# Management Practices

3

Management practices are implemented on agricultural lands for a variety of purposes, including protecting water resources, protecting terrestrial or aquatic wildlife habitat, and protecting the land resource from degradation by wind, salt, and toxic levels of metals. The primary focus of this guidance is on agricultural management practices that control the generation and delivery of pollutants into water resources or remediate or intercept pollutants before they enter water resources.

NRCS maintains a National Handbook of Conservation Practices (USDA–NRCS, 1977), updated continuously, which details nationally accepted management practices. These practices can be viewed at the USDA-NRCS web site at *www.nrcs.usda.gov/technical/efotg/*. In addition to the NRCS standards, many States use locally determined management practices that are not reflected in the NRCS handbook. Readers interested in obtaining information on management practices used in their area should contact their local Soil and Water Conservation District or local USDA office. Two very helpful handbooks for farmers in the Midwest are *60 Ways Farmers Can Protect Surface Water* (Hirschi et al., 1997), and *50 Ways Farmers Can Protect their Ground Water* (Hirschi et al., 1993).

## How Management Practices Work to Prevent Nonpoint Source Pollution

Management practices control the delivery of nonpoint source (NPS) pollutants to receiving water resources by

- ❐ minimizing pollutants available (source reduction);
- ❐ retarding the transport and/or delivery of pollutants, either by reducing water transported, and thus the amount of the pollutant transported, or through deposition of the pollutant; or
- ❐ remediating or intercepting the pollutant before or after it is delivered to the water resource through chemical or biological transformation.

Management practices can minimize the delivery and transport of agriculturally derived pollutants to surface and ground waters. Although a wide variety of BMPs are available, all require regular inspection and maintenance.

Management practices are generally designed to control a particular pollutant type from specific land uses. For example, conservation tillage is used to control erosion from irrigated or non-irrigated cropland. Management practices may also provide secondary benefits by controlling other pollutants, depending on how the pollutants are generated or transported. For example, practices which reduce erosion and sediment delivery often reduce phosphorus losses since phosphorus is strongly adsorbed to silt and clay particles. Thus, conservation tillage not only reduces erosion, but also reduces transport of particulate phosphorus.

In some cases, a management practice may provide environmental benefits beyond those linked to water quality. For example, riparian buffers, which reduce phosphorus and sediment delivery to water bodies, also serve as habitat for many species of birds and plants.

Control of surface transport may increase leaching of pollutants.

Sometimes, however, management practices used to control one pollutant may inadvertently increase the generation, transport, or delivery of another pollutant. Conservation tillage, because it creates increased soil porosity (i.e., large pore spaces), may increase nitrate leaching through the soil, particularly when the amount and timing of nitrogen application is not part of the management plan. Tile drains, used to reduce runoff and increase soil drainage, can also have the undesirable effect of concentrating and delivering nitrogen directly to streams (Hirschi et al., 1997). In order to reduce the nitrogen pollution caused by tile drains, other management practices, such as nutrient management for source reduction and biofilters that are attached to the outflow of the tile drains for interception, may be needed. On the other hand, practices which reduce runoff may contribute to reduced in-stream flows, which have the potential to adversely impact habitat. Therefore, management practices should only be chosen after a thorough evaluation of their potential impacts and side-effects.

## Water Quality Effects of USDA-NRCS Practices

USDA-NRCS conservation practices can be structural (e.g., Waste Treatment Lagoons; Terraces; Sediment Basins; or Fences) or agronomic (e.g., Prescribed Grazing; Nutrient Management; Pest Management; Residue Management; or Conservation Cover.) Not all USDA-NRCS conservation practices are applicable in all areas of the United States. When and where applicable, their effects on water quality may vary based on many factors. Some of these factors include climate, soils, topography, geology, existing cultural and management activities, as well as modifications made to the practice standards that govern how the practices are to be applied in local settings.

Guidance identifying expected effects of USDA-NRCS conservation practices has been prepared and is being kept up to date by discipline and resource specialist in each state. Technical guidance for water quality effects is found in the Conservation Practice Physical Effects (CPPE) documents in Section V of the NRCS Field Office Technical Guide (FOTG). Table 3-1 is a simplified table developed from the CPPE in the Oregon FOTG Section V. This table shows the kind of information available at the local level that can be used to help evaluate the effects of specific conservation practices. For example, in the area for which this guidance was prepared it has been determined that Contour Buffer Strips (NRCS Practice Code 332) can be expected to have beneficial effects on surface water quality, but because the practice increases infiltration it can be expected to have detrimental effects on ground water quality.

**Table 3-1. NRCS conservation practices, pollutants potentially controlled, and sources of pollutants (USDA-NRCS, 1977).**

| NRCS Code | RESOURCE CONCERNS / CONSERVATION PRACTICES | Ground Water | | | | | Surface Water | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pesticides | Nutrients & Organic | Salinity | Heavy Metals | Pathogens | Pesticides | Nutrients & Organic | Salinity | Heavy Metals | Pathogens | Temperature | Low Dissolved Oxygen | Suspended Sediments & Turbidity | Aquatic Habitat Suitability |
| 322 | Channel Vegetation | | | | B | B | B | B | B | B | B | B | | B | B |
| 327 | Conservation Cover | D | B | B | B | B | B | B | | B | B | B | B | B | B |
| 656 | Constructed Wetland | | | | | | B | B | B | B | B | | B | | B |
| 332 | Contour Buffer Strips | D | D | D | D | D | B | B | B | B | | | B | B | B |
| 342 | Critical Area Planting | D | B | B | B | B | B | B | B | B | B | B | B | B | B |
| 400 | Floodwater Diversion | B | B | | | | B | B | B | B | B | B | B | B | |
| 490 | Forest Site Preparation | | | | | | | D | | | | | D | D | D |
| 412 | Grassed Waterway | | | | | | B | B | | | | | B | B | B |
| 561 | Heavy Use Area Protection | | | | | | B | D | | | | | | B | |
| 422 | Hedgerow Planting | | | | | | B | B | | | B | | B | B | |
| 441 | Irrigation System - Micro | B | B | | B | B | B | B | | B | B | B | B | B | B |
| 442 | Irrigation System - Sprinkler | D | D | D | D | D | B | B | | B | B | B | B | B | B |
| 634 | Manure Transfer | | B | B | | | | B | B | | B | B | B | B | |
| 484 | Mulching | D | D | D | D | D | B | B | B | B | B | | B | B | |
| 590 | Nutrient Management | | B | B | B | B | | B | B | B | | | B | | B |
| 528A | Prescribed Grazing | | B | | | | B | B | | | B | B | | B | B |
| 344 | Residue Management, Seasonal | D | D | D | D | D | B | B | B | B | B | B | B | B | B |
| 391 | Riparian Forest Buffer | B | B | B | B | B | | B | B | B | B | B | | B | B |
| 350 | Sediment Basin | D | D | B | D | D | B | B | B | B | B | | | B | B |
| 351 | Well Decommissioning | B | B | B | B | B | | | | | | | | | |
| 657 | Wetland Restoration | | | | | | B | B | | | B | | B | B | B |

B - Beneficial effects expected
D - Detrimental effects expected
Blank - Not Rated

# Management Practice Systems

If multiple sources of a pollutant exist, more than one management practice system will be needed to provide effective control.

Water quality problems cannot usually be solved with one management practice because single practices do not typically provide the full range and extent of control needed at a site. Multiple practices are combined to build *management practice systems* that address treatment needs associated with pollutant generation from one or more sources, transport, and remediation. Management practice systems are generally more effective in controlling the pollutant since they can be used at two or more points in the pollutant delivery process. For example, the objective of many agricultural NPS pollution projects is to reduce the delivery of soil from cropland to water bodies. A system of management practices can be designed to reduce soil detachment, erosion potential, and off-site transport of eroded soil. Such a system could include conservation tillage to reduce soil detachment and cropland erosion. Grassed waterways could be included to carry concentrated flows from the fields in a non-erosive manner, while filter strips might be used to filter sediment from water leaving the field in shallow, uniform flow (Hirschi et al., 1997). Sediment retention basins could be added to trap sediment and runoff from the farm if other practices failed to provide the level of control needed.

Similarly, if nitrogen is the pollutant of concern, nutrient management can be used to minimize the availability of nitrogen for transport from cropland. This can be achieved by matching the application rate with crop needs, based upon soil testing, analysis of nutrient sources, and realistic yield expectations. Proper timing of nutrient application will also reduce nitrogen availability since the time frame over which the applied nitrogen is available but not used by the crop is minimized. Conservation tillage can help reduce overland transport of nitrogen by reducing erosion and runoff, and nutrient management will minimize subsurface losses due to the resulting increased infiltration. Filter strips can be used to decrease nitrogen transport by increasing infiltration, and through uptake of available nitrogen by the field border crop. Nitrogen not controlled by nutrient management, conservation tillage, and filter strips can be intercepted and remediated through denitrification in riparian buffers.

A set of practices does not constitute an effective management practice system unless the practices are selected and designed to function together to achieve water quality goals reliably and efficiently. In the Oregon RCWP project (see Chapter 1 for a discussion of RCWP), dairy farmers installed animal waste management systems to reduce fecal coliform runoff into an important shellfish-producing estuary. Although 12 practices (waste storage, guttering, dike, drains, etc.) initially comprised the animal waste management systems, these systems were not as effective as needed because the practices addressed manure storage but not land application of the manure. Utilization of manure was added as a practice which enabled implementation of complete management practice systems that successfully addressed the need for managing land application to achieve water quality goals (Gale et al., 1993).

## Types of Management Practice Systems

Management practice systems can be separated into three categories:

- ❒ repetitive treatment,

- necessary diversification, or
- a combination of the first two.

Systems that combine individual management practices to treat a pollutant at different points in the pollutant delivery process achieve management objectives through repetitive treatment. The above examples for sediment and nitrogen control both employ repetitive treatment. Conservation tillage, grassed waterways, field borders, and sediment retention basins control soil particles and runoff at various stages in the pollutant delivery process. Nutrient management, conservation tillage, field borders, and riparian buffers provide similar repetitive treatment to control nitrogen losses in the second example.

In some cases a management practice cannot be used without an accompanying practice. For example, if it is necessary to install fence to keep cows from a stream, watering devices may be needed to provide drinking water for the cows. This is an example of necessary diversification.

Some management practice systems include both treatment redundancy and necessary diversification. An example of such a system is an animal waste management system in which some components are included to help others function. For example, diversions and subsurface drains may be necessary to convey runoff and wastes to a waste treatment lagoon for treatment. While the diversions and subsurface drains may not provide any measurable pollution control of their own, they are essential to the overall performance of the animal waste management system. Other components, such as lagoons and waste utilization plans, are added to provide repetitive treatment.

## Site-Specific Design of Management Practice Systems

There is no single, *ideal* management practice system for controlling a particular pollutant in all situations. Rather, the system should be designed based on the type of pollutant; the source of the pollutant; the cause of the pollution at the source; the agricultural, climatic, and environmental conditions; the pollution reduction goals; the economic situation of the farm operator; the experience of the system designers; and the willingness and ability of the producer to implement and maintain the practices. The relative importance of these and other factors will vary depending upon other considerations such as whether the implementation is voluntary (e.g., State cost-sharing program) or mandatory (e.g., discharge permits).

An example of site-specific design of management practice systems can be found in the Rural Clean Water Program (RCWP) which was discussed in Chapter 1. A similar water quality problem existed in RCWP projects conducted in Utah and Florida (Gale et al., 1993). In both projects, eutrophication was caused partly by excess phosphorus contained in dairy runoff. Animal waste management systems were installed in both projects. In the Florida project, seven individual management practices (referred to as “BMPs” in the RCWP) were needed to control the animal manure in barnyard areas, whereas only five BMPs were needed in Utah (Table 3-2). Some BMPs were used in both projects, while other BMPs were used in one but not both projects. Differences existed because the regions in which the two projects were located have significantly different climatic, ecological, and soil characteristics, requiring different approaches to mitigate animal waste problems. In Florida, annual rainfall is approximately 50 inches per year, whereas annual

**Table 3-2. Animal waste management BMP systems used in two agricultural pollution control projects (Utah and Florida).**

| NRCS Code | Individual Animal Waste Management BMPs | UT | FL |
|---|---|---|---|
| 312 | Waste Management System | ** | ** |
| 313 | Waste Storage Structure | ** | ** |
| 356 | Dike | | ** |
| 362 | Diversion | ** | ** |
| 425 | Waste Stirage Pond | ** | ** |
| 428 | Concrete Lining | | ** |
| | | | |
| 633 | Waste Utilization | ** | |

NRCS = Natural Resources Conservation Service, U.S. Department of Agriculture
Source for NRCS codes: USDA—NRCS, 1977

precipitation in Utah is approximately 16 inches per year. Surface water is largely derived from snowmelt in Utah. Dikes were used in the Florida project to prevent runoff and phosphorus from entering the drainage ditches. These dikes were not needed in Utah due to the lower rainfall producing less runoff.

## Practices Must Fit Together for Systems to Perform Effectively

Each practice in a management practice system must be selected, designed, implemented, and maintained in accordance with site-specific considerations to ensure that the practices function together to achieve the overall management goals. If, for example, nutrient management, conservation tillage, filter strips, and riparian buffers are used to address a nitrogen problem, then planting and nutrient applications need to be conducted in a manner consistent with conservation tillage goals and practices (e.g., injecting rather than broadcasting and incorporating fertilizer). In addition, runoff from the fields must be conveyed evenly to the filter strips which, in turn, must be capable of delivering the runoff to the riparian buffers in accordance with design standards and specifications.