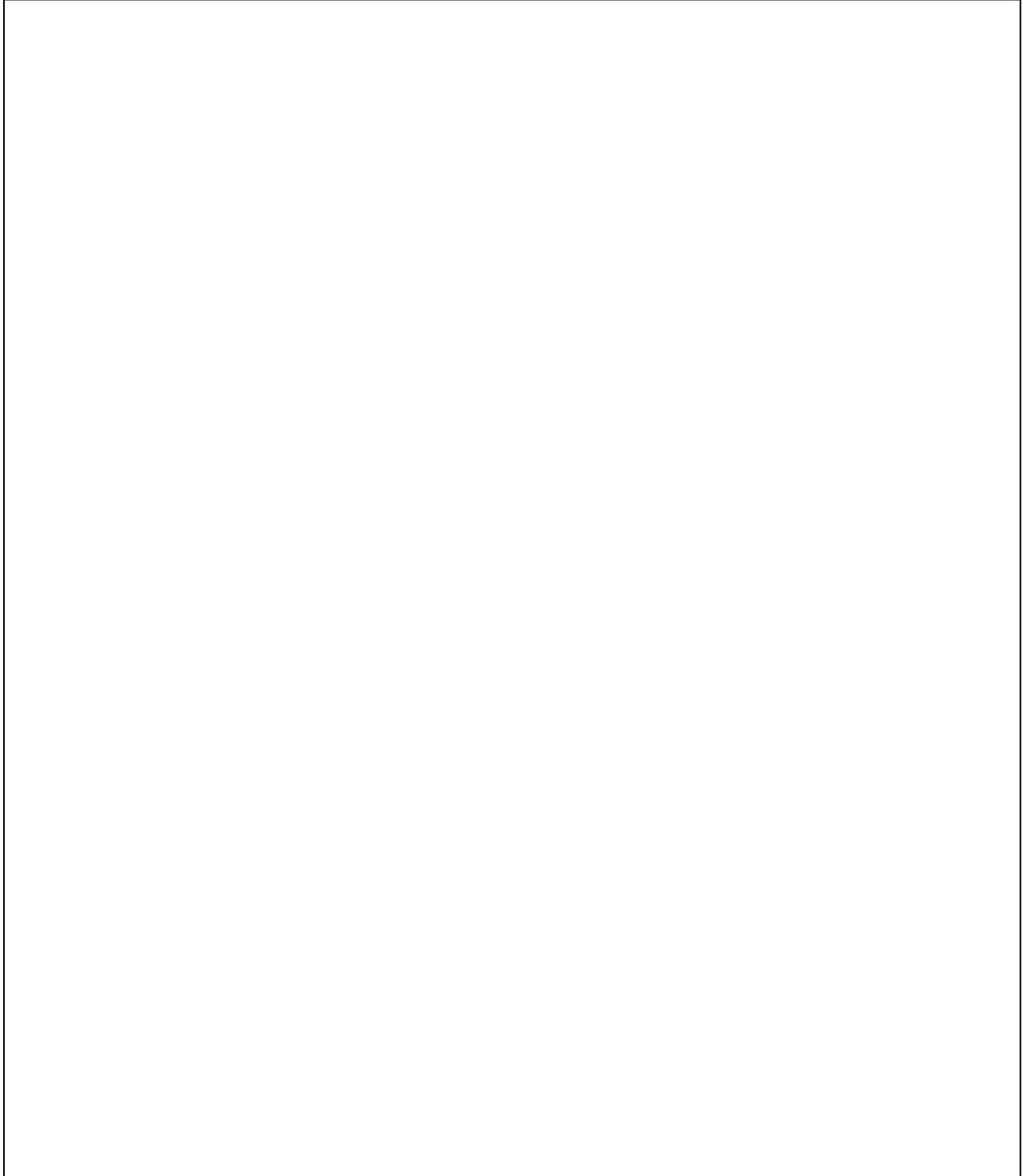
A properly operated and maintained vertical drain is an asset to the farm. This vertical drain was designed and installed to provide an outlet for drainage water from a surface or subsurface drainage system. The estimated life span of this installation is at least 10 years. The life of this installation 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 the well cover securely in place.
- Protect the area from being damaged by agriculture machinery, vehicles, or livestock.
- All fences, railings, and/or warning signs shall be maintained to provide warning and/or prevent unauthorized human or livestock entry.
- Do not allow any foreign debris to accumulate in the immediate vicinity. Remove debris or sediment from the desilting basin.
- Maintain the filter system in accordance with manufacturer's specifications.
- Maintain soil and vegetative covering to the design conditions.
- Inspect for damage from rodents or burrowing animals. Repair any damage. Take appropriate corrective actions to alleviate further damage.
- Check metal surfaces for rust and other damage especially sections in contact with earthfill and with other materials. Repair or replace damaged section and apply paint as a protective covering.
- Immediately repair any vandalism, vehicular, or livestock damage.

**SPECIFIC RECOMMENDATIONS FOR YOUR VERTICAL DRAIN**



**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 VERTICAL DRAIN.**