SECTION 5.2

TILE DRAIN INSTALLATION AND REPAIR

	Overview
Practice 201	Tile Drain Installation
Practice 202	Tile Drain Repair/Replacement
Practice 203	Breather Pipe
Practice 204	Tile Drain Inlet

SECTION 5.2
TILE DRAIN INSTALLATION AND REPAIR

Headwater areas for many of the streams and ditches in Indiana are in the form of closed tile drains. The upper portion of these drains is usually located within agricultural fields where water is collected through the use of perforated drains installed below the ground surface. This section concentrates on these types of drains. It should be noted that in general, these systems are installed and maintained by private landowners. These systems then discharge water to a regulated drain which may either be a larger tile or an open drain.

Stream enclosures, in the form of a long culvert or an unperforated tile drain, are often used in the headwater areas to convey drainage water without disruption to the above-ground land use. Principles provided in this section, as well as those presented in Practice 901, should be consulted when such usage of tile drains is being considered.

Subsurface tile drains consist of a conduit installed beneath the ground surface to collect and/or convey drainage water. Tiles may be constructed of corrugated plastic tubing, clay, or concrete. The choice of tile material depends on the cost, resiliency, strength, and conveyance.

Subsurface drains are often installed in agricultural fields employing one of four systems of layout: parallel, herringbone, double main, or random (Exhibit 201b). The type of system used depends on site topography, land drainage patterns, and other factors. A double main, for example, intercepts runoff on either side of a stream. A random system is useful for draining irregularly dispersed wet pockets in the landscape.

Breather pipes, or pressure relief vents, are recommended where the drain grade changes from steep to flat. The purpose of breather pipes is to allow air entry, and to relieve pressure that otherwise may cause blowouts. Breather pipes may also be replaced or modified as slotted risers which serve as inlets for areas prone to surface ponding.

Installation of surface inlets to tile systems can help remove surface water more quickly. However, surface inlets can also provide a direct conduit to receiving streams for herbicides, pesticides, and other chemicals used in agricultural fields. Buffer strips of permanent grass around inlets should be considered to reduce impact of pollutants.

Subsurface drains that are properly installed require little maintenance to keep operational. However, periodic inspections will help keep drains operating at capacity. Particular attention should be paid to outlets, water-surface inlets, traps and catch basins, and tiles located near trees. To reduce the chance of damage by various activities along roads, markers may be used to signal the location of tile crossings.

Tiles, by their nature, can dramatically alter the hydrology of areas where they are located, as well as the hydrology of adjacent properties. Care should be taken that tiles do not negatively impact valuable wildlife habitat (especially for wetland and stream dependent species), or cause detrimental water level impacts to adjacent property owners. Non-perforated or sealed joint tile should be used in these areas.

Last Print/Revision Date: October 13, 1996

PRACTICE 201
TILE DRAIN INSTALLATION

DESCRIPTION

- A conduit, such as corrugated plastic tubing, clay tile, or pipe, installed beneath the ground surface to collect and/or convey drainage water in headwater areas.

Exhibit 201a: Tile Drain Installation (Source: NRCS Files)

PURPOSE

- Convey watershed's headwater flow with minimal disruption to agricultural fields.
- Improve soil environment for vegetation growth.
- Collect ground water.
- Remove water from heavy use areas.
- Regulate water to control hydrophytic pests such as liver flukes, flies, or mosquitos.

WHERE APPLICABLE

- Areas with a high water table where the benefits of lowering the table would justify installing such a system.

ADVANTAGES

- Relieves artesian pressures.
- Removes surface runoff.
- May enhance crop growing potential.

CONSTRAINTS

- May be relatively expensive to install.
- May drain valuable wetland habitat.
- May negatively affect water levels of adjacent land owners.
- May transport contaminants.
- May outfall into valuable stream habitat that may be negatively impacted by potentially cool, subsurface water.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Clay, concrete, or perforated and non-perforated plastic tubing.
- Conduit should meet strength and durability requirements of the site.
- Filter material, if necessary.

Installation

- Begin digging the trench at the outlet end continue upgrade.
- Trench width should at least equal the outside diameter of the drain, up to 0.5' wider than the drain.
- Round the bottom of the trench so that the drain will be embedded in undisturbed soil for the last 60 degrees of its circumference.
- For corrugated plastic tubing, installation criteria are listed in ASTM Standard F449: "Recommended Practice for Subsurface Installation of Corrugated Thermoplastic Tubing for Agricultural Drainage or Water Table Control".
- Laying of the tile should begin at the lower end of the line and progress up-grade.
- Backfill in a manner that will not displace the conduit.

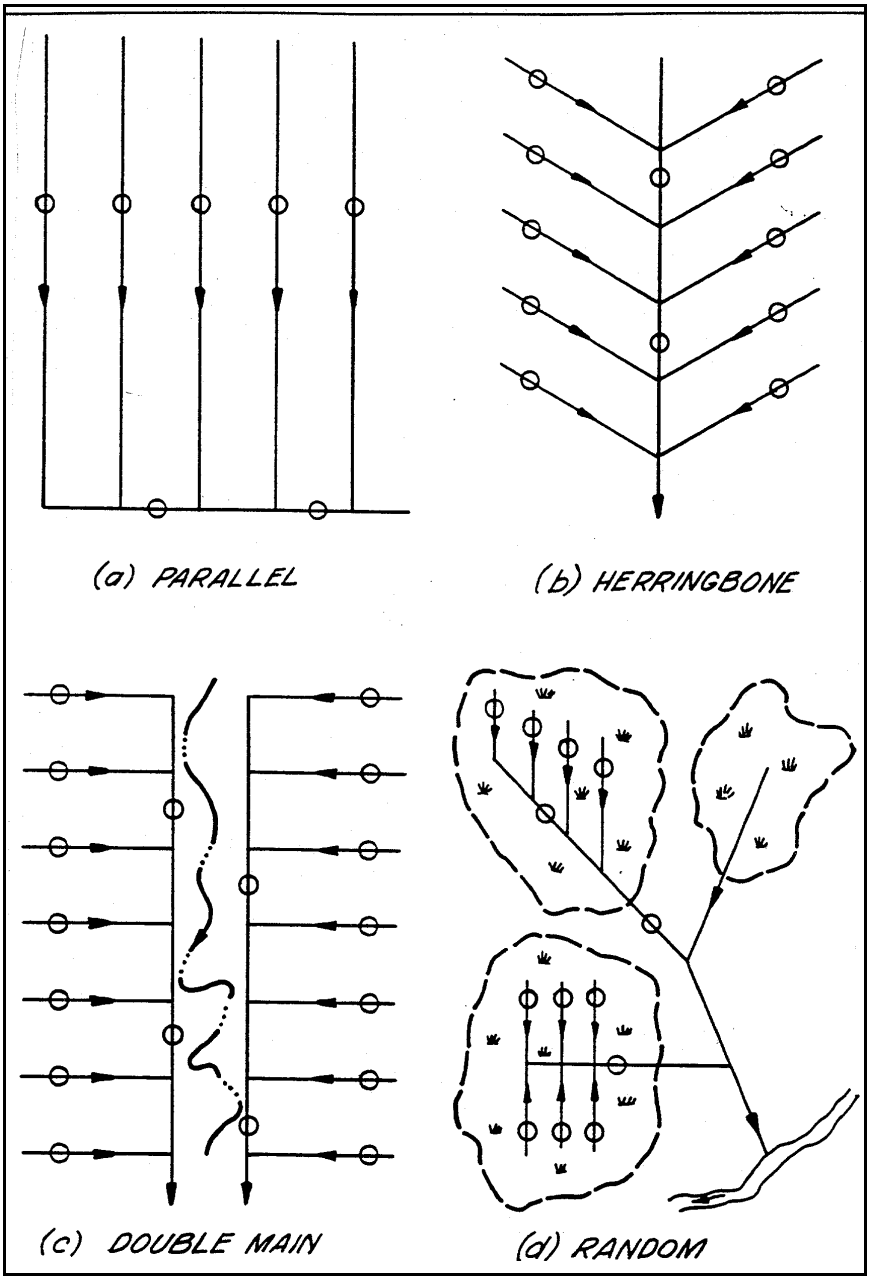

Exhibit 201b: Types of drainage collection systems (Source: NRCS National Engineering Handbook)

Special Considerations

- When the tile drain path is adjacent to or through a wetland area that is designated to be preserved, sealed or non-perforated tile/tubing must be used with sufficient distance before and after the limits of the wetland to protect it against being drained.
- Drainage easements should be considered when installing mutual drains. These easements should be recorded with the county recorder's offices.

Capacity - Determine by one or more of the following:

- Application of drainage coefficients as recommended by the NRCS Indiana Drainage Guide or NRCS Chapter 14, Part II of the Engineering Field Manual, to the area drained, including added capacity required to dispose of surface water entering through surface inlets.
- Comparison of the site with other similar sites where subsurface drain yields have been measured.
- yield of ground water based on the expected deep percolation of irrigated water from the overlying fields, including the leaching requirement.
- Measurement of the rate of subsurface flow at the site during a period of adverse weather and ground water conditions.
- Calculations using Darcy's law or estimation of lateral or artesian subsurface flow.

Size

- Compute by applying Manning's formula.
- Drain tiles should be designed in such a way that pressure flow does not occur in the tile.

Depth, Spacing, and Location

- Should be based on site conditions such as soils, topography, ground water conditions, crops, land use, and outlets.
- Minimum depth should be 2' in mineral soils and 2.5' in organic soils.
- Calculate equipment loads when the depth is less than 6'.

Velocity and Grade

- In areas where sedimentation is not a hazard, the minimum grades shall be based on site conditions and a velocity of at least 0.5' per second.

Soil Texture	Velocity (ft/s)
Sand and sandy loam	3.5
Silt and silt loam	5.0
Silty clay loam	6.0
Clay and clay loam	7.0
Coarse sand or gravel	9.0

Exhibit 201c: Maximum Velocity by Soil Texture

- Filters and filter material, and envelopes and envelope material may be necessary depending on site conditions.

MAINTENANCE

- Keep inlets, trash guards, collection boxes, and structures clean and free of materials that can reduce the flow.
- Repair all broken or crushed lines to insure proper functioning of the drain.
- Repair or replace broken or damaged inlets and breathers damaged by livestock and machinery.
- Periodically inspect outlet conduit and animal guards for proper functioning.

REFERENCES

Related Practices

- Practice 202 Tile Drain Repair/Replacement.
- Practice 203 Breather Pipe.
- Practice 204 Tile Drain Inlet.
- Practice 1001 Tile Drain Outlet Extension.

Other Sources of Information

- NRCS Engineering Field Handbook.
- Illinois Urban Manual.
- ASTM Standard F449.
- Davis' Handbook.
- North Carolina Erosion Control Manual.

Last Print/Revision Date: October 13, 1996

PRACTICE 202
TILE DRAIN REPAIR/REPLACEMENT

DESCRIPTION

- Maintenance, repair, and replacement of tile drains.

Exhibit 202a: Tile Drain Repair/Replacement (Source: NRCS Files)

PURPOSE

- To reestablish drain function by restoring tile segment.

WHERE APPLICABLE

- All subsurface drains.

ADVANTAGES

- Regular repairs and maintenance help avoid future costly repairs and damages.

CONSTRAINTS

- All drains should be maintained.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Varies with project.
- Properly-sized segments should match hydraulic capacity of adjoining pipes (upstream and downstream).

Installation

- Outlets should be kept free of debris. They should be protected from animals by a flap gate or a grating.
- Water surface inlets may require frequent repairs. Erosion around inlets should be repaired, and the inlet grating should be kept free of debris.
- Traps must be kept clean in order to maintain drainage capabilities. Cleanout of the trap may be less frequent as the drain ages.
- Blowouts occur when the tile is subjected to pressure flow. When the tile is subjected to pressure flow, water is forced out of the tile saturating the surrounding soil. As the flow drops, the saturated soil is sucked into the tile. To correct, replace with solid tile or correct the pressure flow problem.

- Tree roots may plug drains. To repair the line, dig it up, clean it, and re-lay it. Please note that this is only a temporary measure that may have to be repeated periodically. One way to prevent recurrence, short of killing the trees, would be to replace the part of the drain near the trees with sewer pipe.
- Drains laid under waterways may carry soil and cause holes. Drains under waterways should be inspected regularly, and the holes repaired as necessary.
- Mineral deposits can sometimes plug the perforations in drains. Indication of the presence of deposits may be seen at the outlets or at junction boxes and inspection holes. Sulphur dioxide gas injected into the upper end of the drain from tanks of compressed gas can open the drain. The gas should be held in the line for 24 hours after the air has been replaced by gas. High pressure hydraulic cleaners are also used.

Special Considerations

- Failure of drains to operate as expected may result from a variety of reasons including: insufficient capacity, drains placed too shallow, lack of auxiliary structures, insufficient drain strength, improper spacing between joints, improper bedding, poor grade and alignment, improper backfilling, and substandard materials.
- Drainage easements should be considered when installing or repairing mutual drains. These easements should be recorded at the County Recorder's Offices.

MAINTENANCE

- Periodically inspect the required area for signs of blowout at the repair site or adjacent to it.

REFERENCES

Related Practices

- Practice 201 Tile Drain Installation.
- Practice 203 Breather Pipe.
- Practice 204 Tile Drain Inlet.

Other Sources of Information

- NRCS Engineering Field Handbook.

Last Print/Revision Date: October 13, 1996

PRACTICE 203
BREATHER PIPE (Pressure Relief Vent)

DESCRIPTION

- Vertical vents that relieve air pressure in subsurface drains.

Exhibit 203a: Breather Pipe (Source: NRCS Files)

PURPOSE

- Relieve pressure in the line.
- Provide air entry into the line.

WHERE APPLICABLE

- Where the drain grade changes from steep to flat.
- Where future inspection may be needed.

ADVANTAGES

- Relieves pressure that might otherwise cause blowouts.
- Provides air entry to a drain for the purposes of venting a line.
- Allows access for inspection and cleanout.
- May also act as a marker.

CONSTRAINTS

- Additional expense.
- May be minor obstacle to farm machinery when installed in agricultural fields.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Riser Pipe.
- Screen or perforated cap.
- T-joint, or other appropriate joint.

Installation

- Place T-connection in line and cement riser pipe to the joint.
- Riser pipe should extend at least 3' above the ground.
- Cover the opening with a perforated cap, or heavy wire mesh.

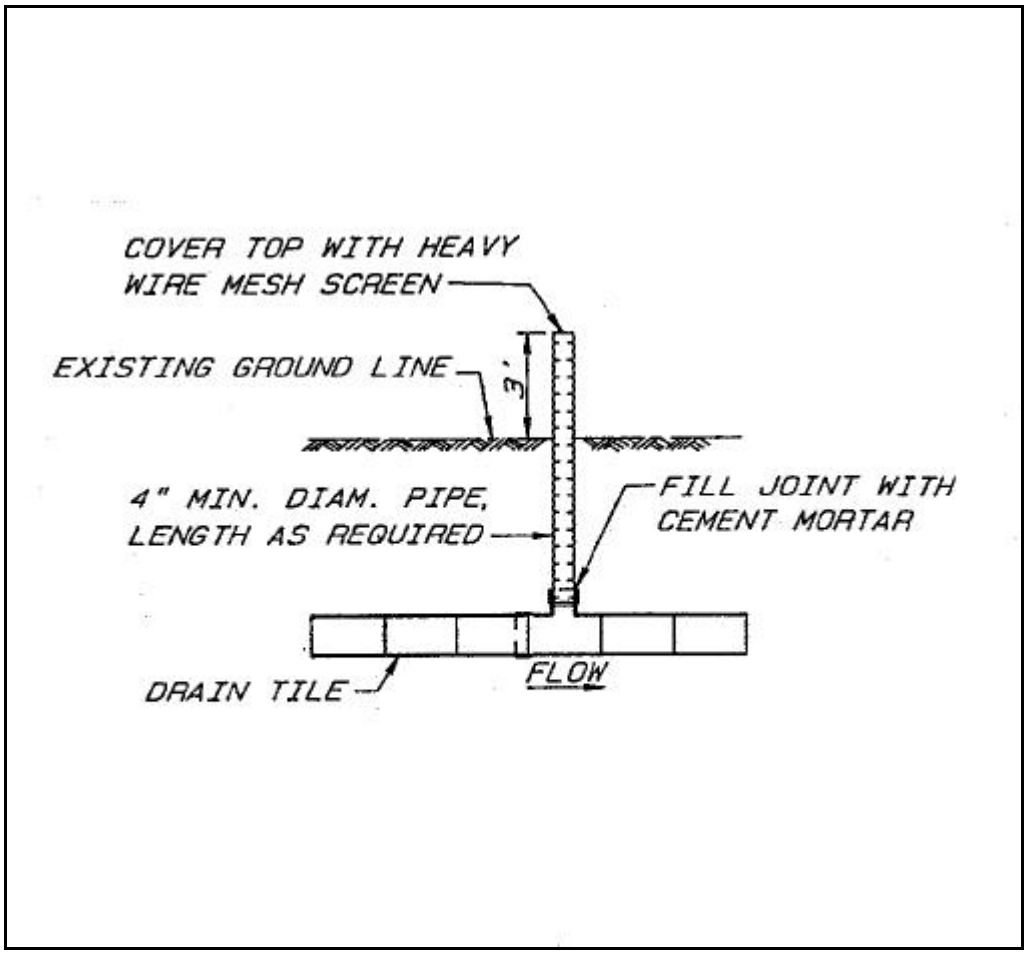

Exhibit 203b: Installation of breather pipe (Source: NRCS Files)

Special Considerations

- Vents should be located at points where the drain grade changes from a steep grade to a flat grade (where the difference in grade exceeds 0.5% or at key locations where future inspections are to occur).

MAINTENANCE

- Keep breathers free of debris.

REFERENCES

Related Practices

- Practice 201 Tile Drain Installation.
- Practice 204 Tile Drain Inlet.
- Practice 202 Tile Drain Repair/Replacement.
- Practice 1001 Tile Drain Outlet Extension.

Other Sources of Information

- NRCS Engineering Field Handbook.

Last Print/Revision Date: October 13, 1996

PRACTICE 204
TILE DRAIN INLET

DESCRIPTION

- Vertical riser with round holes or slots to provide an inlet for surface water.

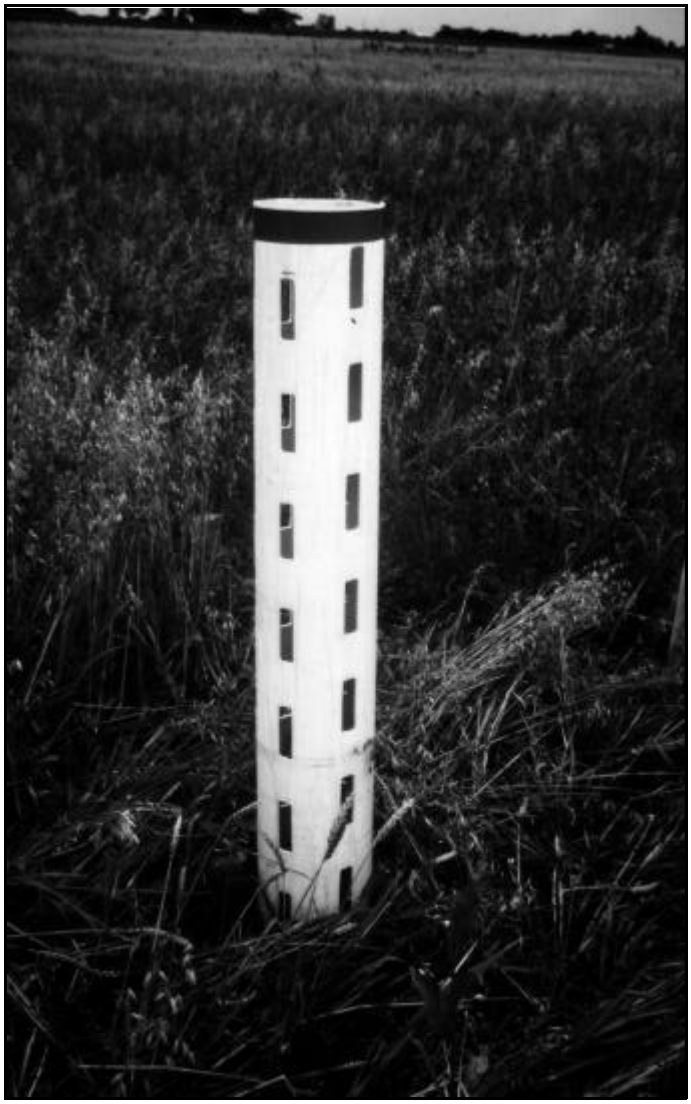

Exhibit 204a: Typical Tile Drain Inlet (Source: NRCS Files)

PURPOSE

- Provide a direct inlet for surface water in a field.
- May also provide air entry into the line or relieve pressure in the line.

WHERE APPLICABLE

- Areas prone to surface ponding.

ADVANTAGES

- Reduces surface ponding.
- Also acts as a breather pipe when no ponding is occurring next to the riser.
- Allows access for inspection and clean-out.
- Also acts as a marker for underground drain location.

CONSTRAINTS

- Additional expense.
- May be minor obstacle to farm machinery when installed in agricultural fields.
- Surface inlets can provide a direct conduit to receiving streams for herbicides, pesticides, and other chemicals used in agricultural fields.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Riser pipe made of aluminum, iron, P.V.C., smooth polyethylene, or steel. (Prefabricated slotted/round-hole intakes may also be available)
- Trash guard or prefabricated perforated cap.
- T-joint, or other appropriate joint.

Installation

- Place T-connection in line and cement riser pipe to the joint.
- Riser pipe should extend at least 3' above the ground.
- The conduit trench from the toe of the backslope to the riser, must be excavated with 1:1 (1V:1H) side slopes and backfield with compacted fill. The backfill around the riser shall be hand tamped.
- Follow installation details shown in Exhibit 204b.

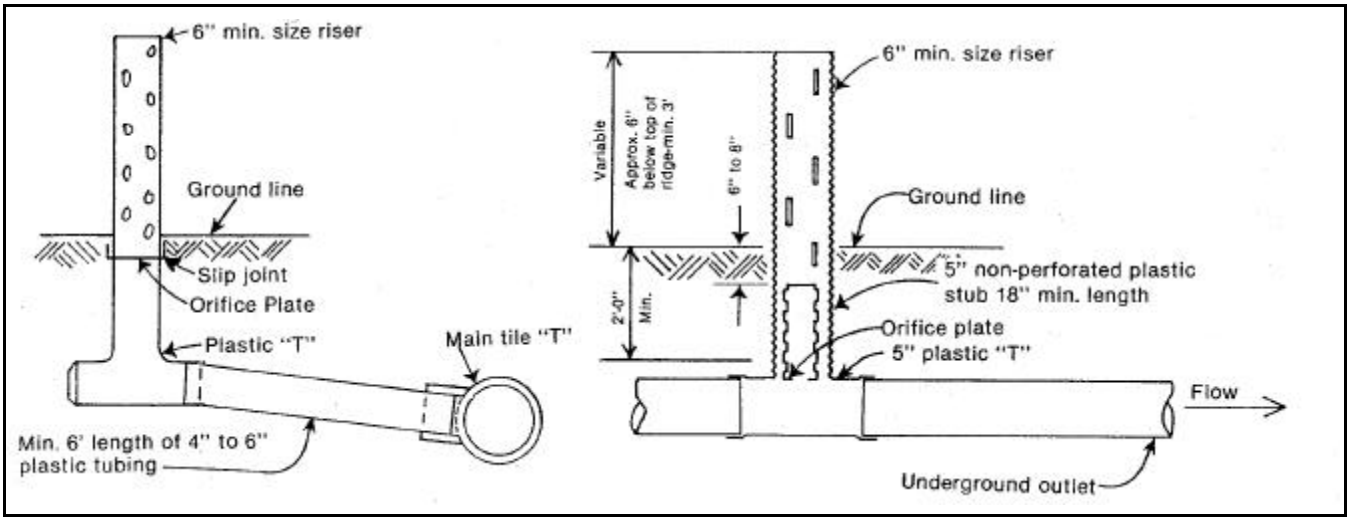

Exhibit 204b: Typical Tile Drain Inlet Installation Details (Source: NRCS Files)

- To make a Slotted Intake, cut ¾" by 4" slots in four (4) rows around the pipe (90 degree spacing). Do not space closer than 2" to the seams or end of pipe. (See Exhibit 204c for details). Slotted intake capacity is about 20 acre-inches per day.

- To make a Round-Hole Intake, Fabricate 24 holes per linear foot, ¾" diameter. Alternate fabrication approximately 12 inches per foot of 1" diameter. (See Exhibit 204c for details). Round-Hole intake capacity is about 8 acre-inches per day.

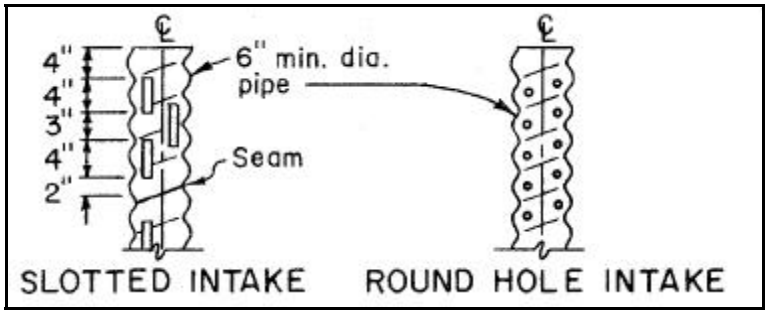

Exhibit 204c: Typical Tile Drain Riser Intake Details (Source: NRCS Files)

- Trash Guard: Top of the riser must be protected by a standard trash guard (Exhibit 204d). Prefabricated trash guards/caps may also be used.

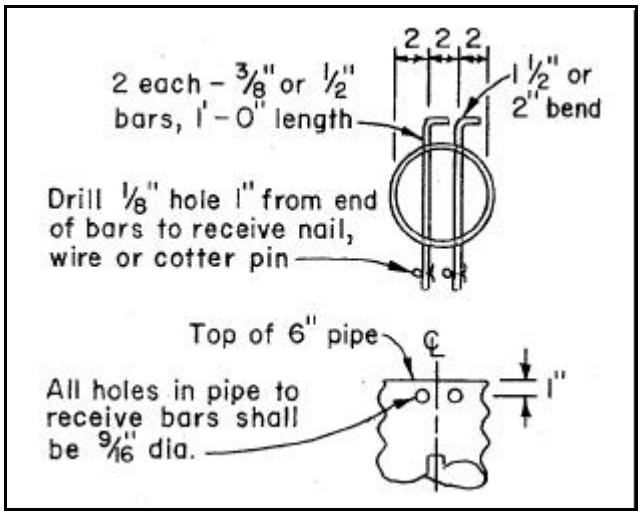

Exhibit 204d: Typical Trash Guard Details (Source: NRCS Files)

Special Considerations

- To protect the water quality and prevent chemicals used in the agricultural farms to get into the intake, a permanent grass buffer zone around the riser must be provided. The size of the buffer depends on the intake size and topography with a minimum diameter of 30 feet.

MAINTENANCE

- Inspect frequently, especially after each storm to insure that the intake remains in working conditions..

REFERENCES

Related Practices

- Practice 201 Tile Drain Installation.
- Practice 202 Tile Drain Repair/Replacement.
- Practice 203 Breather Pipe.
- Practice 1001 Tile Drain Outlet Protection.

Other Sources of Information

- NRCS Engineering Field Handbook.

Last Print/Revision Date: October 13, 1996