Appendix A – Implementation Practices

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INDEX OF PRACTICES

1.0 INTRODUCTION

The Implementation Appendix is a manual designed to assist landowners, managers, and technicians in adopting effective and appropriate practices to reduce nonpoint source pollutants entering streams and watercourses. Practices are defined as actions taken by a landowner or manager to reduce pollutant loads from nonpoint sources. In general, practices described in this manual are meant to be implemented in areas immediately adjacent to the stream channel or waterbody. However, many of the treatments can be utilized effectively in uplands and other areas.

Users of the manual should first the most significant pollutant sources through the development of a TMDL. These sources include animal feeding operations (AFOs), wastewater lagoons, industrial sources, areas of disturbance, stream erosion, agricultural practices, mining practices, and resource management and use. The tables provided in Section 3 link sources directly to specific practices.

It should be noted that while practices are effective when used separately, an implementation strategy utilizing two or more complimentary practices generally provides better results. Any strategy for reducing pollutant loads should work to eliminate the underlying causes of the pollution as well as the identified source. For example, stream bank erosion is often caused by a reduction in woody vegetation and/or the result of intensive livestock or wildlife grazing. Revegetation of the eroding banks without addressing the underlying grazing management issues would reduce the ultimate success of the project.

Many of the practices described in this appendix were developed or supported by the USDA Natural Resource Conservation Service (NRCS). The NRCS has local field offices in rural areas across the United States and provides technical assistance to landowners, municipalities, and tribes. The NRCS can provide additional information on the specific design and installation criteria for many practices. NRCS standard practice codes are listed for each applicable practice.

In addition, the NRCS administers a number of cost-share programs under the Farm Bill to provide on the ground assistance to landowners. These programs can be valuable in providing the financial support to meet project goals. Virtually all of the practices included in this appendix are approved under NRCS funded programs.

The manual is divided into three parts. The first section provides an introduction to the manual and discussion of its uses. The second section describes the use of practices and links practices to level of intensity, area of application and pollutant source. The third section is a compendium of information specific to each practice including a description, purpose, physical effects, treatment areas, and agency technical resources.

Specific costs for practices vary widely by region and over time. As a result, costs are not provided in this appendix. However, the intensity level or level of technical complexity is described for each practice. In general, costs are relative to the technical complexity. Management practices are generally the least costly while those that require intense engineering are the most costly. It should be kept in mind that the implementation of practices based on cost along may not be the most cost-effective approach. Other factors such as load reduction potential, estimated time for load reduction, and maintenance costs can be equally important.

2.0 STRUCTURE OF THE IMPLEMENTATION APPENDIX

This appendix is intended to supplement a "TMDL Implementation Plan" developed for a specific watershed. Each TMDL Implementation Plan discusses specific pollution sources within stream reaches or waterbody and suggests one or more categories of practices to reduce or eliminate the loading from that source or sources. The Appendix includes a set of TMDL Practice Sheets describing specific practices designed to reduce pollution. The practices are also cross-referenced to various pollution sources.

2.1 TMDL PRACTICE SHEETS

Section 3 of the Appendix presents individual TMDL Practice Sheets. These sheets provide information specific to each practice including:

2.1.1 TECHNICAL LEVEL

Each practice is ranked in terms of Level of Intensity. Intensity level refers to the degree of technical expertise necessary to successfully design, install, and maintain specific practices. In general the lower technical levels are the least costly and are implemented first. The landowner can increase the intensity level as necessary. This criterion is also related to cost; the higher the technical level, the higher the cost. Indices listing practices sorted by Pollution Sources and Intensity Level are presented in Section 3.0.

LEVEL 100: Passive Management includes practices that can generally be implemented without significant capital costs or an increase in infrastructure. Examples of passive management are restricted or rotational grazing, changes in timing and extent of irrigation, changes in type or amount of fertilizer, and abandonment and rehabilitation of roads or other disturbed areas.

LEVEL 200: Active Management describes practices that can generally be implemented directly by a landowner or manager. However, these practices will typically require some costs to improve or update infrastructure. Examples of active management include fencing, creation of buffer strips, and establishment of vegetation.

LEVEL 300: Mild Engineering practices are those that not only require active efforts but also assistance from appropriate technical resources. Technical resources could include Extension Service, Natural Resource Conservation Service, and other agency or private practitioners. Practices included in this category include a variety of bioengineering practices to reduce stream bank erosion, off-channel water sources, and irrigation tailwater recovery.

LEVEL 400: Moderate Engineering are those practices that entail a greater risk of failure without appropriate technical expertise. These practices are more expensive and have greater risk of failure. Practices include structural bank protection, structural gully stabilization, and design/installation of more efficient irrigation systems.

LEVEL 500: Intense Engineering practices generally require significant engineering and other technical expertise in both design and construction to ensure success. These practices are generally most expensive and have a significant risk of failure if not implemented correctly. Practices include diversion dams and other primary instream structures, grade stabilization structures in large stream channels, stream channel realignments and construction of waste storage or treatment lagoons. These practices generally require professional engineering or other technical assistance.

2.1.2 DESCRIPTION

This section contains a short narrative describing the concerns addressed by the practice as well as a general description of the tasks involved in the implementation of the practice. More specific information is included in the Planning Considerations section of each sheet.

2.1.3 PURPOSE

This section describes the goals and objectives of the practice including various use or uses of the practices related to specific pollutants and mechanisms for their introduction into waterbodies.

2.1.4 POTENTIAL TREATMENT AREAS

The choice of practices to address the pollutant sources described above is dependent on the area to be treated. Treatment areas can be divided into two broad categories: 1) streamside which refers to the active channel and floodplain of the waterbody and 2) adjacent lands which can further be divided by uses into Agricultural and Developed.

Streamside describes the area that includes the channel, floodplain, and riparian corridor of a stream or waterbody. The area is dominated by riparian plant species and is exposed to disturbance from moderate, frequent flood events. Practices within this area include streambank protection, riparian habitat enhancement

Adjacent Agricultural Lands include those lands devoted to growing of crops and/or livestock. These areas are often adjacent to affected waterbodies. Pollution may take the form of unconstrained runoff of excess nutrients or wastes, sediments eroded from bare soils or fallow fields, or pollutants transported through subsurface flows.

Adjacent Developed Lands are areas near or adjacent to affected waterbodies. Development may take the form of rural or urban housing, industrial facilities, bare or disturbed areas, or streets and other impervious surfaces. Pollution sources are created by runoff of pollutants from these areas.

2.1.5 PRACTICE CATEGORIES

Practices have been grouped into nine categories roughly based on types of use and/or pollutant sources. There may be more than one category of practice that is appropriate for any landowner. For example, agricultural areas may require practices involving livestock management, stream bank protection, irrigation efficiencies, and cropland management.

Livestock Management: Livestock use is common in and around streams and waterbodies especially in the west. Without proper management livestock can increase TMDL loading either directly (through hoof action) or indirectly (by contributing to stream instability and bank erosion). These active and passive practices can be implemented to minimize these impacts.

Stream Bank Protection: Eroding stream banks can be a primary contributor of sediment and other pollutants. Lateral channel instability may be caused by a number of sources and remedied by an equal number of practices.

Irrigation Efficiencies: Inefficient irrigation can be costly to the landowner and increase runoff of pollutants to nearby streams and waterbodies. Numerous practices exist to increase irrigation efficiency.

Recreation Management: Recreation has become a major source of impacts in lands adjacent to streams and waterbodies. Impacts are commonly the result of ground disturbance.

Construction Site Management: This set of practices focuses on limiting loading from the unavoidable ground disturbances and machinery associated with construction zones.

Stormwater Management: Stormwater management is critically important especially in growing urban areas. Higher runoff volumes from impervious surfaces increase pollutants.

Wastewater Management: Undersized, ineffective, or leaking wastewater treatment facilities can contribute significant amounts of pollutant loads to nearby waterbodies.

Mining Practices: Ground disturbance and excavation activities associated with mining practices can increase pollutant loading to nearby waterbodies. A variety of practices can be used to limit pollutants.

Cropland Management: This set of practices is intended to decrease loading from such sources as irrigation return flows, wind, water, and rill erosion, and pesticide/herbicide management.

2.1.5 TMDL SOURCES TREATED

This section describes specific pollutant sources addressed by the practice. These sources are further described in the Implementation Plan.

Animal Feeding Operations (AFOs) refer to feedlots and other confined animal feeding operations. In general pollution is related to the containment and neutralization of animal wastes. Residential livestock corrals and holding pens located adjacent to a waterbody can also produce significant pollution. The pollution may be created by inadequate drainage and/or improper or nonexistent containment. Sources can be introduced to the waterbody either from overland and/or groundwater flow. A specialized subcategory is effluents from fish farms and hatcheries.

Wastewater Disposal Lagoons refer to pollution sources related to urban wastewater treatment. In general, pollution from these sources is created by leaking, undersized or improperly placed lagoons.

Industrial Sources refer to any source produced directly or indirectly by hazardous products of industrial processes. These sources may include such direct impacts as oil or other hazardous chemical spills to the cumulative impacts from disbursed oil and other chemicals generated from stormwater runoff.

Disturbed Areas are lands where the topsoil has been broken and is available for transport to an adjacent waterbody. Examples are road or building construction sites, abandoned or fallow fields, and lands with heavy recreational and/or livestock use.

Stream Erosion refers to active erosion within a stream channel or adjacent floodplain. The erosion can be the result of lateral instability (bank erosion) or vertical instability (gullying). Underlying causes for bank erosion is often the result of the removal of riparian vegetation or mechanical channel alterations (channelization or berming). Gullying is often initiated by an increase in runoff over easily erodible soils creating headcuts.

Agricultural Practices include a variety of sources including residue management, pest and/or weed control, lack of crop rotation, fallow fields, and irrigation application/management.

Mining Activities refers to a variety of pollution sources created by current or historic mining activities.

Resource Management & Use refers to sources attributable to reservoir impoundments, stream regulation, and water diversions.

2.1.6 POLLUTANTS ADDRESSED
This section lists the major pollutants targeted by the implementation of the practice.

2.1.7 LOAD REDUCTION POTENTIAL
This section qualitatively describes the potential reduction of TMDL loading by implementation of the practice. The actual load reduction is dependent on the extent of the practice and the existing loading levels.

2.1.8 EXPECTED MAINTENANCE qualitatively describes the expected maintenance costs related to the practice.

2.1.9 ESTIMATED TIME FOR LOAD REDUCTION provides an expectation for the time necessary for significant load reductions. Reductions expected to occur immediately or within months after implementation are described as Short. Moderate represents a time period a few months to 2 years. Long suggests load reductions will be spread over 2 or more years.

2.1.10 ASSOCIATED TMDL PRACTICES describes other practices described in this appendix that can be implemented in conjunction with the practice to increase effectiveness.

2.1.11 PERMITTING REQUIREMENTS describes the regulatory permits generally required to implement the practice. This list may not be complete. Check with Utah Department of Natural Resources (see website below), Army Corps of Engineers, and other agencies for stream alteration permits and additional specific permitting requirements.

http://waterrights.utah.gov/strmalt/default.htm

2.1.12 TECHNICAL REFERENCES describes sources for design, implementation specifications, and technical assistance available from the Natural Resources Conservation Service (NRCS). The NRCS has a large set of conservation practices (many of which are included in this appendix) to meet water quality and other resource concerns and several grant programs for implementation. This information is available at a local NRCS field office or on the Utah NRCS website.

http://www.ut.nrcs.usda.gov

Specifications for the bioengineering practices were developed by the NRCS Plant Materials Center in Aberdeen, Idaho. There are large numbers of useful papers and reports related to stream bank stabilization and bioengineering available at the following website.

http://www.nhq.nrcs.usda.gov/BCS/PMC/pubs/IDPMCpubs-wet.html

2.1.13 PLANNING CONSIDERATIONS briefly summarizes the technical considerations necessary for successful implementation of each practice. It should be noted that detailed planning considerations for all practices are beyond the scope of this document. In many cases technical assistance can be obtained from the local Natural Resources Conservation District field office (see Section 2.1.12). Many of the corresponding NRCS practices are listed in each practice sheet.

Practices in levels 100 & 200 (Passive and Active Management) can often be implemented directly by the landowner. Level 300 (Mild Engineering) practices can often be implemented by landowners with guidance from an experienced technician. Professional assistance in design and implementation is generally necessary in Levels 400 – 500 (Moderate and Intense Engineering).

2.2 RIPARIAN PLANTING ZONES

Many of the treatments described within this manual involve the use of vegetation to reduce source loads. It is recommended that native plant species be utilized whenever possible, especially near the stream. To be successful, plant species must be installed in zones that meet specific needs of soil moisture and disturbance regime. The following zone descriptions are adapted from "Riparian Planting Zones in the Intermountain West" NRCS, Plant Material Center, Aberdeen, ID (Figure 1).

***Toe Zone*:** The Toe Zone is located at or below the elevation of base flow. Generally, this is the zone of highest stresses and the most erosion and is critical to successful treatment of streambank erosion. In perennial streams the zone rarely supports woody species and is generally colonized by wetland plants with a tolerance for very wet soil conditions.

***Bank Zone*:** The Bank Zone is the area between baseflow water elevation and the bankfull discharge elevation. It is less erosive than the toe zone but is still exposed to erosive river currents, wind generated waves, wet and dry cycles, and freezing or thawing cycles. The bank zone is generally vegetated with early seral or colonizing herbaceous species, flexible stemmed willows, and low shrub species.

***Overbank Zone*:** The Overbank Zone is located between the bankfull stage elevation and the overbank elevation. It is relatively flat and often has layered soils. Because it is periodically flooded, usually about every 2-5 years, the zone is exposed to erosive water currents. Vegetation in the overbank zone should be flood tolerant. Shrubby willows, dogwoods, birch, and other species with flexible stems will predominate here. Larger shrub type willows will generally occur on the

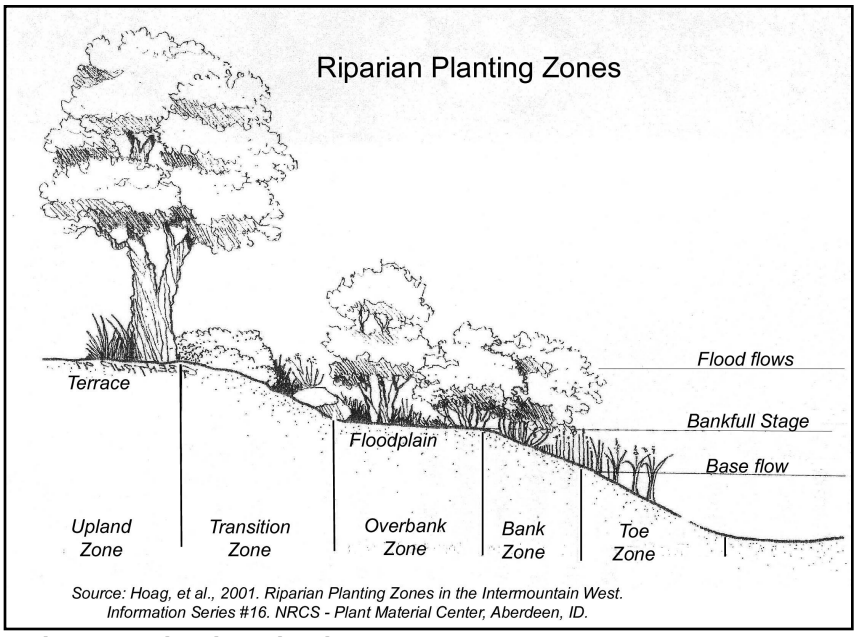


Figure 1. Riparian Planting Zones

higher end of the zone. Cottonwoods and tree type willows may survive well at the higher end of the zone. Species that have large inflexible stems should not be part of the planting plan in the lower parts of this zone as they can cause significant disruption to the stream dynamics.

***Transition Zone*:** The Transition Zone is located between overbank elevation and upland elevation. This zone is less often subjected to erosive water currents except during high water events. Species in this zone are not extremely flood or inundation tolerant. This is the zone where larger tree species are typically found.

***Upland Zone*:** The Upland Zone is found outside the riparian area and is dominated by more drought tolerant upland species.

3.0 USE OF THE IMPLEMENTATION APPENDIX

This appendix is designed to be used in conjunction with a TMDL and/or an Implementation Plan (Plan) created for a specific watershed. The most significant pollutant sources will be identified within the Plan and one or more categories of practices will be recommended to reduce or eliminate sources of water quality impairment. Practices are presented on a series of TMDL Practice Sheets. Each sheet presents a range of information to allow the landowner to assess its benefits, effectiveness, and cost.

As a general rule, management changes are the most cost-effective practices to implement. With that in mind, it is recommended that landowners implement practices from the Passive and Active Management levels first and monitor results. If additional efforts are warranted, practices from the higher intensity levels should be considered.

Practices are grouped by technical level in Table 1. An listing of practices by potential TMDL Sources is presented in Table 2 and listed by pollutant in Table 3.

4.0 TECHNICAL REFERENCES

Comprehensive technical descriptions of specific practices are beyond the scope of this document. However, additional technical information on these practices is available from the following sources and websites:

EPA, 2000. Recommended Practices Manual: A Guideline for Maintenance and Service of Unpaved Roads. U.S. Environmental Protection Agency.

http://www.epa.gov/owow/nps/unpavedroads.html

Hoag, J. Chris, and Gary Bentrup, 1998. Practical Streambank Bioengineering Guide, NRCS Plant Materials Center, Aberdeen, ID.

http://www.nhq.nrcs.usda.gov/BCS/PMC/pubs/IDPMCpubs-wet.html

NRCS-EFH-16. Engineering Field Handbook, Chapter 16, Streambank and Shoreline Protection. Available from Natural Resource Conservation Service state or local offices or at website below.

http://www.info.usda.gov/ced/

NRCS-EFH-18. Engineering Field Handbook, Chapter 18, Soil Bioengineering
Available from Natural Resource Conservation Service state or local offices or at website below.

http://www.info.usda.gov/ced/

NRCS-FOTG. Field Office Technical Guide, Section IV, Practice Standards and Specifications. Available from Natural Resource Conservation Service state or local offices or at website below.

http://www.ut.nrcs.usda.gov

Rosgen, David. L., 2000. The Cross-Vane, W-weir, and J-Hook Vane Structures; Their description, design, and application for stream stabilization and river restoration. Wildland Hydrology, Fort Collins, CO.
http://www.wildlandhydrology.com

USDA Forest Service, 2000. Soil Bioengineering (An alternative for Roadside Management.) #00771801-SDTDC. San Dimas Technology Development Center, San Dimas, CA.

TABLE 1. PRACTICES BY TECHNICAL LEVEL

TABLE 2. PRACTICES BY TMDL SOURCE

	PRACTICE	AFOs	Industrial Sources	Disturbed Areas	Stream Erosion	AG Practices	Mining Practices	Natural Sources	Page
301 -	Brush Layer				*			*	A-1
302 -	Brush Mattress			*	*			*	A-3
303 -	Brush Revetment			*	*			*	A-5
330 -	Brush Trench	*			*	*		*	A-7
500 -	Constructed Wetland	*	*			*			A-9
100 -	Construction Site Mgmt		*	*					A-11
200 -	Cover Crop			*		*			A-13
520 -	Cross-Vane Weir Diversion				*	*			A-15
400 -	Detention Basin	*		*		*	*		A-17
331 -	Erosion Control Fabric	*		*	*	*	*		A-19
210 -	Exotic Removal			*	*	*		*	A-21
220 -	Fencing			*	*	*			A-23
332 -	Fiberschines/Biologs			*	*		*		A-25
240 -	Filter Strip	*		*	*	*			A-27
420 -	Grade Stabilization Structure		*	*	*	*	*	*	A-29
120 -	Grazing Management			*	*	*			A-31
440 -	Irrigation Land Leveling					*			A-33
450 -	Irrigation Pipeline					*			A-35
451 -	Irrigation, Drip					*			A-37
452 -	Irrigation, Sprinkler					*			A-39
453 -	Irrigation, Surface					*			A-41
454 -	Irrigation, Tailwater Recovery				*	*			A-43
140 -	Irrigation Water Mgmt					*			A-45
250 -	Mulching			*		*			A-47
160 -	Nutrient Management					*			A-49
180 -	Pest Management					*			A-51
260 -	Pole/Post Planting			*	*	*		*	A-53
190 -	Residue Management					*			A-55
470 -	Road Stabilization		*	*		*			A-57
521 -	Rock RipRap			*	*	*	*	*	A-59
421 -	Rock Vane				*			*	A-61
422 -	Rock Weir				*	*			A-63
221 -	Seeding			*	*	*	*	*	A-65
333 -	Silt Fence	*		*	*	*	*		A-67
360 -	Sloped Drain		*	*		*	*		A-69
334 -	Straw Roll/bale Barrier	*		*			*		A-71
522 -	Stream Channel Stabilization			*	*		*		A-73
335 -	Terrace	*		*		*	*		A-75
423 -	Toe Rock				*			*	A-77
304 -	Vertical Bundle				*			*	A-79
270 -	Waste Utilization	*				*			A-81
370 -	Watering Facility				*	*			A-83
305 -	Willow Fascines				*			*	A-85

TABLE 3 PRACTICES BY POLLUTANT

APPENDIX A

Individual TMDL Practice Sheets

301 Brush Layer

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

This technique uses bundles of willow cuttings (Salix spp.) in buried trenches along the slope of an eroding streambank.

PURPOSE

This willow "terrace" is used to reduce the length of slope of the streambank. The willow cuttings will sprout and take root, thus stabilizing the streambank with a dense matrix of roots. Some toe protection such as a wattle, fiberschine, or rock may be necessary with this technique.

PRACTICE CATEGORIES

Stream Bank Protection

TMDL SOURCES TREATED

Stream Erosion
Natural Sources

POLLUTANTS ADDRESSED

Sediments	Nutrients & Organics
Salinity	Habitat Alteration
	Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Brush Layer

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS
Streamside

ASSOCIATED TMDL PRACTICES
Pole/Post Planting
Brush Revetment
Toe Rock
Willow Fascine
Brush Mattress

PERMITTING REQUIREMENTS
None if installed by hand. If toe rock is also installed permits under Section 404 and 401 of the Clean Water Act may be required.

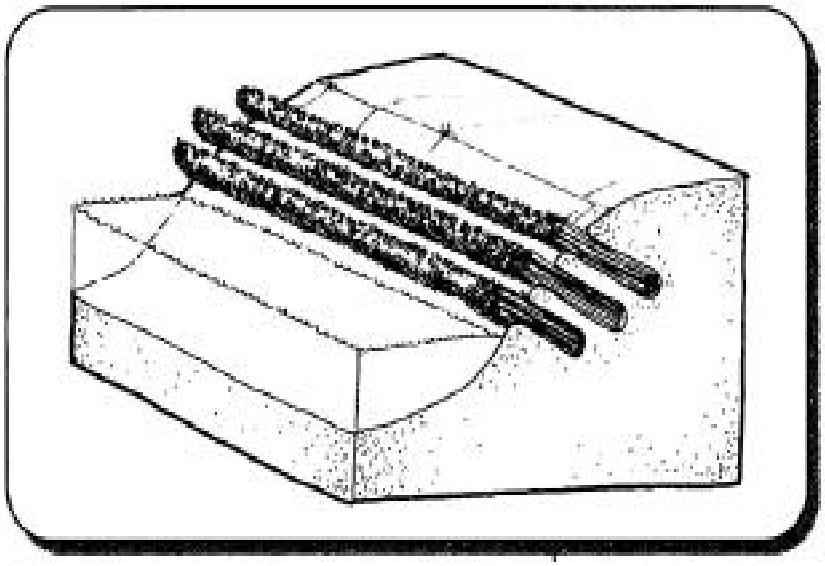
APPLICABLE NRCS/OTHER REFERENCES
Hoag, et al, 1998
NRCS-EFH-16
NRCS -FOTG
395Stream Habitat Improvement & Management
580Streambank and Shoreline Protection

PLANNING CONSIDERATIONS
1. Coyote willow (Salix exigua) is a particularly good species for this method because of its' dense rooting system. This technique can also be used with a mixture of redoiser dogwood (Cornus sericea) and willow but to encourage rooting in the dogwood, the stems will need to be manually nicked or cut and treated with rooting hormone.

2. A critical inventory step is to determine the availability of moisture for the cuttings. This technique is best applied to areas with bank seepage to supply enough moisture for the cuttings. In semi-arid to arid regions, the upper portion of the streambank may not have enough permanent moisture to establish the cuttings, and thus, other techniques may be required.

3. Another critical step with this technique is to determine if toe protection is necessary. In many cases rock will be necessary to provide adequate protection. In addition to toe protection, erosion control fabric can be used to protect the soil between the layers.

4. Give careful attention to the upstream and downstream ends of the treatment area to prevent flows from getting behind the layers. Tying into existing features on site such as trees and rocks or the additional placement of brush and rocks are possible solutions.



302 Brush Mattress

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

Use of a rnat of live willow cuttings along the slope of an eroding streambank, placed in a trench at the toe of the slope and anchored with a fascine. A grid of rope and wooden stakes is used to secure the mat to the slope. The willow cuttings will sprout and take root, thus stabilizing the streambank with a dense matrix of roots.

PURPOSE

Brush mattress treatment provides immediate protection for eroding banks equivalent to 4 - 6 inch rock. Over time the live poles root into the bank creating strong, living bank protection.

Reduction in streambank erosion.
Reduction in surface water contaminants (suspended sediments)
Improvement in aquatic habitat suitability.

PRACTICE CATEGORIES

Stream Bank Protection
Recreation Management

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Natural Sources

POLLUTANTS ADDRESSED

Sediments
Salinity
Nutrients & Organics
Low Dissolved Oxygen
Habitat Alteration
Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Brush Mattress

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS
Streamside

ASSOCIATED TMDL PRACTICES
Pole/Post Planting
Vertical Bundle
Willow Fascine
Brush Revetment

PERMITTING REQUIREMENTS
None if installed by hand. If toe rock is also installed permits under Section 404 and 401 of the Clean Water Act may be required.

APPLICABLE NRCS/OTHER REFERENCES
Hoag, et al, 1998
NRCS-EFH-16
NRCS -FOTG
395Stream Habitat Improvement & Management
580Streambank and Shoreline Protection

PLANNING CONSIDERATIONS

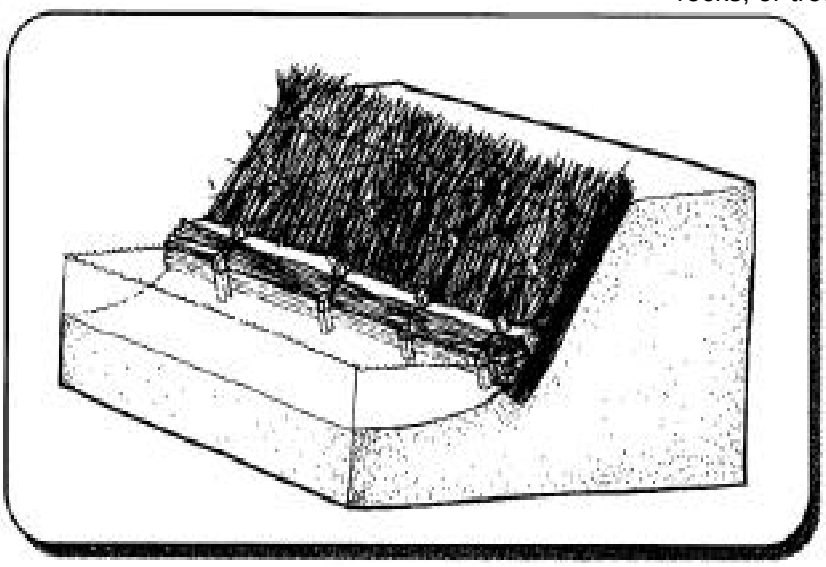
1. Prepare the slope of the streambank by clearing away large debris, however, do not remove woody debris from the stream channel because this provides important fish habitat. The brush mattress technique is probably most effective on slopes no steeper than 2H:1V. Excavate a horizontal trench, 8 to 12 inches deep, at the toe of the streambank along the length of the area to be treated.

2. Place willow cuttings in the trench. Make sure the cut ends reach the bottom of the trench. Spread the cuttings along the face of the slope until a thickness of 4 to 6 inches is achieved.

3. Pound in a grid of 36 inch long wooden stakes into the mattress every 3 to 4 foot centers. Use longer stakes in less cohesive soil. Secure the brush mattress by using 3/8-inch rope. Tie the cord in horizontal runs and then diagonally between each row of stakes. After wiring the mattress, drive the stakes in further to compress the mattress tightly against the streambank.

4. Construct a fascine the length of the area to be treated.

5. Backfill around the fascine and mattress by using material excavated from the trench, making sure to work soil into the branches. Use buckets of water to wash the soil down into the stems. Key the upstream end of the mattress and fascine into the streambank to prevent high flows from getting behind the mattress. It is a good idea to protect this area with some revetment, large rocks, or tree trunks.



303 Brush Revetment

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

Brush or trees are secured to the streambanks to slow excessive erosion by diverting the current away from the bank's edge. The revetment material does not need to sprout. Always plant live willows or other quickly sprouting species behind the revetment to provide permanent cover and roots.

PURPOSE

Reduce sediment input to stream caused by erosion of raw or sloughing stream banks.The revetment also traps sediment from the stream and sloughing streambank and provides overhead cover for fish habitat.

PRACTICE CATEGORIES

Stream Bank Protection
Recreation Management

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Natural Sources

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Brush Revetment

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS

Streamside
Developed Lands

ASSOCIATED TMDL PRACTICES

Pole/Post Planting
Seeding
Erosion Control Fabric
Vertical Bundles

PERMITTING REQUIREMENTS

None if installed by hand. If toe rock is also installed permits under Section 404 and 401 of the Clean Water Act may be required.

APPLICABLE NRCS/OTHER REFERENCES

Hoag, et al, 1998
NRCS-EFH-16
NRCS -FOTG
395Stream Habitat Improvement & Management
580Streambank and Shoreline Protection

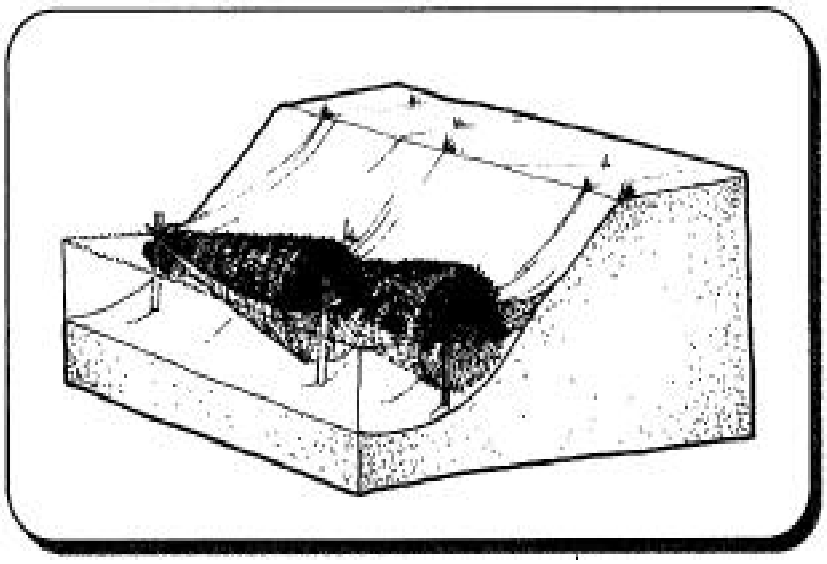
PLANNING CONSIDERATIONS

1. Installation of brush or tree revetment can usually be accomplished throughout the year. However, for safety reasons avoid high water periods.

2. Typically, the trunks of the revetment should be placed between the annual low and high water levels. In areas of extreme fluctuation in water levels, it may be necessary to place a second row of revetment at the high water line in order to prevent scouring behind the revetment during flood events.

3. It is critical that the revetment extend upstream and downstream at least 1 to 3 tree lengths past the eroded area being treated to prevent flows from getting behind the revetment. Key the upstream and downstream ends of the revetment into the bank and reinforced with additional brush or rock. These endpoints are the sections most likely to fail and require substantial protection.

4. Never disturb the site unnecessarily. Remember that the goal is to stabilize a site. The less it is disturbed, the easier it will be to restore.



330 Brush Trench

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

This technique uses bundles of willow cuttings (Salix spp.) in a buried trench along the top of an eroding streambank.

PURPOSE

The willow cuttings will sprout and take root, thus stabilizing the streambank with a dense matrix roots. This willow "fence" filters storm runoff or irrigation returns before it enters the stream and is a good method for alleviation of piping problems.

PRACTICE CATEGORIES

Livestock Management
Stream Bank Protection
Irrigation Efficiencies
Recreation Management
Stormwater Control

TMDL SOURCES TREATED

Animal Feeding Operations
Stream Erosion
Agricultural Practices
Natural Sources

POLLUTANTS ADDRESSED

Sediments	Nutrients & Organics
Salinity	Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Brush Trench

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Filter Strip
Mulching
Seeding
Silt Fence

PERMITTING REQUIREMENTS

None if installed by hand or away from a stream or wetand.

APPLICABLE NRCS/OTHER REFERENCES

Hoag, et al, 1998
NRCS-EFH-16
NRCS -FOTG
395Stream Habitat Improvement & Management
580Streambank and Shoreline Protection

PLANNING CONSIDERATIONS

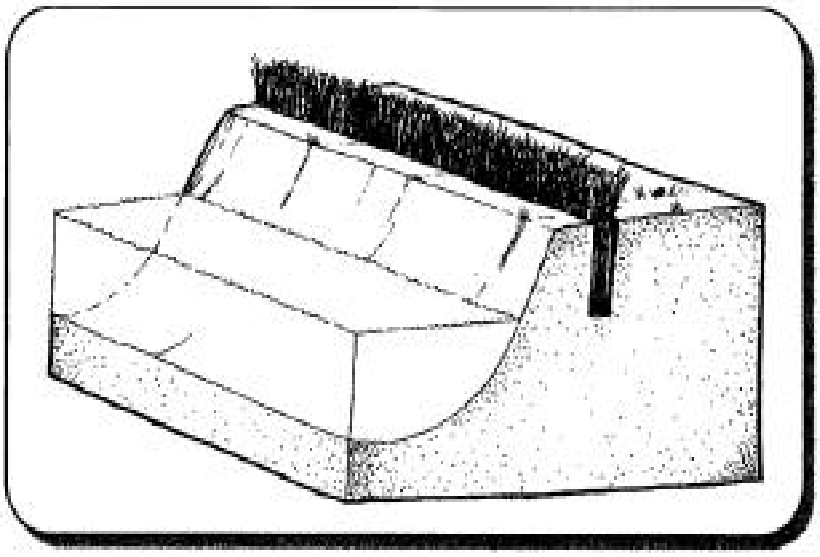
1. Coyote willow (Salix exigua) is a particularly good species for this method because of its' dense root system. This technique can also be used with redoiser dogwood (Cornus spp.). However, to encourage rooting with dogwoods, the stems need to be manually nicked or cut and treated with rooting hormone.

2. A critical inventory step is to determine the availability of moisture for the cuttings. Either the cuttings will have to reach the capillary fringe of the permanent water table or there will need to be sufficient overland runoff or bank seepage to sustain the willows.

3. Another critical step with this technique is to determine if toe protection is necessary. In some cases, brush revetment or fiberschines may be adequate, while other instances may require rock. In addition to the toe protection, a treatment for the mid-bank may also be needed.

5. Give careful attention to both endpoints of the treatment to prevent flows from getting behind the trench. Tying into existing features on site such as trees or rocks or utilizing additional brush or rock are some possible solutions.

6. Never disturb the site unnecessarily. Remember the goal is to stabilize a site. The less it is disturbed, the easier it will be to restore.



500 Constructed Wetland

TMDL Practice Sheet

LEVEL 500: INTENSE ENGINEERING

DESCRIPTION

A wetland complex constructed to filter and clean domestic or livestock operation wastewater, agricultural irrigation returns, or other waters.

PURPOSE

The biological processes in wetland systems can significantly improve water quality. These facilities are designed to provide final cleaning to wastewater once solids and pathogens have been removed.

PRACTICE CATEGORIES

Stormwater Control
Wastewater Management

TMDL SOURCES TREATED

Animal Feeding Operations
Industrial Sources
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pathogens
Nutrients & Organics
Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Constructed Wetland

TMDL Practice Sheet

LEVEL 500: INTENSE ENGINEERING

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Post/Pole planting
Brush Trench
Seeding
Irrigation Water Management

PERMITTING REQUIREMENTS

Variable requirements depending on location. A permit under Section 404 and 401 of the Clean Water Act may be necessary.

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
656Constructed Wetland
657Wetland Restoration
658Wetland Creation
659Wetland Enhancement

PLANNING CONSIDERATIONS

Constructed wetlands are complex physical and biological systems. Individual cells are designed in series to sequentially clean waters. Vegetation types and flow velocities should be carefully designed to meet project objectives.

Considerations:
What are the water qualtiy objectives of the treatment?

What quantity of water is intended to be treated?

What wetland area is needed to achieve these objectives?

What are the appropriate vegetative communities?

What water quality monitoring procedures need be implemented?

100 Construction Site Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

DESCRIPTION

Construction Site Management involves managing the activities of a construction site to eliminate or minimize pollutants. Practices include appropriate handling of potential pollutants, special wastes, or certain hazardous wastes which could be accidentally discharged as well as erosion control measures throughout the site.

PURPOSE

Install measures and/or management plans to minimize pollutants to water during construction operations (e.g. Equipment Maintenance Procedures, Spill Containment Plan, Designated Washout Area, Solid Waste Management)

PRACTICE CATEGORIES

Construction Site Management
Stormwater Control
Mining Lands Management

TMDL SOURCES TREATED

Industrial Sources
Disturbed Areas

POLLUTANTS ADDRESSED

Sediments
Pesticides
Nutrients & Organics
Heavy Metals
Low Dissolved Oxygen

LOAD REDUCTION POTENTIAL

◉ LOW ○ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Construction Site Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Developed Lands

ASSOCIATED TMDL PRACTICES

Strawbale Barrier
Silt Fence
Erosion Control Fabric
Detention Basin

PERMITTING REQUIREMENTS

NPDES

APPLICABLE NRCS/OTHER REFERENCES

USDA-USFS. 2000
EPA, 2000
NRCS-EFH-18

PLANNING CONSIDERATIONS

Provide adequate disposal features.

Properly dispose of or recycle used oils, hydraulic fluids, gear lubricants, used batteries.

Repair leaks of hydraulic fluids, oils, and other fluids as soon as possible.

Provide spill containment dikes around sored oil and chemical drums.

Areas chosen for equipment maintenance need to be located away from channels and have natural or constructed features which would contain and prevent contamination of streamcourses from leaks or spills of oils, fuels or fluids.

200 Cover Crop

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

DESCRIPTION

Growing a crop of grass, small grain or legumes primarily, for seasonal protection and soil improvement.

PURPOSE

This practice is used to control erosion, add fertility and organic material to the soil, improve soil tilth, and increase infiltration and aeration of the soil. The use of cover crops improves the soil while reducing wind, rill, and water erosion.

PRACTICE CATEGORIES

Irrigation Efficiencies
Stormwater Control
Cropland Management

TMDL SOURCES TREATED

Disturbed Areas
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Pathogens

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Cover Crop

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Agricultural Lands

ASSOCIATED TMDL PRACTICES

Irrigation water management
Nutrient Management
Pest Management

PERMITTING REQUIREMENTS

None

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
340 Cover Crop

PLANNING CONSIDERATIONS

The cover crop should be terminated as late as feasible to maximize plant growth and still prepare the seedbed for the subsequent crop.

Deep-rooted species provide maximum nutrient recovery.

Consider that grasses utilize more soil nitrogen, and legumes utilize both nitrogen and phosphorus. Avoid cover crop species that attract potentially damaging insects.

Acceptable benefits, for most purposes, are usually accomplished when the plant density is at least 25 stems per feet, the combined canopy and surface cover is at least 60 percent, and the above ground (dry weight) biomass production is at least 2700 lb/acre.

Cover crops may be used to improve site conditions for establishment of perennial species.

520 Cross-Vane Weir Diversion

TMDL Practice Sheet

LEVEL 500: INTENSE ENGINEERING

DESCRIPTION

A diversion dam is designed to divert water from a watercourse such as a waterway or stream into another watercourse, irrigation canal, stream, water-spreading system, or another waterway. The cross-vane weir is installed in a V-shape angled upstream and tilted down in the middle throat.

PURPOSE

The Cross-Vane Weir effectively diverts stream flow while maintaining the transport of flood waters and sediments. The geometry increases flow and velocity in the center of the river maintaining sediment transport and allows fish migration. Traditional flat topped structures pond water and trap sediment which ultimately leads to failure. Failure often destabilizes the stream channel increaseing bank erosion and/or channel incision.

PRACTICE CATEGORIES

Stream Bank Protection
Irrigation Efficiencies
Cropland Management

TMDL SOURCES TREATED

Stream Erosion
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments Habitat Alteration

LOAD REDUCTION POTENTIAL

◉ LOW ○ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Cross-Vane Weir Diversion

TMDL Practice Sheet

LEVEL 500: INTENSE ENGINEERING

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands

ASSOCIATED TMDL PRACTICES

Grazing Management
Water Facilities
Irrigation Water Management
Irrigation Pipeline

PERMITTING REQUIREMENTS

Permits are required under Sections 404 and 401 of the Clean Water Act. Water diversions are based on a water right administered by state and/ or federal agencies.

APPLICABLE NRCS/OTHER REFERENCES

Rosgen, 2000

PLANNING CONSIDERATIONS

The effects of this practice on water quantity, water quality, and the environment should be considered during the planning process.

Some effects to be considered are:

Effects on the water budget, on volume and rate of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge,

Effects of the use of diverted waters for irrigation,

Effects on the original watercourse, on the newly constructed watercourse, and on the area where the water is being diverted to and from,

Effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances carried by runoff,

Effects on the natural migration of fish.

400 Detention Basin

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

A Detention Basin is a constructed basin designed to collect and temporarily store water or waterborne debris or sediment. The basin is generally considered a temporary practice with periodic maintanence.

PURPOSE

To preserve the capacity of reservoirs, ditches, diversions, and streams and to prevent undesirable deposition on bottom lands and developed areas by providing basins for deposition and storage of silt, sand, gravel, stone, agricultural wastes, and other detritus. However, to be effective sediment basins must be cleaned out regularly and must be carefully engineered to match area hydrology.

PRACTICE CATEGORIES

Construction Site Management
Stormwater Control
Mining Lands Management
Cropland Management

TMDL SOURCES TREATED

Animal Feeding Operations
Disturbed Areas
Agricultural Practices
Mining Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Pathogens
Nutrients & Organics
Heavy Metals

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ○ MEDIUM ◉ HIGH

Detention Basin

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS

Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Silt Fence
Straw Bale Barrier
Sloped drain
Brush Trench

PERMITTING REQUIREMENTS

Section 404 and 401 permits necessary from Army Corps of Engineers if basin is constructed in a stream channel or wetland.

APPLICABLE NRCS/OTHER REFERENCES

USDA-USFS. 2000
EPA, 2000
NRCS-EFH-18

PLANNING CONSIDERATIONS

Water Quantity

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and groundwater recharge.
2. Effects on downstream flows and aquifers that would affect other water uses and users.
3. Effects on volume of discharge flow on the environmental, social, and economic conditions.
4. Effects on the water table downstream and the results of changes of vegetative growth.

Water Quality

1. Effects on erosion, movement of sediment, pathogens, and soluble and sediment-attached substances that could be carried by runoff.
2. Effects on the visual quality of onsite and downstream water resources.
3. Effects of construction and early establishment of protective vegetation on the surface and ground water.
4. Effects on wetlands and water-related wildlife habitats.

331 Erosion Control Fabric

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

Erosion control fabrics are commercially-available products that can be used to prevent erosion on slopes until vegetation establishes and has a chance to stabilize the slope. Woody cuttings and herbaceous plants can be planted into the fabric and seed can be placed underneath the fabric.

PURPOSE

To prevent the erosion of raw banks and floodpllains until native vegetation is reestablished.

TMDL SOURCES TREATED

Animal Feeding Operations
Disturbed Areas
Stream Erosion
Agricultural Practices
Mining Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Nutrients & Organics
Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

PRACTICE CATEGORIES

Stream Bank Protection
Irrigation Efficiencies
Recreation Management
Construction Site Management
Stormwater Control
Mining Lands Management
Cropland Management

Erosion Control Fabric

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Willow Fascines
Willow Pole Planting
Brush Trenchs
Brush Layers
Toe Rock

PERMITTING REQUIREMENTS

None if applied by hand or away from streams or wetlands.

APPLICABLE NRCS/OTHER REFERENCES

Hoag, et al, 1998
NRCS-EFH-16

PLANNING CONSIDERATIONS

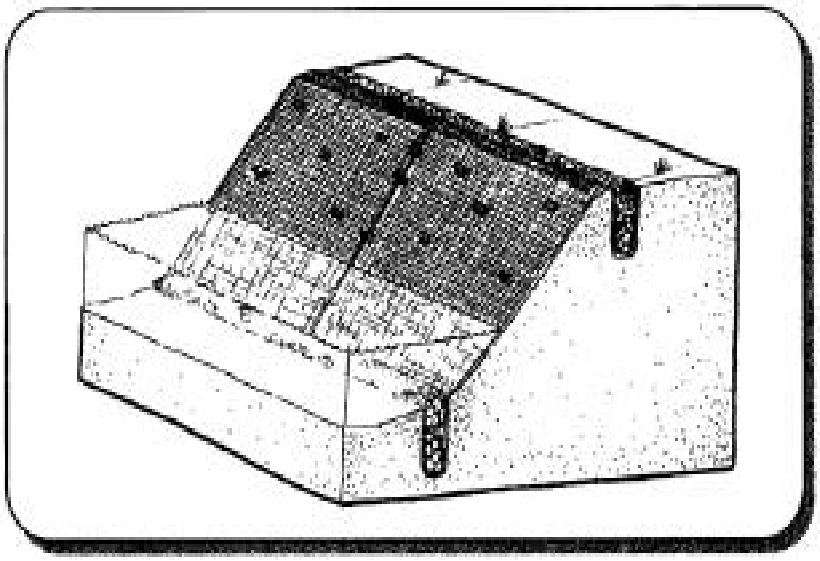
1. An important step with this technique is to ensure the upstream and downstream ends of the erosion control blanket are well keyed into the bank to prevent high flows from pulling the blanket out. Cobble should be placed in the key trenches to prevent the fabric from being pulled out.

2. Another important step is where the fabric overlaps, it should be shingled away from the direction of the current to prevent flows from pulling at the fabric.

3. Never disturb the site unnecessarily. Remember the goal is to stabilize a site. The less it is disturbed, the easier it will be to restore.

If the area is grazed, restrict livestock from treated areas to allow the eroded section of streambank to heal. Exclosure fences are the most efficient means to accomplish this goal. Managers should resist the temptation to put the exclosure fences at the high water line. The exclosure areas should include enough of the riparian zone to allow the stream to shift naturally over time.

If the area is farmed, a riparian buffer strip should be established and maintained. A buffer strip on both sides of the stream should be set aside to allow for natural riparian vegetation and stream function. A wider buffer strip is strongly encouraged and will yield greater benefits.



210 Exotic Removal

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

DESCRIPTION

Removal of exotic plant species which compete with native vegetation and/or destabilizes stream channels. Exotic plant species can create conditions which greatly increase either stream bank erosion and/or gullying and can outcompete native vegetation decreasing forage and habitat.

PURPOSE

Restore natural plant community balance. Reduce competition for space, moisture, and sunlight between desired and unwanted plants. Manage noxious woody plants. Restore desired vegetative cover to protect soils, control erosion, reduce sediment, improve water quality and enhance stream flow. Maintain or enhance wildlife habitat including that associated with threatened and endangered species.

PRACTICE CATEGORIES

Livestock Management
Stream Bank Protection
Cropland Management

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Agricultural Practices
Natural Sources

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Habitat Alteration

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Exotic Removal

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Fencing
Grazing Management
Mulching
Seeding
Pole/Post Planting

PERMITTING REQUIREMENTS

None unless practice takes place near stream or wetland. In these cases permits under Section 404 and 401 of the Clean Water Act may be required.

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
314 Brush Management
548 Grazing Land Mechanical Treatment

PLANNING CONSIDERATIONS

For mechanical treatment methods, plans and specifications will include types of equipment and any modifications necessary to enable the equipment to adequately complete the job. Also included should be:
• Dates of treatment
• Operating instructions
• Techniques or procedures to be followed

For chemical treatment methods, plans and specifications will include:
• Herbicide name
• Rate of application or spray volumes
• Acceptable dates of application
• Mixing instructions (if applicable)
• Any special application techniques, timing considerations, or other factors that must be considered to ensure the safest, most effective application of the herbicide
• Reference to label instructions

For biological treatment methods, plans and specifications will include:
• Kind of biological agent or grazing animal to be used
• Timing, duration, and intensity of grazing or browsing
• Desired degree of grazing or browsing use for effective control of target species
• Maximum allowable degree of use on desirable non-target species
• Special precautions or requirements when using insects or plants as control agents.

220 Fencing

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

DESCRIPTION

A fence is a constructed barrier to livestock, wildlife, or people. This practice may be applied to any area where livestock and /or wildlife control is needed, or where access to people is to be regulated.

PURPOSE

1) Reduction in sheet and rill erosion, wind erosion, ephemeral gully erosion, classis gully erosion, and streambank erosion.
2) Reduction in surface water contamination (suspended sediments).
3) Improvement in plant suitability, plant productivity, and plant health.
4) Improvement in aquatic habitat suitablility.

PRACTICE CATEGORIES

Livestock Management
Stream Bank Protection
Recreation Management
Construction Site Management
Mining Lands Management
Cropland Management

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Low Dissolved Oxygen
Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Fencing

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Grazing Management
Watering Facility

PERMITTING REQUIREMENTS

Generally none

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
382 Fence

PLANNING CONSIDERATIONS

A wide variety of fencing is available. However, fencing material and construction quality should always designed and installed to assure the fence will meet the intended purpose and longevity requirements of the project.

The standard fence is constructed of either barbed or smooth wire suspended by posts with support structures. Other types include woven wire for small animals, electric fence as a cost efficient alternative, and suspension fences which are designed with heavy but widely spaced posts and support structures.

Things to consider when planning a fence include the following:

1. For ease of maintenance purposes avoid as much irregular terrain as possible.

2. Wildlife movement needs should be considered.

3. State and local laws may apply to boundary fences.

4. Consider livestock handling, watering and feeding requirements when locating fences

5. Consider soil erosion potential and feasibility of fence construction when planning fences on steep or irregular terrain.

332 Fiberschines/Biologs

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

This technique uses a coconut-fiber roll product to protect the streambank by stabilizing the toe of the slope and by trapping sediment from the sloughing streambank.

PURPOSE

Provides protection from erosive currents on the toe of streambanks. Traps sediment from sloughing streambanks. Cuttings and herbaceous riparian plants are planted into the fiberschine and behind it. By the time the fiberschine decomposes, riparian vegetation will have stabilized the streambank.

PRACTICE CATEGORIES

Stream Bank Protection
Stormwater Control

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Mining Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity

LOAD REDUCTION POTENTIAL

◉ LOW ○ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Fiberschines/Biologs

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS

Streamside

ASSOCIATED TMDL PRACTICES

Pole Plantings
Brush Trenches
Brush Layers
Willow Faschines
Brush Mattress

PERMITTING REQUIREMENTS

None if installed by hand.

APPLICABLE NRCS/OTHER REFERENCES

Hoag, et al, 1998
NRCS-EFH-16

PLANNING CONSIDERATIONS

1. Installation of the fiberschine can usually be accomplished throughout the year. High water periods should be avoided for safety reasons.

2. The fiberschine should extend upstream and downstream past the eroded area being treated to prevent flows from getting behind the fiberschine. Analysis and calculations may reveal that additional toe protection is necessary. In many cases, rock may be appropriate if placed properly. Improperly placed rock can result in erosion problems on the opposite streambank as well as downstream.

3. Be sure to key the upstream and downstream end of the fiberschine into the streambank and secure it with some hard materials such as tree trunks or large rocks.

4. If this method is used in a highly erodible area and bank shaping is not possible, a tiered fiberschine technique may be necessary. Three fiberschines of different diameters are often used but various numbers and combinations of sizes can be used.

5. Never disturb the site unnecessarily. Remember the goal is to stabilize a site. The less it is disturbed the easier it will be to restore.

240 Filter Strip

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

DESCRIPTION

A strip or area of herbaceous vegetation situated between cropland, grazing land, or disturbed land (including forest land) and environmentally sensitive areas.

PURPOSE

A filter strip removes pollutants from runoff before the material enters a body of water. It also serves as a buffer between water and the fields above the water so that pesticides and other chemicals are not applied directly adjacent or into the water body. Filter strips also reduce sedimentation of streams, lakes and other bodies of water.

PRACTICE CATEGORIES

Stream Bank Protection
Recreation Management
Construction Site Management
Stormwater Control
Mining Lands Management
Cropland Management

TMDL SOURCES TREATED

Animal Feeding Operations
Disturbed Areas
Stream Erosion
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Pathogens
Nutrients & Organics
Heavy Metals
Low Dissolved Oxygen

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Filter Strip

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Exotic Removal
Seeding
Fencing

PERMITTING REQUIREMENTS

None

APPLICABLE NRCS/OTHER REFERENCES

NRCS-FOTG
393 Filter Strip

PLANNING CONSIDERATIONS

Filter strips should be strategically located to reduce runoff, and increase infiltration and ground water recharge throughout the watershed.

Filter strips for the single purposes of wildlife/beneficial insect habitat or to enhance watershed function should be strategically located to intercept contaminants thereby enhancing the water quality of the watershed.

To avoid damage to the filter strip consider using vegetation that is somewhat tolerant to herbicides used in the upslope crop rotation.

Consider using this practice to enhance the conservation of declining species of wildlife, including those that are threatened or endangered.

Consider using this practice to protect National Register listed or eligible (significant) archaeological and traditional cultural properties from potential damaging contaminants.

Filter strip size should be adjusted to a greater flow length to accommodate harvest and maintenance equipment.

420 Grade Stabilization Structure

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

A grade stabilization structure is used to control the grade and head cutting in natural or artificial channels. These structures can consist of rock, rock and brush, or rock and biologs.

PURPOSE

Stabilize the grade and control erosion in natural or artificial channels, to prevent the formation or advance of gullies. There can be a significant reduction in classic gully erosion, a moderate reduction in streambank erosion with significant reduction in surface water suspended sediments

PRACTICE CATEGORIES

Stream Bank Protection
Recreation Management
Construction Site Management
Mining Lands Management
Cropland Management

TMDL SOURCES TREATED

Industrial Sources
Disturbed Areas
Stream Erosion
Agricultural Practices
Mining Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Nutrients & Organics
Habitat Alteration

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Grade Stabilization Structure

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS
Streamside

ASSOCIATED TMDL PRACTICES
Brush Trench
Irrigation Water Management
Erosion Control Fabric

PERMITTING REQUIREMENTS
ACOE 401 and 404 permits may be required

APPLICABLE NRCS/OTHER REFERENCES
NRCS -FOTG
410Grade Stabilization Structure

PLANNING CONSIDERATIONS

Grade stabilization structures are located so that the elevation of the inlet of the spillway is set at an elevation that will control upstream headcutting. A wide range of alternative types of structures are available for this practice and an intensive site investigation is required to plan and design an appropriate grade stabilization structure for a specific site.

120 Grazing Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

DESCRIPTION

Managing the controlled harvest of vegetation with grazing animals. Duration and intensity of grazing should be based on desired plant health and expected productivity of key forage species to meet management unit objectives. Management may include exclusion, seasonal rotation, rest, or some combination.

PURPOSE

The purpose is to improve or maintain the health and vigor of plant communities, improve or maintain water quality and reduce accelerated soil erosion and maintain and improve soil condition. All plant communities have sustainability levels. Proper management provides a healthy riparian plant community that stabilizes stream banks, creates habitat, slows flood velocities, and often provides greater amounts of forage.

PRACTICE CATEGORIES

Livestock Management
Stream Bank Protection

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Pathogens
Nutrients & Organics
Low Dissolved Oxygen
Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Grazing Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands

ASSOCIATED TMDL PRACTICES

Fencing
Watering Facility

PERMITTING REQUIREMENTS

None

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
528 Prescribed Grazing
472 Use Exclusion
516 Pipeline
614 Water Facility

PLANNING CONSIDERATIONS

Removal of herbage will be in accordance with site production limitations, rate of plant growth, and the physiological needs of forage plants.

Manage kind of animal, animal number, grazing distribution, length of grazing periods, and timing of use to provide sufficient deferment from grazing during the growing period.

Protect soil, water, air, plant, and animal resources when locating livestock feeding, handling, and watering facilities.

Manage grazing animals to maintain adequate vegetative cover on sensitive areas (i.e. riparian, wetland, habitats of concern, karst areas).

Duration and intensity of grazing will be based on desired plant health and expected productivity of key forage species to meet management unit objectives.

Adjust grazing periods and/or stocking rates to meet the desired objectives for the plant communities and the associated resources, including the grazing animal.

Schedule livestock movements based on rate of plant growth, available forage and utilization, not calendar dates.

Periodic rest from grazing may be needed to maintain or restore the desired plant community following episodic events, such as wildfire or severe drought.

Maintain adequate ground cover and plant density to maintain or improve filtering capacity of the vegetation.

Minimize concentrated livestock areas to enhance nutrient distribution and improve or maintain ground cover.

440 Irrigation Land Leveling

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

Reshaping the surface of land to be irrigated to planned grades.

PURPOSE

Permits uniform and efficient application of surface irrigation water without significant erosion, loss of water quality, or damage to soil and crops from waterlogging. Effects are moderate reduction in sheet erosion, with a slight reduction in runoff and flooding. There may also be a slight reduction in suspended sediments in surface water.

PRACTICE CATEGORIES

Irrigation Efficiencies
Cropland Management

TMDL SOURCES TREATED

Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity

LOAD REDUCTION POTENTIAL

◉ LOW ○ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Irrigation Land Leveling

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS

Agricultural Lands

ASSOCIATED TMDL PRACTICES

Cover Crop
Seeding
Irrigation Water Management

PERMITTING REQUIREMENTS

None if leveling is away from streams and wetlands.

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
464Irrigation Land Leveling
466Land Smoothing

PLANNING CONSIDERATIONS

In the design consider the excavation and fill material required for or obtained from such structures as ditches, ditch pads, and roadways. The appropriate yardage shall be included when balancing cuts and fills and determining borrow requirements.

Consider related structures and measures needed to control irrigation water and/or storm water runoff. Consider crops, method of irrigation, soil intake rates, field slope, irrigation stream size and resulting deep percolation and runoff when determining or evaluating length of irrigation runs.

Consider the depth of cuts and the resulting available plant rooting depths to saline soils and to shallow water tables.

In areas with sediment-laden irrigation water, consider increasing the required height of the water surface at the point of delivery.

Consider effects on irrigation efficiencies, especially on volumes and rates of runoff, infiltration, evapotranspiration and deep percolation.

Consider effects on water flows and aquifers, and the affect to other water uses and users.
Consider the effects on adjacent wetlands.

450 Irrigation Pipeline

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

A pipeline and appurtenances installed as an integral part of an irrigation system or stormwater control network.

PURPOSE

The purpose of the practice is to reduce erosion, conserve water, and protect water quality. Underground pipelines serve as an integral part of the irrigation water distribution system, and significantly improve the overall efficiency of the system. Moderate reductions in sheet, gully and irrigation induced erosion can occur.

PRACTICE CATEGORIES

Irrigation Efficiencies
Stormwater Control
Cropland Management

TMDL SOURCES TREATED

Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Irrigation Pipeline

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS

Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Irrigation Water Management
Irrigation, Drip
Irrigation, Sprinkler

PERMITTING REQUIREMENTS

None.

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
430Irrigation Pipeline

PLANNING CONSIDERATIONS

Pipelines must be properly sized and installed. The pipe diameter is a function of the length of pipeline, the expected flow, and the slope. For pipelines of any length, engineering design is often required.

451 Irrigation System, Drip

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

A planned system in which all necessary components have been installed for efficient application of irrigation water directly to the root zone of the plants by means of emitters, orifices, or porous tubing.

PURPOSE

To efficiently and uniformly apply irrigation water and maintain soil moisture for optimum plant growth. Moderate reductions in sheet, and gully erosion. Along with moderate reduction in surface water suspended sediments.

PRACTICE CATEGORIES

Irrigation Efficiencies
Cropland Management

TMDL SOURCES TREATED

Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Nutrients & Organics

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Irrigation System, Drip

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS
Agricultural Lands

ASSOCIATED TMDL PRACTICES
Irrigation Water Management
Irrigation Pipeline

PERMITTING REQUIREMENTS
None.

APPLICABLE NRCS/OTHER REFERENCES
NRCS -FOTG
441Irrigation System, Microirrigation

PLANNING CONSIDERATIONS

Water quality is usually the most important consideration when determining whether a microirrigation system is feasible. Well and surface water often contains high concentrations of undesirable minerals (chemicals). Surface water can contain organic debris, algae, moss, bacteria, soil particles, etc. Well water can also contain sand.

Microirrigation can influence runoff and deep percolation by raising the soil moisture level and decreasing available soil water storage capacity, increasing the probability of runoff or percolation below the root zone from storm events. The movement of sediment, soluble chemicals, and sediment-attached substances carried by runoff may affect surface water quality. The movement of dissolved substances below the root zone may affect groundwater quality.

On systems where chemicals are injected, care shall be taken so the injected nutrients do not react with other chemicals in the irrigation water to cause precipitation and plugging.

Microirrigation will effect a change in plant growth and transpiration because of changes in the volume of soil water.

There may be a potential for development of saline seeps or other salinity problems resulting from increased infiltration near restrictive layers.

Field shape and slope frequently dictate the most economical lateral direction. Whenever possible, laterals should be laid downslope for slopes of less than 5% if lateral size reduction can be attained. For steeper terrain, lateral lines should be laid along the field contour and pressure compensating emitters should be specified or pressure control devices used along downslope laterals.

452 Irrigation System, Sprinkler

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

A sprinkler irrigation system is a planned system in which all necessary components have been installed for efficient application of irrigation water by means of nozzles operated under pressure.

PURPOSE

To efficiently and uniformly apply irrigation water to maintain adequate soil moisture for optimum plant growth without causing excessive water loss, erosion, or reduced water quality. These systems can reduce sheet, gully and irrigation induced erosion, reduce suspended sediments in surface water, and improve aquatic habitat suitability

PRACTICE CATEGORIES

Irrigation Efficiencies
Cropland Management

TMDL SOURCES TREATED

Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Nutrients & Organics

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Irrigation System, Sprinkler

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS
Agricultural Lands

ASSOCIATED TMDL PRACTICES
Irrigation Water Management
Irrigation Pipeline

PERMITTING REQUIREMENTS
None

APPLICABLE NRCS/OTHER REFERENCES
NRCS -FOTG
442 Irrigation System, Sprinkler

PLANNING CONSIDERATIONS

Sprinkler irrigation designs are based on an evaluation of the site considering soil, topography, water supply, energy supply, crops to be grown, labor requirements, and expected operating conditions.

Sprinkler irrigation systems are a better choice for sandy soils. Conversely, if the soils are very slowly permeable (clayey), the site may not be well adapted to sprinkler irrigation due to excessive runoff and erosion.

The net depth of application shall be based on the available moisture capacity of the soil in the root zone of the crop irrigated or a lesser amount consistent with the land user's operation plan. The gross depth shall be determined by using field application efficiencies consistent with the conservation of water resources.

The design rate of application shall be within a range established by the minimum practical application rate under local climatic conditions and the maximum rate consistent with the intake rate of the soil and the conservation practices used on the land. If two or more sets of conditions are in the design area, the lowest maximum application rate for areas of significant size shall apply.

Distribution patterns and spacing. A combination of sprinkler spacing, nozzle sizes, and operating pressure that most nearly provides the design application rate and distribution shall be selected. The velocity of prevailing winds and other conditions must be considered.

453 Irrigation System, Surface

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING


NRCD Photo

DESCRIPTION

A system in which all necessary water-control structures have been installed for the efficient distribution of water by surface means, such as furrows, borders, contour levees, or contour ditches, or by subsurface means. Poorly designed surface irrigation often leads to inefficient water spread, excessive erosion, and additional pollutants into adjacent waterbodies.

PURPOSE

The purpose of the practice is to efficiently convey and distribute irrigation water to the point of application without causing erosion, water loss, or reduction in water quality. When combined with good irrigation management, moderate reduction in sheet, gully or irrigation induced erosion with moderate reductions in suspended sediments in surface water.

PRACTICE CATEGORIES

Irrigation Efficiencies
Cropland Management

TMDL SOURCES TREATED

Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Nutrients & Organics

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Irrigation System, Surface

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS
Agricultural Lands

ASSOCIATED TMDL PRACTICES
Irrigation Water Management
Irrigation Land Leveling
Irrigation System, Tailwater

PERMITTING REQUIREMENTS
None.

APPLICABLE NRCS/OTHER REFERENCES
NRCS -FOTG
443Irrigation System, Surface & Subsurface

PLANNING CONSIDERATIONS

When planning this practice the following items should be considered, where applicable:

Effects of nutrients and pesticides and other dissolved substances on surface and ground water quality.

Effects of water level control on the salinity of soils, soil water or downstream water quality.

Effects of water levels on such soil nutrient processes as plant nitrogen use or denitrification.

Impact of salt leaching on system management and capacity requirements.

Implementation considerations include:
·the water budget, especially volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

·plant growth and transpiration because of changes in the volume of soil water.

·downstream flows or aquifers that impact other water uses or users.

·the volume of downstream flow that could have environmental, social, or economic impacts.

·field water table in providing a suitable rooting depth for anticipated land uses.

·erosion and the movement of sediment and soluble and sediment-attached substances carried by runoff.

·temperature of downstream waters.

·aquatic and wildlife communities, wetlands or water-related wildlife habitats.

·the visual quality of water resources.
·cultural resources.

454 Irrigation System, Tailwater Recovery

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

A planned irrigation system in which all facilities utilized for the collection, storage, and transportation of irrigation tailwater for reuse have been installed.

PURPOSE

The purpose of this practice is the conservation of farm irrigation water supplies and water quality by collecting the water that runs off the field surface for reuse in the farm irrigation system. There can be moderate reductions in surface water contamination of pesticides, organic nutrients and suspended sediments entering streams.

PRACTICE CATEGORIES

Stream Bank Protection
Irrigation Efficiencies
Cropland Management

TMDL SOURCES TREATED

Stream Erosion
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Nutrients & Organics

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ○ MEDIUM ◉ HIGH

Irrigation System, Tailwater Recovery

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS

Agricultural Lands

ASSOCIATED TMDL PRACTICES

Irrigation Water Management
Irrigation Land Leveling
Irrigation System, Drip
Irrigation System, Sprinkler

PERMITTING REQUIREMENTS

None.

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
447Irrigation System, Tailwater Recovery

PLANNING CONSIDERATIONS

Irrigation systems should be designed to limit tailwater volumes to that needed for effective operation. This reduces the need or minimizes the size and capacity of collection, storage, and transportation facilities.

Changes in irrigation water management activities will be necessary to accommodate return flows.

Nutrient and pest management measures should be planned to limit chemical-laden tailwater as much as practical. Chemical-laden water can create a potential hazard to wildlife, especially waterfowl that are drawn to ponded water.

Protection of system components from storm events and excessive sedimentation should be considered. Downstream flows or aquifer recharge volumes dependent on runoff will be reduced. Existing wetland hydrology could be impacted by this practice.

140 Irrigation Water Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

DESCRIPTION

Irrigation water management is the process of determining and controlling the volume, frequency, and application rate of irrigation water in a planned, efficient manner. Effective management produces larger crops and reduces water demand and unintentional return flows.

PURPOSE

Effectively use available irrigation water in managing and controlling the moisture environment of crops and other vegetation. The objectives are to promote a desired response, minimize soil erosion, minimize loss of plant nutrients, and protect both the quantity and quality of water resources.

PRACTICE CATEGORIES

Irrigation Efficiencies
Cropland Management

TMDL SOURCES TREATED

Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Nutrients & Organics
Low Dissolved Oxygen

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Irrigation Water Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Agricultural Lands

ASSOCIATED TMDL PRACTICES

Cover Crop
Nutrient Management
Mulching
Seeding

PERMITTING REQUIREMENTS

None

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
449Irrigation Water Management

PLANNING CONSIDERATIONS

·Consideration should be given to managing precipitation effectiveness, crop residues, and reducing system losses.

·Modify plant populations, crop and variety selection, and irrigated acres to match available or anticipated water supplies.

·Consider potential for spray drift and odors when applying agricultural and municipal waste waters.

·Equipment modifications and/or soil amendments such as polyacrylamides and mulches should be considered to decrease erosion.

·Consider the quality of water and the potential impact to crop quality and plant development.

·Quality of irrigation water should be considered relative to its potential effect on the soil's physical and chemical properties, such as soil crusting, pH, permeability, salinity, and structure.

·Avoid traffic on wet soils to minimize soil compaction.

·Consider the effects that irrigation water has on wetlands, water related wildlife habitats, riparian areas, cultural resources, and recreation opportunities.

·Management of nutrients and pesticides.

·Schedule salt leaching events to coincide with low residual soil nutrients and pesticides.

·Water should be managed in such a manner as to not drift or come in direct contact with surrounding electrical lines, supplies, devices, controls, or components that would cause shorts in the same or the creation of an electrical safety hazard to humans or animals.

·Consideration should be given to electrical load control/ interruptible power schedules, repair and maintenance downtime, and harvest downtime.

·Consider improving the irrigation system to increase distribution uniformity of irrigation water application.

250 Mulching

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

DESCRIPTION

Mulching is applying a protective cover of plant residue or other suitable material not produced on the site to the soil surface. This may be hay or crop residue hauled to the site and applied.

PURPOSE

This practice is used to help control erosion, protect crops, conserve moisture, prevent compaction/ crusting, reduce runoff, and help control weeds. The practice is utilized on sites subject to erosion and high runoff that need the additional protection from material brought in from off the site.

PRACTICE CATEGORIES

Irrigation Efficiencies
Construction Site Management
Mining Lands Management
Cropland Management

TMDL SOURCES TREATED

Disturbed Areas
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments Nutrients & Organics

LOAD REDUCTION POTENTIAL

◉ LOW ○ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Mulching

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Construction Site Management
Grazing Management
Irrigation Water Management

PERMITTING REQUIREMENTS

None

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
484 Mulching

PLANNING CONSIDERATIONS

• Consider the effects of mulching on evaporation, infiltration and runoff. Mulch material may affect microbial activity in the soil surface, increase infiltration, and decrease runoff, erosion and evaporation. Increased infiltration may increase nutrient and chemical transport below the root zone. The temperature of the surface runoff may also be lowered.

• Mulched soil retains moisture, requires less watering and reduces the chance of water stress on plant materials. Mulch also minimizes evaporation from the soil surface and hence reduces losses from bare soil areas.

• Mulch materials high in organic matter with a high water holding capacity and high impermeability to water droplets may adversely affect the water needs of plants.

• Clear and infra-red transmissible (IRT) plastics have the greatest warming potential. They are transparent to incoming radiation and trap the longer wavelengths radiating from the soil. Black mulches are limited to warming soils by conduction only and are less effective.

• Clear mulches allow profuse weed growth and may negate the benefits of soil warming. Black mulches provide effective weed control. Wavelength selective (IRT) blends the soil warming characteristics of clear mulch with the weed control ability of black mulch.

• Consider potential toxic allopathic effects that mulch material may have on other organisms. Animal and plant pest species may be incompatible with the site.

• Consider the potential for increased pathogenic activity within the applied mulch material.

• Keep mulches 3 to 6 inches away from plant stems and crowns to prevent disease and pest problems. Deep mulch provides nesting habitat for ground-burrowing rodents that can chew extensively on bark on tree trunk and/or tree roots. Light mulch applied after the first cold weather may prevent rodents from nesting.

160 Nutrient Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT


NRCS Photo

DESCRIPTION

This practice involves managing the amount, placement, and timing of plant nutrients to obtain optimum yields and minimize the risk of surface and groundwater pollution.

PURPOSE

To budget and supply nutrients for plant production. To properly utilize manure or organic by-products as a plant nutrient source. To minimize agricultural nonpoint source pollution of surface and ground water resources. To maintain or improve the physical, chemical and biological condition of soil.

PRACTICE CATEGORIES

Cropland Management

TMDL SOURCES TREATED

Agricultural Practices

POLLUTANTS ADDRESSED

Pesticides

Nutrients & Organics
Low Dissolved Oxygen
Habitat Alteration

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Nutrient Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

POTENTIAL TREATMENT AREAS
Agricultural Lands

ASSOCIATED TMDL PRACTICES
Irrigation Water Management

PERMITTING REQUIREMENTS
None

APPLICABLE NRCS/OTHER REFERENCES
NRCS -FOTG
590 Nutrient Management

PLANNING CONSIDERATIONS

In areas with an identified or designated nutrient-related water quality impairment, an assessment should be completed of the potential for nitrogen and/or phosphorus transport from the field. The Leaching Index (LI) and/or Phosphorus Index (PI), or other recognized assessment tools, may be used to make these assessments. The results of these assessments and recommendations may be discussed with the producer and included in the plan.

Plans developed to minimize agricultural nonpoint source pollution of surface or ground water resources shall include practices and/or management activities that can reduce the risk of nitrogen or phosphorus movement from the field.

180 Pest Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

DESCRIPTION

Utilizing environmentally sensitive prevention, avoidance, monitoring and suppression strategies, to manage weeds, insects, diseases, animals and other organisms (including invasive and non-invasive species), that directly or indirectly cause damage or annoyance.

PURPOSE

Effective application of pesticides can enhance quantity and quality of crops. The appropriate pesticide applied as directed will minimize cost and reduce negative impacts on soil resources, water resources, air resources, plant resources, animal resources and/or humans.

PRACTICE CATEGORIES

Cropland Management

TMDL SOURCES TREATED

Agricultural Practices

POLLUTANTS ADDRESSED

Pesticides

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Pest Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

POTENTIAL TREATMENT AREAS
Agricultural Lands

ASSOCIATED TMDL PRACTICES
Irrigation Water Management

PERMITTING REQUIREMENTS
None

APPLICABLE NRCS/OTHER REFERENCES
NRCS -FOTG
595 Pest Management

PLANNING CONSIDERATIONS

The pest management component of a conservation plan shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s).

As a minimum, the pest management component of a conservation plan shall include:

·Plan map and soil map of managed site, if applicable (use RMS plan maps if available).

·Location of sensitive resources and setbacks, if applicable (use RMS plan maps if available).

·Environmental risk analysis, with approved tools and/or procedures, for probable pest management recommendations by crop (if applicable) and pest.

·Interpretation of the environmental risk analysis and identification of appropriate mitigation techniques.

·Operation and maintenance requirements.

260 Pole/Post Planting

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

DESCRIPTION

Establishing woody plants by planting or transplanting seedlings, saplings or cuttings, direct seeding, or natural regeneration.

PURPOSE

To establish woody plants for forest products, wildlife habitat, long-term erosion control and improvement of water quality, treat waste, reduction of air pollution, sequestration of carbon, energy conservation, and enhance aesthetics

PRACTICE CATEGORIES

Stream Bank Protection
Recreation Management
Construction Site Management
Mining Lands Management

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Agricultural Practices
Natural Sources

POLLUTANTS ADDRESSED

Sediments
Salinity
Nutrients & Organics
Low Dissolved Oxygen
Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Pole/Post Planting

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Seeding
Vertical Bundle
Willow Fascines
Brush Mattress
Brush Trench
Brush Revetment

PERMITTING REQUIREMENTS

Generally none as long as stream banks are sloped by hand.

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
595 Pest Management
322 Channel Vegetation
391 Riparian Forest Buffer
395 Stream Habitat Improvement & Mgmt
612 Tree/shrub Establishment

PLANNING CONSIDERATIONS

Use locally adapted seed, seedlings or cuttings. Priority should be given to plant materials that have been selected and tested in tree/shrub improvement programs. All plant materials should comply with a minimum standard, such as the American Nursery and Landscape Association, Forest Service, or state-approved nursery.

Plans for landscape and beautification plantings should consider foliage color, season and color of flowering, and mature plant height.

Where multiple species are available to accomplish the planned objective, consideration should be given to selecting species which best meet wildlife needs.

Tree/shrub arrangement and spacing should allow for and anticipate the need for future access lanes for purposes of stand management.

Residual chemical carryover should be evaluated prior to planting.

Species considered locally invasive or noxious should not be used.

Species used to treat waste should have fast growth characteristics, extensive root systems, capable of high nutrient uptake, and may produce wood/fiber products in short rotations.

For optimal carbon storage, select plant species that are adapted to the site to assure strong health and vigor and plant the full stocking rate for the site.

190 Residue Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

DESCRIPTION

Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round while growing crops (includes No-Till, Strip Till, Mulch, Ridge Till, Direct Seeding, and Seasonal residue management).

PURPOSE

The effective management of plant material on the soil surface reduces sheet, rill erosion, and wind erosion. The organic material maintains or improves soil condition and conserves soil moisture. Strategies manage available moisture to increase plant available moisture or reduce plant damage from freezing or desiccation. These practices also provide food and escape cover for wildlife.

PRACTICE CATEGORIES

Cropland Management

TMDL SOURCES TREATED

Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity
Pesticides

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Residue Management

TMDL Practice Sheet

LEVEL 100: PASSIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Agricultural Lands

ASSOCIATED TMDL PRACTICES

Nutrient Management
Cover Crop
Filter Strip
Mulching

PERMITTING REQUIREMENTS

None.

APPLICABLE NRCS/OTHER REFERENCES

NRCS-FOTG
329 A Residue Management - No Till & Strip Till
329 B Residue Management - Mulch
329 C Residue Management - Ridge Till
344 Residue Management - Seasonal

PLANNING CONSIDERATIONS

Removal of plant residue by baling or grazing may have a negative impact on resources. These activities should not be performed without full evaluation of impacts on other resources.

Production of adequate amounts of crop residue necessary for the proper functioning of this practice can be enhanced by selection of high residue producing crops and crop varieties, by the use of cover crops, and by adjustment of plant populations and row spacing. When planting in a low residue seedbed, completing tillage and planting in a single operation, or by performing primary tillage no more than three days before planting can minimize exposure to erosion; and in limited moisture areas, can conserve moisture for germination.

Leaving standing stubble taller than the six inch minimum will increase the amount of snow trapped. Leaving one or two rows of unharvested crop standing at intervals across the field can enhance the value of residue for wildlife habitat. Unharvested crop rows have the greatest value when they are adjacent to other cover types, such as grassy or brushy areas or woodland.

470 Road Stabilization

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

The stabilization of roads and other embankments by use of rock, vegetation, and/or geotextiles.

PURPOSE

Stabilizing unstable banks reduces sediment imputs from erosion and protects the related infrastructure. Traditional stabilization relied on expensive rock treatments. Other options are available the include the use of erosion control fabric, toe rock, and revegetation to stabilize banks.

PRACTICE CATEGORIES

Stream Bank Protection
Recreation Management
Construction Site Management
Stormwater Control
Mining Lands Management

TMDL SOURCES TREATED

Industrial Sources
Disturbed Areas
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity
Pesticides

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ○ MEDIUM ◉ HIGH

Road Stabilization

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Toe Rock
Brush Revetment
Brush Mattress
Brush Trench
Erosion Control Fabric
Rock Riprap

PERMITTING REQUIREMENTS

Permits under Section 404 and 401 of the Clean Water Act are required if the bank is adjacent to a stream or wetland.

APPLICABLE NRCS/OTHER REFERENCES

EPA, 2000
USDA-USFS. 2000
NRCS-EFH-18

PLANNING CONSIDERATIONS

Planning considerations include the height and slope of the bank, the climate, value of the road or infrastructure. In general, hardening the bank with rock riprap is the most costly approach. Often the installation of native plant materials can spread sloe and runoff to reduce erosion. Erosion control cloth can be used to temporarily stabilize the bank until the vegetation is established.

521 Rock RipRap

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

Use of rock or other hard material to armor eroding banks. The hardening is applied directly to the area of eroding bank. The rock extends to a depth to minimize failure due to scour during high flow events.

PURPOSE

This traditional practice involves the use of rock to harden a bank thereby reducing erosion. When expensive infrastructure is threatened, bank hardening may be warranted. However, the practice is expensive and has unintended impacts on habitat and stream function. Toe rock, rock vanes and/or a variety of bioengineering practices offer effctive, lower cost alternatives.

PRACTICE CATEGORIES

Livestock Management
Stream Bank Protection
Construction Site Management
Stormwater Control
Mining Lands Management

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Agricultural Practices
Mining Practices
Natural Sources

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Rock RipRap

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Grazing Management
Toe Rock
Brush Mattress
Vertical Bundles
Road Stabilization
Rock Vane

PERMITTING REQUIREMENTS

Permits are required under Sections 404 and 401 of the Clean Water Act if installed adjacent to a stream or wetland.

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
580Streambank and Shoreline Protection

PLANNING CONSIDERATIONS

Rock riprap is expensive and can adversely impact downstream landowners. As a result it should be designed specifically to meet project objectives. In general, technical assistance is recommended when designing and installing this practice.

The rock should extend down to a depth below scour from high flows.

Upstream and downsteam ends of the rock must be tied into the streambank to minimize risk of failure.

In general, the height of rock protection should be limited to floodplain or other appropriate flood stage elevation.

Design Considerations include:
- Size of rock,
- Length and height of bank to be protected
- Depth of toe protection (scour depth)
- Cost

Impacts to be considered:
- Potential effect to downstream landowners,
- Potential effects on stream processes,
- Potential loss of habitats,
- Alternative practices

421 Rock Vane/Barb

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

A constructed rock (or in some cases logs are used) structure located on the outside of stream bends, directed upstream and sloping from the bank down to the stream bed.

PURPOSE

Vanes and barbs are used to redirect stream flows away from banks, reducing bank erosion by reducing the near-bank channel slope and stream velocity.

PRACTICE CATEGORIES

Stream Bank Protection

TMDL SOURCES TREATED

Stream Erosion
Natural Sources

POLLUTANTS ADDRESSED

Sediments
Habitat Alteration
Salinity

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Rock Vane/Barb

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

POTENTIAL TREATMENT AREAS
Streamside

ASSOCIATED TMDL PRACTICES
Brush revetment
Fiberschenes/Biologs
Pole planting
Brush Mattress
Toe Rock

PERMITTING REQUIREMENTS
Permits are required under Sections 404 and 401 of the Clean Water Act.

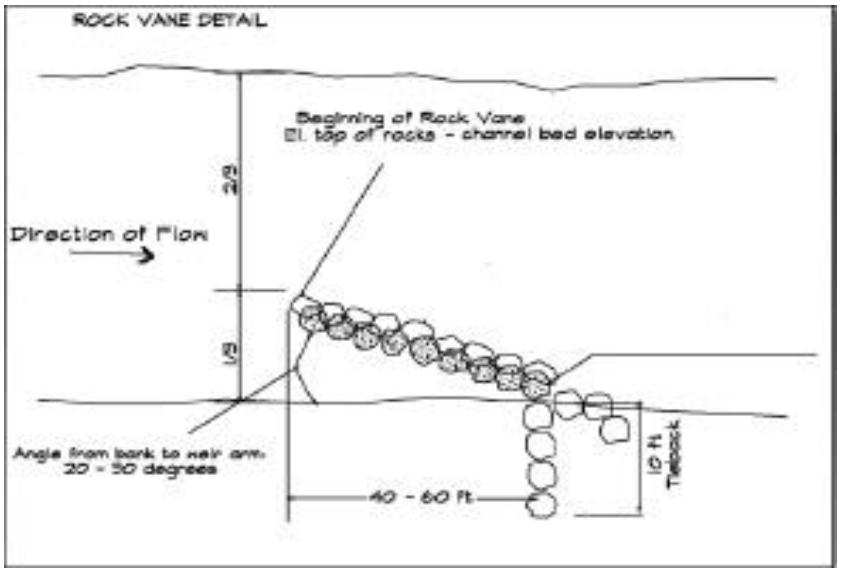
APPLICABLE NRCS/OTHER REFERENCES
Rosgen, 2000
NRCS-EFH-16

PLANNING CONSIDERATIONS
Rock vanes or barbs must be very carefully designed and installed. They are generally installed in series along an eroding bank at the outside of a meander. The structure is keyed into the bank to reduce the chance of the stream eroding around it. At the bank the structure elevation should be higher than the floodplain to allow high flows to spread. The vane is angled sharply upstream at a 20˚ - 30˚ from the bank as it dips down to the channel bed elevation.

Vanes/barbs are spaced such that flow striking the bank below one vane is intercepted by the next and redirected.

Vanes/barbs can be constructed of large rock, generally 2 - feet in diameter, angular rock riprap, logs, or upright posts. It is critical that the structure extend below the level of stream scour in the channel bed to protect from undermining and failure.

These structures are less expensive than rock riprap and provide better habitat benefits. However, they inhibit the stream channels natural need to adjust. Bioengineering practices such as vertical bundles, brush mattresses, brush revetment, and pole planting should be considered and installed if applicable.



422 Rock Weir

TMDL Practice Sheet

LEVEL 500: INTENSE ENGINEERING

DESCRIPTION

This is a grade control structure constructed from large rocks. Can also be used as a diversion for off channel watering facilities.

PURPOSE

Appropriately located and constructed, weirs reduce water generated stress and reduce stream velocity against banks, while concentrating flows in the center of the channel. The effect is to reduce bank erosion and protect against channel incision or downcutting.

PRACTICE CATEGORIES

Stream Bank Protection

TMDL SOURCES TREATED

Stream Erosion
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Salinity
Pesticides
Nutrients & Organics
Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Rock Weir

TMDL Practice Sheet

LEVEL 500: INTENSE ENGINEERING

POTENTIAL TREATMENT AREAS
Streamside

ASSOCIATED TMDL PRACTICES
Irrigation Water Management
Water Facilities

PERMITTING REQUIREMENTS
Permits are required under Sections 404 and 401 of the Clean Water Act.

APPLICABLE NRCS/OTHER REFERENCES
Rosgen, 2000

PLANNING CONSIDERATIONS
Rock weirs can be used to stabilize incising channels and to provide more stable diversion systems for irrigation and livestock water.

Rock weirs must be very carefully designed and installed. They should only be installed in the transition or riffle sections of stream between meanders. The structure is keyed into both banks to reduce the chance of the stream eroding around it. At the banks the structure elevation should be higher than the floodplain to allow high flows to spread. The weir arms are angled sharply upstream at a 20˚ - 30˚ from the bank as it dips down to the channel bed elevation.

Weirs can be constructed of large rock, generally 2 - feet in diameter, angular rock riprap, logs, or upright posts. It is critical that the structure extend below the level of stream scour in the channel bed to protect from undermining and failure.

These structures are more stable than traditional flat topped diversion dams because they maintain natural water and sediment transport. The central flow also allows fish passage.

221 Seeding

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

DESCRIPTION

Used to establish forage species. Also used to apply an herbaceous seed mix to disturbed areas usually by broadcasting, mulching, hydroseeding or aerial seeding.

PURPOSE

Revegetate disturbed areas of ground to prevent erosion of soils. Generally native grass seed is applied to revegetate bare or disturbed ground. In and around wetlands and riparian areas, wetland seed mixes are used.

PRACTICE CATEGORIES

Livestock Management
Stream Bank Protection
Irrigation Efficiencies
Recreation Management
Construction Site Management
Stormwater Control
Mining Lands Management
Cropland Management

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Agricultural Practices
Mining Practices
Natural Sources

POLLUTANTS ADDRESSED

Sediments	Nutrients & Organics
Salinity	Heavy Metals
Pesticides	Low Dissolved Oxygen
Pathogens	Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Seeding

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Streamside
Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Tree planting
Exotic removal
Erosion control fabric
Mulching

PERMITTING REQUIREMENTS

None

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
322 Channel Vegetation
342 Critical Area Planting
512 Pasture & Hayland Planting
550 Range Planting
390 Riparian Herbaceous Cover

PLANNING CONSIDERATIONS

Successful seeding requires the use of appropriate native plant seeds sowed during the appropriate time of year. In general the seed is covered with a mulch, compost, or hydro mulch to retain moisture, protect the seed, and provide cover.

333 Silt Fence

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

A porous plastic fabric barrier installed to temporarily contain surface sediments on disturbed lands.

PURPOSE

Silt fences are available commercially and are used to contain loose sediments generated on construction sites and other disturbed areas. Water is allowed to flow through the fabric while sediments are trapped.

PRACTICE CATEGORIES

Stream Bank Protection
Recreation Management
Construction Site Management
Stormwater Control
Mining Lands Management

TMDL SOURCES TREATED

Animal Feeding Operations
Disturbed Areas
Stream Erosion
Agricultural Practices
Mining Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity
Pesticides

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ○ MEDIUM ◉ HIGH

Silt Fence

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS

Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Straw bale Barrier
Sediment Basins

PERMITTING REQUIREMENTS

None.

APPLICABLE NRCS/OTHER REFERENCES

EPA, 2000
USDA-USFS. 2000
NRCS-EFH-18

PLANNING CONSIDERATIONS

Silt fences are installed perpendular to overland water flow. In large areas fences are installed in series to slow the flow of water across disturbed lands. These fences should be considered temporary, installed to buy time for seeding or other revegetation practices to mature.

While the practice does not generally require regulatory permits, it is often a requirement in stream alteration permits to minimize pollutants during construction projects.

360 Sloped Drain

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

A sloped drain is a pipe to convey water from one elevation to a lower one without erosion.

PURPOSE

Storm water flowing over steep slopes can be very erosive. The sloped drain conveys this water from one elevation to another without the erosion. These drains can be used to convey storm water or returning irrigation waters.

PRACTICE CATEGORIES

Stream Bank Protection
Irrigation Efficiencies
Recreation Management
Construction Site Management
Stormwater Control
Mining Lands Management
Cropland Management

TMDL SOURCES TREATED

Industrial Sources
Disturbed Areas
Agricultural Practices
Mining Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity
Pesticides

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Sloped Drain

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS

Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Detention Basin
Erosion Control Fabric
Irrigation System, Tailwater Recovery

PERMITTING REQUIREMENTS

None.

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
410Grade Stabilization Structure

PLANNING CONSIDERATIONS

Sloping drains should be engineered with enough capacity to carry expected flows. If not, water will flow around them creating erosion and threatening the drain. Inlets should regularly be cleared of debris.

334 Straw Roll/bale Barrier

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

A semi-permiable barrier to temporarily contain sediments generated by flows across bare or disturbed ground.

PURPOSE

Ground disturbances created during construction can result in quantities of sediment and other pollutants as storm flows erode surface soils. The barriers temporarily trap sediments while allowing waters to flow through.

PRACTICE CATEGORIES

Recreation Management
Construction Site Management
Stormwater Control
Mining Lands Management
Cropland Management

TMDL SOURCES TREATED

Animal Feeding Operations
Disturbed Areas
Mining Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ○ MEDIUM ◉ HIGH

Straw Roll/bale Barrier

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS

Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Silt Fence

PERMITTING REQUIREMENTS

None.

APPLICABLE NRCS/OTHER REFERENCES

EPA, 2000
USDA-USFS. 2000
NRCS-EFH-18

PLANNING CONSIDERATIONS

Straw bales are temporarily placed perpendicular to surface sheet flow. In small channels velocities are high enough to require anchoring of the bales with steel or wooden stakes. These barriers should be considered temporary and require maintenance.

522 Stream Channel Stabilization

TMDL Practice Sheet

LEVEL 500: INTENSE ENGINEERING

DESCRIPTION

Reconstruction or restoration of a reach of stream. May involve channel re-alignment, grade control and bank stabilization structures and a variety of bio-engineering practices.

PURPOSE

Used when a stream reach has reached or crossed a threshold of stability from which natural recovery may take too long or be unachievable. This practice significantly reduces sediment input to a system and jump starts the riparian recovery process.

PRACTICE CATEGORIES

Stream Bank Protection
Mining Lands Management

TMDL SOURCES TREATED

Disturbed Areas
Stream Erosion
Mining Practices

POLLUTANTS ADDRESSED

Sediments
Habitat Alteration
Water Temperature
Flow Alterations

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Stream Channel Stabilization

TMDL Practice Sheet

LEVEL 500: INTENSE ENGINEERING

POTENTIAL TREATMENT AREAS
Streamside

ASSOCIATED TMDL PRACTICES
Various Bioengineering practices
Toe Rock
Rock vanes
Rock weirs
Post/pole planting
Seeding

PERMITTING REQUIREMENTS
Permits are always required under Sections 404 and 401 of the Clean Water Act.

APPLICABLE NRCS/OTHER REFERENCES
NRCS -FOTG
584Stream Channel Stabilization

PLANNING CONSIDERATIONS
Stream channels and their processes are complex and dynamic. As a result, restoration of stable dimension, pattern, and profile to a stream channel is a highly technical undertaking. It should only be undertaken with qualified technical assistance.

This practice potentially includes realignment of stream channels as well as widening floodplains, and stabilizing grade. However, stream adjustment to inadequate designs can create greater impacts than the original condition.

Considerations:
What are project objectives?

What portions of the system are currently working?

What are the causes for impairment (including watershed causes) and how can they be addressed?

What is the naturally stable dimension, pattern, and profile of the stream channel?

What is the minimum practice necessary to achive project objectives?

What monitoring procedures should be implemented to measure success?

Management changes to eliminate causes should be considered and implemented first, followed by revegetation and other bioengineering practices using native plants. Structural practices and changes to channel dimension or pattern should be implemented only if other measures are not deemed to be effective.

335 Terrace

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

A terrace is an earth embankment, channel, or a combination ridge and channel constructed across the slope to intercept runoff water.

PURPOSE

Terracing provides level surfaces along sloping fields increasing irrigation efficiencies and reducing surface sheet flows. The vegetated strips between terraces provide a filter for sediment and nutrients carried downslope by surface runoff.

PRACTICE CATEGORIES

Irrigation Efficiencies
Cropland Management

TMDL SOURCES TREATED

Disturbed Areas
Agricultural Practices
Mining Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Salinity
Pesticides

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Terrace

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS

Agricultural Lands
Developed Lands

ASSOCIATED TMDL PRACTICES

Filter Strip
Cover Crop
Irrigation Land Leveling

PERMITTING REQUIREMENTS

None

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
600Terrace

PLANNING CONSIDERATIONS

This practice generally applies to cropland but may also be used on other areas where field crops are grown such as wildlife or recreation lands.

Terraces are installed for one or more of the following purposes: 1) Reduce slope length for erosion control, 2) Reduce sediment content in runoff water, 3) Improve water quality, 4) Intercept and conduct runoff to a safe outlet, 5) Retain runoff for moisture conservation, 6) Prevent gully development, 7) Reform the land surface for better farmability, and 8) Reduce flooding.

A variety of terrace configurations has developed as a result of research and field experience. Four common types of terraces include broad-based which are farmed on both sides and used on more uniform gently sloping fields; flat channel which are used to conserve moisture; steep backslope which result in a benching effect; and narrow based which have permanent cover planted on both sides of the ridge.

Terraces may be parallel on fairly uniform terrain or vary from parallel when the terrain is undulating. Since parallel terraces are more acceptable, designs often provide for cuts and fills to improve terrace alignment and farmability.

Channel grades may be uniform or variable as long as the water velocity is nonerosive and meet other design criteria. The runoff from terraces may be handled by grassed waterways or underground pipe outlets depending on site conditions and economics.

Soil infiltration may also be utilized for disposal of runoff when level terraces are installed and the soil is sufficiently permeable to remove the water stored in the channel before crop damage occurs.

Terraces require careful design, layout and construction. Additional information including standards and specifications are on file in the local NRCS Field office Technical Guide.

423 Toe Rock

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

DESCRIPTION

Layer of rock placed on the toe an eroding bank, extending up to bankfull elevation. Often used in conjunction with other bio-engineering practices.

PURPOSE

Toe rock reduces the erosion potential at a bank by providing armoring and reducing the stress and velocity of water against the toe of a stream bank. When combined with bioengineering practices such as Brush trench, post/pole planting, and seeding.

PRACTICE CATEGORIES

Stream Bank Protection

TMDL SOURCES TREATED

Stream Erosion
Natural Sources

POLLUTANTS ADDRESSED

Sediments	Nutrients & Organics
Salinity	Habitat Alteration

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Toe Rock

TMDL Practice Sheet

LEVEL 400: MODERATE ENGINEERING

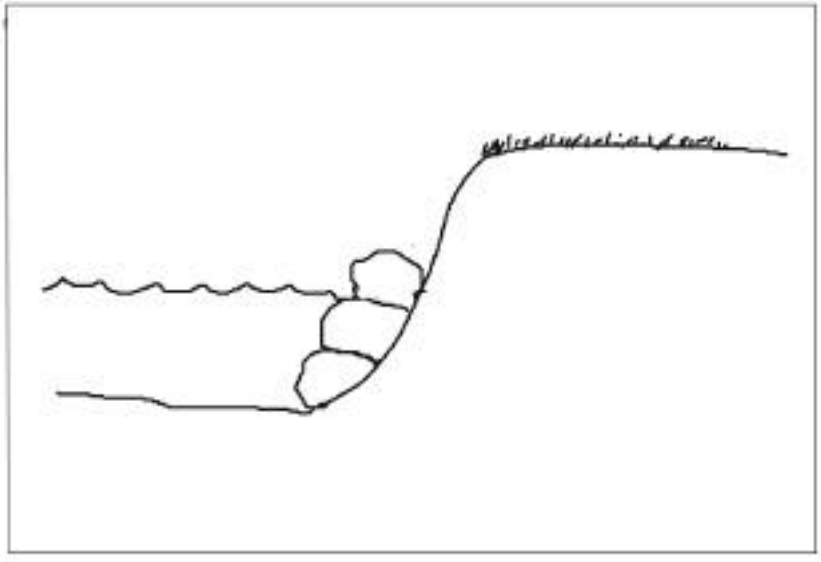
POTENTIAL TREATMENT AREAS
Streamside

ASSOCIATED TMDL PRACTICES
Brush Trench
Brush Revetment
Post/Pole planting
Seeding

PERMITTING REQUIREMENTS
Permits are required under Sections 404 and 401 of the Clean Water Act.

APPLICABLE NRCS/OTHER REFERENCES
NRCS-EFH-16
NRCS -FOTG
580Streambank and Shoreline Protection

PLANNING CONSIDERATIONS
Toe rock is an armoring technique to provide additional strength to stream banks. A variety of rock sizes can be used but must be designed to withstand stream forces. The rock is installed in a trench that extends below the stream scour level. Toe rock should not extend above the elevation of the adjacent floodplain. Often a filter fabric is installed behind the rock to keep stream flows from washing out soils behind the structure.



304 Vertical Bundle

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

This technique uses bundles of willow cuttings (Salix spp.) placed in vertical trenches along an eroding streambank. The willow cuttings will sprout and take root, thus stabilizing the streambank with a dense matrix of roots.

PURPOSE

This practice applies to streambanks of natural or constructed channels and shorelines of lakes, reservoirs, or estuaries where they are susceptible to erosion. Erosion is controlled by the physical structure of the woody stems increasing roughness and providing bank protection.

PRACTICE CATEGORIES

Stream Bank Protection
Recreation Management

TMDL SOURCES TREATED

Stream Erosion
Natural Sources

POLLUTANTS ADDRESSED

Sediments
Salinity
Nutrients & Organics
Habitat Alteration
Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Vertical Bundle

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS
Streamside

ASSOCIATED TMDL PRACTICES
Brush Revetment
Erosions Control Fabric
Fibeschines/Biologs
Post/Pole Planting
Seeding

PERMITTING REQUIREMENTS
None if installed by hand. If part of an extensive stream project or mechanical means are used, a permit under Sections 404 & 401 of the Clean Water Act may be required.

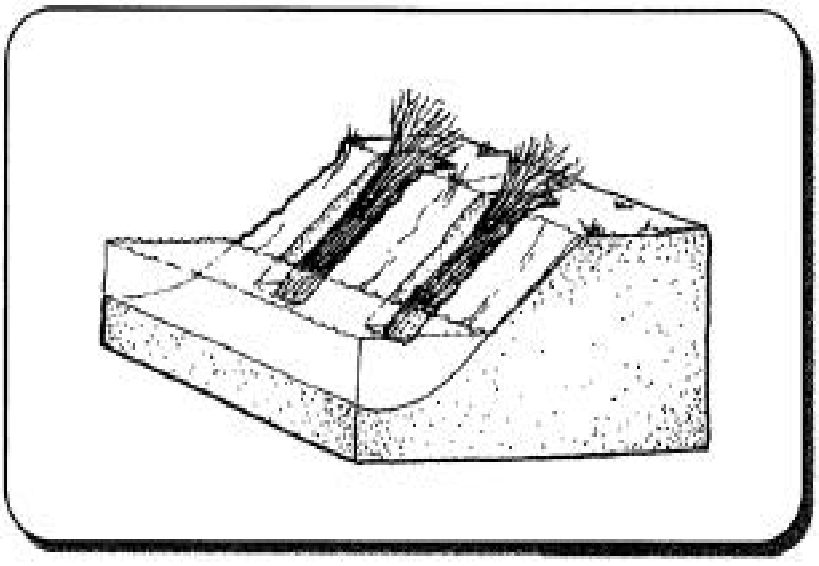
APPLICABLE NRCS/OTHER REFERENCES
Hoag, et al, 1998
NRCS -FOTG
580Streambank and Shoreline Protection

PLANNING CONSIDERATIONS
1. Coyote willow (Salix exigua) is a particularly good species for this method because of its dense root system. This technique can also be used with a mixture of redoiser dogwood (Cornus spp.) and willow, but to encourage dogwood rooting, the stems will need to be manually nicked or cut and treated with rooting hormone.

2. Some protection should always be placed in front of the bundles. In particular, the toe of the slope is very susceptible to erosive flows and scour. Analysis and calculations of forces will provide guidance for suitable toe protection. Careful attention must be given to both endpoints of the treatment to prevent flows from getting behind the bundles. Tying into existing features on site, such as trees, rocks, etc. or utilizing additional brush revetment are some possible solutions.

3. In areas where rip-rap is being placed, vertical willow bundles can be installed prior to placement of the rip-rap. Instead of installing a geotextile fabric on the streambank, pea gravel should be used. This will allow willow growth to protrude through the rip-rap.

4. Never disturb the site unnecessarily. Remember the goal is to stabilize a site. The less it is disturbed, the easier it will be to restore.



270 Waste Utilization

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

DESCRIPTION

Applying agricultural waste or other waste on the land in an environmentally acceptable manner while maintaining or improving the natural resources.

PURPOSE

·Protect water quality
·Provide fertility for crop, forage, fiber production and forest products
·Improve or maintain soil structure;
·Provide feedstock for livestock
·Provide a source of energy

PRACTICE CATEGORIES

Livestock Management
Cropland Management

TMDL SOURCES TREATED

Animal Feeding Operations
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments
Nutrients & Organics
Pesticides
Pathogens

LOAD REDUCTION POTENTIAL

◉ LOW ○ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

○ LOW ◉ MEDIUM ○ HIGH

Waste Utilization

TMDL Practice Sheet

LEVEL 200: ACTIVE MANAGEMENT

POTENTIAL TREATMENT AREAS

Agricultural Lands

ASSOCIATED TMDL PRACTICES

Cover Crops
Grazing Management
Irrigation Management
Nutrient Management

PERMITTING REQUIREMENTS

None

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
633 Waste Utilization
590 Nutrient Management

PLANNING CONSIDERATIONS

The effect of Waste Utilization on the water budget should be considered, particularly where a shallow ground water table is present or in areas prone to runoff. Limit waste application to the volume of liquid that can be stored in the root zone.

Minimize the impact of odors of land-applied wastes by making application at times when temperatures are cool and when wind direction is away from neighbors. Agricultural wastes contain pathogens and other disease-causing organisms. Wastes should be utilized in a manner that minimizes their disease potential.

Priority areas for land application of wastes should be on gentle slopes located as far as possible from waterways. When wastes are applied on more sloping land or land adjacent to waterways, other conservation practices should be installed to reduce the potential for offsite transport of waste.

It is preferable to apply wastes on pastures and hayland soon after cutting or grazing before re-growth has occurred.

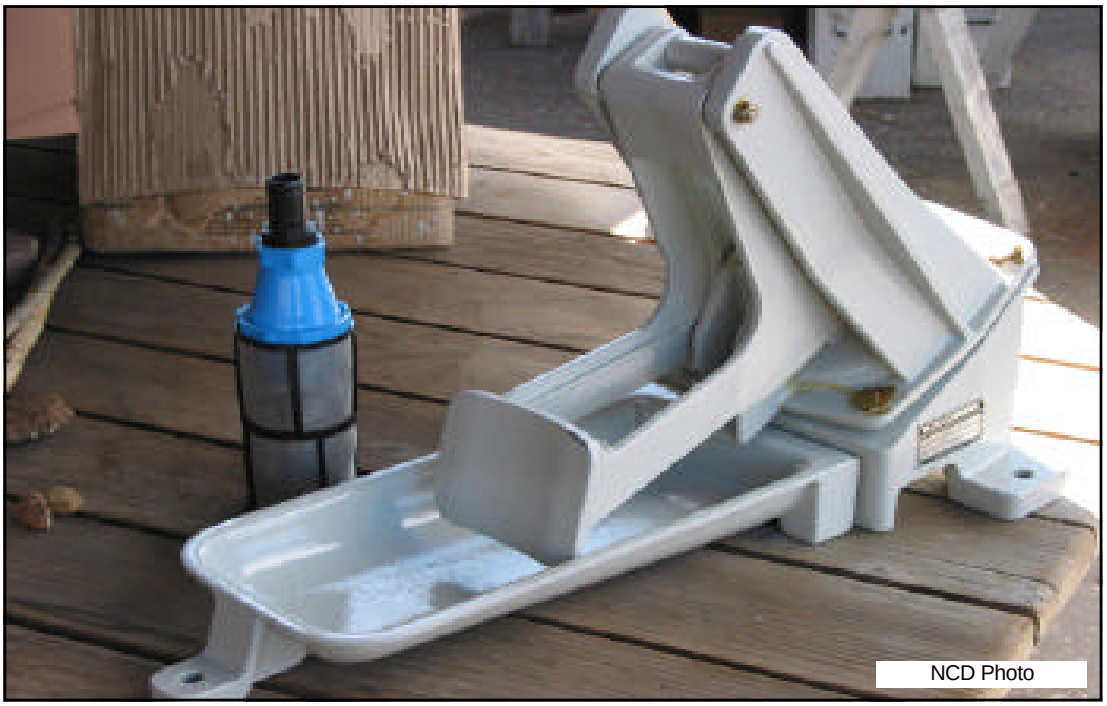
Reduce nitrogen volatilization losses associated with the land application of some waste by incorporation within 24 hours.

Minimize environmental impact of land-applied waste by limiting the quantity of waste applied to the rates determined using the practice standard Nutrient Management (590) for all waste utilization.

370 Watering Facility

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING



DESCRIPTION

A device (tank, trough, or other watertight container) for providing animal access to water. The nuzzle pump shown above provides clean, fresh water away from a stream using the livestocks own power to pump the water.

PURPOSE

Provide watering facilities for livestock and/or wildlife at selected locations in order to protect and enhance vegetative cover, provide erosion control through better grassland management, protect streams, ponds and water supplies from contamination by providing alternative access to water.

PRACTICE CATEGORIES

Livestock Management
Stream Bank Protection
Cropland Management

TMDL SOURCES TREATED

Stream Erosion
Agricultural Practices

POLLUTANTS ADDRESSED

Sediments	Nutrients & Organics
Salinity	Low Dissolved Oxygen
Pathogens	Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ◉ MEDIUM ○ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

◉ IMMEDIATE ○ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Watering Facility

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS

Agricultural Lands

ASSOCIATED TMDL PRACTICES

Fencing
Cross-Vane Weir Diversion
Grazing Management

PERMITTING REQUIREMENTS

None if installed away from streams and wetland areas.

APPLICABLE NRCS/OTHER REFERENCES

NRCS -FOTG
516Pipeline
614Water Facility

PLANNING CONSIDERATIONS

The purpose of a watering facility is to provide adequate water for livestock and/or wildlife while minimizing impacts to streambanks and other areas that produce sediments.

Water facilities should be located to minimize trail erosion and maximize forage.

Topography should be evaluated to minimize trail erosion and flooding erosion from tank overflow.

Watering facilities should be accessible to small animals. Escape ramps for birds and small animals should be installed.

Adequate protection for livestock from wind and snow/ rain during the winter and sun/heat during the summer should be considered.

The facility should allow for ice expansion without damage.

The facility should require the minimum maintenance possible.

305 Willow Fascines

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

DESCRIPTION

Willow wattles (Salix spp.) or live fascines are cigar or sausage-like bundles of live cuttings tied together and inserted into a shallow trench dug into the streambank.

PURPOSE

Reduce erosion on streambanks by reducing the force of water against a bank
The willow bundles will sprout and take root, thus stabilizing the streambank with a dense matrix of roots. This is a good technique to break up slope length and minimize erosion.

PRACTICE CATEGORIES

Stream Bank Protection

TMDL SOURCES TREATED

Stream Erosion
Natural Sources

POLLUTANTS ADDRESSED

Sediments
Salinity
Nutrients & Organics
Habitat Alteration
Water Temperature

LOAD REDUCTION POTENTIAL

○ LOW ○ MEDIUM ◉ HIGH

ESTIMATED TIME FOR LOAD REDUCTION

○ IMMEDIATE ◉ MONTHS-2 YEARS ○ > 2 YEARS

EXPECTED MAINTENANCE

◉ LOW ○ MEDIUM ○ HIGH

Willow Fascines

TMDL Practice Sheet

LEVEL 300: MILD ENGINEERING

POTENTIAL TREATMENT AREAS
Streamside

ASSOCIATED TMDL PRACTICES
Brush Mattress
Erosion Control Fabric
Vertical Bundles
Seeding
Tree Planting
Pole Planting

PERMITTING REQUIREMENTS
Generally none if installed by hand. If part of an extensive stream project or mechanical means are used, a permit under Sections 404 & 401 of the Clean Water Act may be required.

APPLICABLE NRCS/OTHER REFERENCES
Hoag, et al, 1998
NRCS-EFH-16

PLANNING CONSIDERATIONS
1. Coyote willow (Salix exigua) is a particularly good species for this method because of its' dense root system. This technique can also be used with a mixture of redoiser dogwood (Cornus spp) and willows. To encourage rooting in the dogwood, the stems need to be manually nicked or cut and treated with rooting hormone.

2. If this method is used in a highly erodible area, some protection should be placed in front of the wattles to prevent scour. Analysis and calculations of forces will provide guidance for suitable toe protection. In some cases, brush revetment or fiberschines may be adequate, while other situations may require rock. If no other protection is used, the wattle should be 12 to 24 inches in diameter.

3. Another variation of this technique is to cover the wattles with erosion control fabric to prevent the soil from being washed away from the wattles. Secure the fabric under the first wattle. Poles can be planted into the permanent water table between the wattles. The following illustration also shows the use of a rock toe to prevent scour.

4. Rooting hormones and fertilizers do not significantly improve success for the cost of the materials.

5. Never disturb the site unnecessarily. Remember the goal is to stabilize a site. The less it is disturbed, the easier it will be to restore.