

CHAPTER 6

AGRICULTURAL RUNOFF

Introduction

Controlling non-point sources of water pollution will be necessary to meet the goals of the Clean Water Act. Sediment and associated nutrients from agricultural cropland have been identified as the greatest non-point source sediment and nutrient loading to Lake Erie from the TMACOG region.

The requirements for agricultural pollution abatement under the Areawide Water Quality Management Plan are addressed in this chapter. They include:

1. The designation of management agencies with responsibilities to implement agricultural Best Management Practices (BMPs).
2. The identification and prioritization of critical agricultural non-point source water quality problem areas.
3. Selection of BMPs best suited to individual watersheds and counties.
4. The development of operational programs including costs and schedules for action.

Chapter III Water Quality Management Framework identifies Designated Management Agencies (DMAs) for agricultural runoff, at the state, federal, and local levels. The Soil and Water Conservation Districts are DMAs for their respective counties. This provision follows the Ohio Agricultural Pollution Abatement Program pursuant to Section 1515 of the Ohio Revised Code and a similar Michigan program.

The priority areas, Best Management Practices, and operational programs are all addressed in this chapter.

Areawide Issues

Phosphorus has been identified as the principal limiting nutrient in the eutrophication of Lake Erie and other area streams. Eutrophication is a natural aging process generally describing the fertility (mainly aquatic plant productivity) of lakes. Over time, a lake will become filled with sediment and organic materials from streams draining its watershed. On a geological time scale, all lakes will presumably cease to exist because of this natural process. However, man's activities can alter natural processes and accelerate this extinction process to a human, rather than a geological time scale. This phenomenon is "cultural eutrophication" as opposed to the natural aging process.

Cultural eutrophication is caused by an excessive load of nutrients (usually phosphorus). These nutrients can produce nuisance growths of algae and higher aquatic plants. While some lakes are naturally eutrophic, excessive nutrient loads that induce eutrophication usually result from human activity.

The U.S. Army Corp of Engineers Lake Erie Wastewater Management Study (1979) concluded that if point source discharges met a 1.0 mg/1 phosphorus limit, a further reduction of 46.5% of the non-point sources would be necessary to restore Lake Erie from its eutrophic state. Specifically, these estimates were based on improving the Western and Central Basins of Lake Erie to a meso-trophic condition, meaning that lake fertility levels are classified as moderate.

TOTAL PHOSPHORUS MASS TRANSPORT - 1975¹

	Total Transport Tons Per Year	Point Source Input Total Tons Per Year	Non-Point Transport Tons Per Year
Maumee River Basin above Waterville, Ohio	2,685	432 ²	2,253
Portage River Basin above Woodville, Ohio	129	49 ³	80
Sandusky River Basin above Fremont, Ohio	405	31 ⁴	374

The fine-textured silt and clay soils found in northwestern Ohio and southeastern Michigan are easily displaced and washed away by the rain. The soil loss rates are not high at about 1 ton/acres per year. However, the drainage areas are large, especially the Maumee, which is the largest Great Lakes tributary.

River Basin	Drainage Area (Square Miles)⁵
Maumee	6,608
Portage	581
Sandusky	1,420

The increased use of conservation tillage was found to correspond to decreases in suspended-sediment discharge over time at two locations in the Maumee River Basin.⁶ A 49.8 percent decrease in suspended-sediment discharge was detected when data from 1970–74 were compared to data from 1996–98 for the Auglaize River near Ft. Jennings, Ohio. A decrease in suspended-sediment discharge of 11.2 percent was detected from 1970–98 for the Maumee River at Waterville, Ohio.

Heidelberg College Water Quality Laboratory has provided long-term gauging and water quality sampling for several Lake Erie tributaries. Since the mid 1970s. Discharges from the rivers of sediment and nutrient can vary widely from year to year, depending on the amount and severity of rainfall. Consistent monitoring over a long period of time is necessary to show whether sediment and nutrient loads are increasing or decreasing. The table below gives a trend summary for four primarily agricultural watersheds. The parameters are TSS: Total Suspended Solids, TP: Total Phosphorus, SRP: Soluble Reactive Phosphorus, NO₃: nitrate, and TKN: Total Kjeldahl Nitrogen. The Maumee River station is at Waterville, and the Sandusky River station is at the Tindall Bridge upstream of Fremont.⁷

¹ *Lake Erie Wastewater Management Study* – converted from metric tons

² *Maumee Level "B" Study*, GLBC, 1976

³ TMACOG 208 Study, 1976

⁴ Heidelberg College Water Quality Laboratory Data, 1976

⁵ *Lake Erie Wastewater Management Study, Volume 1L: Main Report*; Table I-1

⁶ *Status and Trends in Suspended-Sediment Discharges, Soil Erosion, and Conservation Tillage in the Maumee River Basin—Ohio, Michigan, and Indiana U.S. Department of the Interior U.S. Geological Survey* Water-Resources Investigations Report 00-4091, 2000

⁷ *Trends in Water Quality in LEASEQ Rivers and Streams (Northwestern Ohio), 1975-1995*, Heidelberg College Water Quality Laboratory, R. Peter Richards and David B. Baker

River	Flow	Parameter				
		TSS	TP	SRP	NO3	TKN
Maumee R.	9.2	-18.1 *	-41.6 *****	-84.5 *****	21.3	-28.4 *****
Sandusky R.	6.7	-27.2 *****	-46.3 *****	-87.9 *****	12.0	-21.0 *****
Honey Cr.	-16.7	-2.5	-28.7 *****	-78.5 *****	45.9 *****	-14.2 **
Rock Cr.	-30.5 *	-37.2 *****	-41.4 *****	-54.8 *****	-36.9 **	-40.6 *****

Percent change from 1975 to 1995, estimated as described in the text. Negative numbers corresponding to decreasing concentrations, positive numbers to increasing concentrations. Significance levels are based on t-values adjusted for autocorrelation. *: p<.05, **: p<.01, ***: p<.001, ****: p<.0001.

* Percent change during 1983 to 1995 only, reflecting the shorter period of record for Rock Creek

Heidelberg College's data for sediment and nutrients at the four stations from 1975-1995 generally shows decreases in sediment and phosphorus loads, but increases in nitrates. The inference is that farming conservation practice changes over those 20 years reduced sediment loads (and phosphorus as well, because phosphorus tends to attach to fine soil particles). Conservation practice changes, however, have not similarly reduced nitrate loadings; nitrates are soluble, and are carried more by water flow than sediment. Use of tile drainage may increase loadings of soluble nitrates to the rivers. It should be noted, however, that the data, especially for nitrates, is highly variable and dependent on weather. The changes in nitrate concentrations may not be statistically significant.

Phosphorus Reduction Strategies

The Lake Erie Phosphorus Reduction Strategy is based on nutrient reductions needed for the lake's recovery. The strategy⁸ notes that phosphorus loading to the lake from municipal sewage treatment plants fell from 11900 metric tons to 4500 metric tons from 1970 to 1980. the Strategy incorporates lake-wide phosphorus reduction targets⁹

State	1982 Phosphorus Load to Lake Erie in Metric Tons/year	Phosphorus Reduction Target by 1998, Metric Tons/Year
Ohio	5,617	1,365
Michigan	1,525	185
Indiana	600	90
Pennsylvania	135	20
New York	250	40
Total	8,127	1,700

The Strategy then breaks Ohio phosphorus loadings down by watershed and type of source:

Tributary	Point Source Phosphorus, metric tons/year	Non-Point Source Phosphorus, metric tons/year	Total Phosphorus, metric tons/year
Ottawa	0	74.2	74.20
Maumee (74% of GLNPO estimate)	222.5	2,113.3	2,335.80
Portage & Toussaint	13.7	535.1	548.80
Sandusky	44.1	711.4	755.50
Huron & Vermilion	40.4	455.4	495.80

⁸ State of Ohio Water Quality Management Plan Phosphorus Reduction Strategy for Lake Erie, Ohio EPA June 1985

⁹ US EPA Great Lakes National Program Office, 1984

Black & Rocky	158.0	206.5	364.50
Cuyahoga	590.2	224.3	814.50
Chagrin	73.7	39.2	112.90
Grand	27.1	71.4	98.50
Ashtabula & Conneaut (54% of GLNPO estimate)	4.2	12.1	16.30
Total	1,173.90	4,442.90	5,616.80

Phosphorus is a major cause of eutrophication, but it is transported by sediment that is a pollutant in its own right. Sediment is the most prevalent non-point source pollutant by volume. Studies show that erosion rate from urban land is about ten times greater than on land in cultivated row crops. Because the great majority of the region's land use is agricultural, erosion from cropland poses a major pollution problem. Farming lays bare great expanses of soil that remain exposed to wind and rain for months, sometimes during periods of heavy rain. The Ohio phosphorus reduction goals set target reductions for each county.¹⁰

County	Agricultural Phosphorus Reduction Target from 1982 baseline, metric tons/year	Urban Phosphorus Reduction Target	Total Phosphorus Reduction Target
Lucas	17.3	19.2	36.50
Ottawa	21.0	4.2	25.20
Sandusky	38.3	3.3	41.60
Wood	69.6	7.4	77.00
Total	146.20	34.10	180.30

Progress toward achieving these agricultural phosphorus reduction goals has been substantial. NRCS tracked reductions for each Lake Erie county in Ohio through 1997. For the entire Lake Erie basin, 49% of the agricultural phosphorus reduction target had been met by 1997; four of the TMACOG counties reached substantially higher reductions. Agricultural phosphorus reductions through 1997 are given below.¹¹

County	Agricultural Phosphorus reduction through 1997 (pounds)	Agricultural Phosphorus reduction target (pounds)	Percent of Goal
Lucas	29,567	38,060	Zero Divide
Monroe			
Ottawa	27,742	46,200	76.31%
Sandusky	64,296	84,260	71.49%
Wood	109,467	153,120	71.84%
Totals	231,072	321,640	71.84%

The Ohio Lake Erie Buffer Team, a coalition of conservation agencies whose goal is to encourage landowners to put conservation buffers into practice and help meet agricultural phosphorus and sediment reduction targets. In particular, the team has made a concerted effort to use cost share conservation buffer programs (described later in this chapter). Continued use and expansion of

¹⁰ *Phosphorus Reduction Goals by County*. USDA Soil Conservation Service 1990?? I think we got this either from Steve Davis or Diana Holt. What is the precise citation??

¹¹ USDA NRCS, 1997

conservation buffers will bring the counties still closer to their agricultural phosphorus reduction targets than they were in 1997. The acres put into conservation buffers since 1997 are given in the following table.¹²

County	Continuous CRP Acres	CREP Acres	319 Watershed Project Acres	Wetland Reserve Acres	Total Agricultural Conservation Buffer Acres
Lucas	119.4	29	0	0	148.40
Ottawa	242.7	93	186.7	636.8	1,159.20
Sandusky	610.0	100	7.55	0	717.55
Wood	2,203.6	649	71.4	56	2,980.00
Total	3,175.70	871.00	584.65	692.80	5,324.15

Water Quality Impact of Suspended Sediment

1. Increased levels of suspended solids (sediment) increase the cost of treating water supplies.
2. Suspended sediment lessens the aesthetic appeal of water. It can affect the appearance of a body of water for recreational purposes along with affecting the odor and taste of public water supplies.
3. It increases wear of various types of machinery, such as pump motors.
4. Excessive quantities of suspended sediment reduce light penetration, reducing photosynthesis.
5. It reduces the visibility for the sight feeding of fish and the fisherman's ability to catch fish.
6. It is a safety hazard for boaters, swimmers, and water skiers by reducing visibility in the water.

Water Quality Impact of Deposited Sediment

1. When deposited in reservoirs, it depletes the storage capacity.
2. Sediment creates shallow water areas that will support nuisance vegetation and detract from the beauty of a lake.
3. It impairs biological systems by covering bottom spawning and feeding areas of fish. In addition, it reduces the productivity of many macroinvertebrate species that are food for fish.
4. Deposited sediment fills ditches, which impairs drainage. The results include lower crop yields, safety hazards, and possible property damage.
5. When sediment is deposited in streams and channels, it can increase flood damage by reducing drainage capacity.
6. It causes navigation problems in rivers and harbors. Many of the region's harbors and rivers require periodic, costly dredging. Toledo Harbor requires dredging annually.

In agricultural runoff, two of the principal pollutants (sediment and phosphorus) may be controlled through the same BMPs because phosphorus tends to attach to silt and clay soil particles.

Nitrate Impacts on Water Quality

Nitrogen is an essential plant nutrient and is applied to cropland as a fertilizer. Nitrogen is also a nutrient for aquatic plants although it is less of a limiting factor than phosphorus, and therefore, has

¹² USDA NRCS, 2001 with data through 4/13/2001

not received the same level of attention in water quality control strategies. The concentrations of nitrate nitrogen increase during runoff events. However, nitrates are soluble and are carried to streams with runoff rather than adsorbed to sediment as is phosphorus. Tile drains are a pathway for nitrates to reach streams.

The drinking water standard for nitrate is 10 mg/l. Concentrations above that level are common in Lake Erie tributaries, especially following storm events. Nitrate is a concern for drinking water supplies. Water utilities are required to issue health advisories when nitrate levels exceed the standard of 10 ppm. The Nebraska Cooperative Extension summarizes its health effects:

"Nitrate is relatively non-toxic substance that occurs naturally as part of the nitrogen cycle. However, nitrate can be converted readily by bacteria into nitrite. This occurs in the environment, in foods, and in the human mouth and gastrointestinal tract. Once nitrogen is converted into nitrate it can have harmful health effects. For example, high nitrates in drinking water can cause methemoglobinemia resulting from the reaction of nitrites with hemoglobin in red blood cells affecting the ability of the blood to carry sufficient oxygen to individual cells of the body".¹⁵

Methemoglobinemia is also known as "blue baby syndrome." Infants are the most susceptible to nitrates, and are advised not to drink public water under health advisories.

Heidelberg College Water Quality Laboratory has summarized nutrient trends in Lake Erie watersheds for the period of 1975-1995.

"The science of nutrient management has advanced greatly during the study period. An evolution in perspective from fertilizer applications designed to build fertility levels to those aimed at maintenance, proper credits for nutrients applied in manures, precision application of fertilizers, and yield monitoring are all aspects of nutrient management that have matured substantially and come into widespread application during the study period. In addition, heightened awareness of environmental issues has strengthened incentives to use nutrients efficiently. These developments have undoubtedly been major causes of the trends in nutrient use detailed in the following paragraphs.

"Sales of fertilizer increased in the early part of the study period, reached a peak about 1980, and have declined since then. This pattern appears to reflect a change in attitude about fertilization. In the 1970s, the prevailing view about fertilizer was "more is better". In the early 1980s, this view began to change, as fertilizer prices increased and as soil tests revealed that many fields already contained as many nutrients as crops could utilize. In the Maumee watershed, sales of fertilizer phosphorus decreased 22% between 1971 and 1995, and 37% relative to their peak level in 1979. Fertilizer nitrogen sales have increased 25% relative to their level in 1971, but decreased 28% relative to their peak in 1981 (Figure 8). In the Sandusky watershed, fertilizer phosphorus sales decreased 17% between 1971 and 1995, and 25% relative to their peak in 1979. Fertilizer nitrogen sales are anomalous: the data document a steady increase during the study period, amounting to 46%. The reason for this continued and substantial increase is not apparent, though we note that the land area planted in corn has increased slightly in the Sandusky watershed while decreasing in the Maumee watershed. In addition, nitrogen from application of manure has decreased more sharply in the Sandusky watershed than in the Maumee (see below), perhaps requiring an increase in fertilizer nitrogen to compensate.

¹⁵ Well Water, Nitrates and the "Blue Baby" Syndrome /Methemoglobinemia, Nebraska Cooperative Extension NF91-49

“Row-crop agriculture has dominated the area during the period of study, and animal agriculture has been less important. Animal populations declined between 1975 and 1995, particularly those of cattle, dairy cows, and sheep. Consequently, production of animal manures and their associated nutrients also decreased. In the Maumee watershed, phosphorus associated with manure decreased by 17%, and nitrogen by 22%. In the Sandusky watershed, the decreases are larger: 34% and 37% respectively.

“Assuming that all manure produced and all fertilizer sold were applied to crops in the watershed, manure accounted for 24% of the phosphorus and 22% of the nitrogen applied in the Maumee basin, on average during the study period, and 20% of the phosphorus and 18% of the nitrogen applied in the Sandusky watershed. Phosphorus from fertilizer and manure decreased by 30% in the Maumee watershed and by 19% in the Sandusky over the period 1975-1995. Nitrogen from fertilizer and nutrients decreased by 8% in the Maumee watershed but increased by 10% in the Sandusky watershed.”¹⁴

Baseline Studies

Pollution From Land Use Activities (PLUARG)

The Canada-United States Agreement on Great Lakes Water Quality signed in 1972 requested the International Joint Commission (IJC) to conduct a study of pollution of the boundary waters of the Great Lakes system from agricultural, forestry and other land use activities. The International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG), fulfilled this charge.

Eutrophication, due to elevated nutrient inputs, particularly in the lower lakes (Erie and Ontario), and the increasing contamination of these water bodies by toxic substances, were identified as the major pollution problems in the basin. PLUARG concluded that the eutrophic condition of Lake Erie could not be caused by point source pollutants. PLUARG findings included:

1. The Great Lakes are being polluted from land drainage sources by phosphorus, sediments, some industrial organic compounds, previously used pesticides and potentially some heavy metals.
2. The lakes most affected by phosphorus and toxic substances are Erie and Ontario.
3. Intensive agricultural is the largest contributor of phosphorus.
4. Erosion from crop production on fine textured soils and from disturbed soil in urbanizing areas was the main sources of sediment.

PLUARG issued recommendations for agricultural non-point sources¹⁵. More recent studies have added the last two recommendations:

- Development of Management Plans
- Control of Phosphorus
- Control of Sediment
- Agricultural Land Use to help farmers develop and implement water quality plans
- Control of Nitrates
- Animal Waste Management

Lake Erie Wastewater Management Study (LEWMS)

The Lake Erie Wastewater Management Study (LEWMS) was conducted by U.S. Army Corps of Engineers in 1979. It studied the water quality conditions of Lake Erie and the development of a

¹⁴ *Trends in Agriculture in the LEASEQ Watersheds, 1975-1995*, R. Peter Richards* and David B. Baker Water Quality Laboratory

¹⁵ *Environmental Management Strategy for the Great Lakes System*, IJC.

wastewater management program to improve and rehabilitate the water quality of Lake Erie. The Study identified non-point sources of pollution as a problem that must be solved in order to achieve water quality improvement in Lake Erie. It devoted special attention to the reduction of agricultural runoff pollution. Its conclusions include:¹⁶

- The bulk of the phosphorus from non-point and point sources reached Lake Erie in association with suspended sediment transported during storm events.
- The biological availability of sediment bound phosphorus varied considerably with flow and between river basins.
- Reducing gross erosion would reduce phosphorus loads to Lake Erie.
- Non-point source phosphorus is derived principally from agricultural land use, particularly crop production.
- Adoption of conservation tillage and no-till practices appeared to be an economically feasible method of reducing potential erosion in the Lake Erie Basin.
- A maximum rural non-point source phosphorus reduction of 4,100 to 5,100 MT/yr would result if the maximum reduced tillage scenario were achieved and erosion reduction were 90% effective in reducing phosphorus.
- Tillage practices other than conservation tillage and no-till were shown to be unable to achieve significant erosion reductions.
- In addition to conservation tillage and no-till practices, other controls of sediments and phosphorus must be appropriately applied. These controls include animal waste management, gully erosion control via waterways and structures, and farm conservation plans.
- An education and technical assistance program is needed to accelerate the adoption of conservation tillage, no-till, and other cost effective Best Management Practices.
- The environmental benefits of erosion control extend well beyond a reduction in phosphorus.

Other Lake Erie Basin wide benefits resulting from sediment reductions include: reduced sedimentation and reduced dredging costs in Lake Erie harbors, lower water treatment costs for sediment removal from domestic water supplies, less movement and transport of other sediment attached pollutants such as insecticides and herbicides, and reduced in-stream sedimentation which benefits the fishery resources. In addition, BMPs that help prevent sedimentation also improve aquatic habitat, such as riparian buffer zones.

TMACOG 208 Studies

For the 1980 *Areawide Water Quality Management Plan*, TMACOG developed information on the sources of agricultural non-point source pollution to provide target phosphorus reductions to achieve sediment and phosphorus goals.

The goal for phosphorus loading to Lake Erie was 11,000 MT/yr. In order to achieve this goal, the Lake Erie Wastewater Management Study calculated that there must be a 46.5% reduction in non-point phosphorus.

¹⁶ *Lake Erie Wastewater Management Study Methodology Report*, U.S. Army Corps of Engineers, March 1979.

TMACOG prepared an evaluation of tillage practices that would be required to achieve this reduction. Phosphorus loading could be reduced if conservation till or no-till were applied to all suitable soils:

- by 31% if conservation tillage practices were 60% effective; or
- by 46.6% if conservation tillage practices were 90% effective.

It is not likely that all suitable soils will be farmed with conservation tillage, but other factors may help assist the region meet phosphorus load reductions.

- Only agricultural runoff was considered, and much sediment and associated nutrients can be reduced through certain runoff controls.
- Only reductions achievable through conservation tillage practices were accounted for and additional reductions can be achieved through other Best Management Practices.
- Reductions in sheet erosion attributed to minimum tillage practices were conservative it was anticipated in 1980 that new conservation tillage equipment would achieve higher rates of sediment reduction.

Areawide Policies

The previous sections have defined the nature of the problems of agricultural pollution and the recommended reductions deemed necessary by various studies of the problem. This section lists the policy statements developed by TMACOG to solve their problems.

POLICY 1 The Soil and Water Conservation Districts shall be responsible for programs of agricultural pollution abatement pursuant to Chapter 1515 of the Ohio Revised Code.

POLICY 2 The *Areawide Water Quality Management Plan* shall include a compilation of Best Management Practices for the TMACOG area. Each County Soil and Water Conservation District (SWCD) shall be responsible for its own list of acceptable BMPs. Each County BMP list is herewith incorporated by reference as part of the *Areawide Water Quality Management Plan*.

POLICY 3 Each County SWCD shall:

1. Assist in implementation of agricultural pollution abatement in the areas of sediment, erosion, and animal waste control by providing technical assistance to landowners, following standards developed by the Ohio DNR Division of Soil and Water, the Michigan Department of Natural Resources (MDNR), and USDA Natural Resources Conservation Service (NRCS).
2. Implement of the *Areawide Water Quality Management Plan* by:
 - a. Conducting agricultural education programs to encourage use of BMPs.
 - b. Support legislation essential to agricultural pollution abatement.
 - c. Work with other SWCDs and local agencies through the Maumee RAP, Portage River Basin Council, and Sandusky River Watershed Coalition to develop BMP demonstration and implementation projects.
 - d. Pursue funding from conservation programs including small watershed protection and cost-sharing for BMPs.

POLICY 4 The *Areawide Water Quality Management Plan* recommends the following principles for agricultural pollution control:

1. Water quality problems resulting from erosion of soil particles and agricultural chemicals adsorbed to them should be controlled through implementation of the policies, rules, and BMPs of Federal, State, and local Management Agencies described below and incorporated by reference as part of this Plan.
2. The BMPs recommended in this Chapter are practices that should be considered. Each County SWCD should select practices best suited to each area based on local conditions.
3. Use of BMPs should be encouraged through outreach and educational programs, technical assistance to farmers, and voluntary conservation incentives.

Implementation Programs and Agency Responsibilities

Federal, State, and county agencies have well-established roles and working relationships with agricultural conservation programs. Generally, agencies use a voluntary approach with technical assistance, incentives, and cost-sharing to encourage use of agricultural BMPs. A variety of agencies and organizations have cooperative roles in promoting BMPs at the following levels: federal, state, regional, county, watershed councils, and agricultural university extension programs.

- **USDA, US Department of Agriculture**

USDA provides technical assistance and funding through two agencies: Farm Services Agency (FSA), and the Natural Resources Conservation Service (NRCS)

- **US EPA**

Responsible for regulations to implement the Clean Water Act including NPDES permits where applicable. Provides non-point source grant funding.

- **Ohio EPA, Ohio Department of Agriculture, Michigan DEQ, and Michigan Department of Agriculture**

Ohio EPA, Ohio Department of Agriculture, and MDEQ are responsible for agricultural technical assistance and regulation at the state level from US EPA requirements. Regulatory oversight includes Animal Feeding Operations (AFFs), also known as Animal Feeding Operations (AFOs), and issuing Permits to Install and NPDES permits for point source discharges where applicable. MDEQ and OEPA are responsible for US EPA non-point source grants at the state level, in cooperation with other state agencies. In Ohio, the Department of Agriculture issues Permits to Install and Permits to Operate for all livestock facilities over 1,000 animal units. In Ohio legislation has been passed to move responsibility for NPDES permits for livestock facilities that discharge and NPDES stormwater construction general permits from Ohio EPA to Ohio Department of Agriculture. The transition will be complete upon approval by US EPA, which is pending.

In Ohio, Revised Code requires the Director of Agriculture to deny an application for a NPDES permit if the proposed discharge or source would conflict with an areawide waste treatment management plan adopted in accordance with section 208 of the Federal Water Pollution Control Act.¹⁷ This provision applies only to agricultural facilities that require Permits to Install from ODA:

- Animal Feeding Operations that have a wastewater discharge and have less than 1,000 animal units
- Confined Animal Feeding Operations with 1,000 or more animal units regardless of whether they have a discharge.

¹⁷ Ohio Revised Code §903.08(E)(3)

This Plan recommends no provisions beyond current law and regulation.

The Michigan Department of Agriculture develops and adopts Generally Accepted Agricultural and Management Practices (GAAMPs) for farms and farm operations. These voluntary practices are based on available technology and scientific research to promote sound environmental stewardship and help maintain a farmer's right to farm.¹⁸ The GAAMPs cover five specific areas of production agriculture, including:

- Manure Management/Utilization
- Pesticide Utilization/Pest Control
- Nutrient Utilization
- Care of Farm Animals
- Cranberry Production

GAAMPs are used by USDA in Michigan to target cost share funds. This Plan incorporates the first three categories by reference, related to manure management, pesticide use, and nutrient use.

- **Ohio DNR and Michigan DNR**

The natural resources agencies provide technical assistance and funding to the SWCDs/SCDs and coordinate programs to promote conservation and habitat.

Rules 1501:15-5-01 to 1501:15-5-18 of the Administrative Code establish state standards for a level of management and conservation practices in farming, silvicultural operations and concentrated animal feeding operations on farms in order to abate excessive soil erosion or the pollution of waters of the state by soil sediment including pollutants attached to the sediment and animal waste. These rules further define Ohio's pollution abatement grant program for landowners or operators to voluntarily install conservation practices.¹⁹ The Ohio DNR Division of Soil and Water Conservation is responsible for administering these rules and programs.

Agricultural pollution complaints must be filed with the Chief of the Ohio DNR Division of Soil and Water Conservation in writing.²⁰ The Chief of the Division may issue abatement orders where a violation exists. Failure to comply with orders is a misdemeanor of the first degree.²¹

Ohio DNR, through its Coast Management Program, submitted its *Ohio Coastal Nonpoint Pollution Control Program Plan* to NOAA in September 2000. The *Areawide Water Quality Management Plan* supports the goals and recommendations of that document; and recommends its Chapter 3 as source of information on agricultural programs, legislation, and agency management responsibilities, as well as incorporation of the agricultural "management measures" into local, regional and state policy.²²

- **Lucas, Ottawa, Sandusky, and Wood County SWCDs; Monroe County SCD**

The Soil and Water Conservation Districts (called Soil Conservation Districts in Michigan) provide technical assistance and conduct educational programs at the local level, working directly with land owners. They are the principle implementing agencies for encouraging farmers to adopt BMPs.

¹⁸ Michigan Department of Agriculture website, 2001

¹⁹ Ohio Administrative Code, 1501:15-5-01(A)

²⁰ Ohio Administrative Code, 1501:15-5-15(B)

²¹ Ohio Administrative Code, 1501:15-5-16(A)(2)

²² For more information on the ODNR *Ohio Coastal Nonpoint Pollution Control Program Plan*, please see <http://www.dnr.state.oh.us/odnr/soil+water/Coastalnonpointprogram.htm>

In Ohio, SWCD Boards of Supervisors review and act upon operation and management plans. An operation and management plan” means a written record, developed or approved by the District Board of Supervisors or the Chief of the Division of Soil and Water Conservation, for the owner or operator of agricultural land or concentrated animal feeding operations that contains implementation schedules and operational procedures for a level of management and best management practices which will abate the degradation of the waters of the state by animal waste and by soil sediment including attached pollutants.²⁵

- **Ohio State University Extension, Michigan State University Extension**

OSU and MSU conduct research and educational programs, and provide extensive technical recommendations to the agricultural community.

- **TMACOG Environmental Council**

The Environmental Council is responsible for maintaining the *Areawide Water Quality Management Plan*. TMACOG, through the watershed councils, works with other agencies to develop and coordinate BMP programs.

- **Watershed Councils**

The Maumee RAP, Portage River Basin Council, and Sandusky River Watershed Coalition provide mechanisms for public involvement with natural resource and water quality issues for river basin areas. They may lead the development of multi-county BMP projects by coordinating agencies at the watershed level. Each of these watershed councils has a representative and vote on the Environmental Council.

More detailed agency responsibilities and roles are given below.

- **Soil and Water Conservation Districts**

The Soil and Water Conservation Districts in Ohio and the Soil Conservation District in Monroe County, Michigan are Designated Management Agencies for agricultural pollution abatement. They offer voluntary programs to that promote use of agricultural BMPs. Their responsibilities and the associated responsibilities of Ohio’s and Michigan Department of Natural Resources are described below.

- **Ohio** —The main responsibility for agricultural pollution abatement rests with the Ohio Department of Natural Resources and the Soil and Water Conservation Districts at the county level. ODNR programs are administered by the SWCDs that act as staff to the Soil and Water Conservation Commissions (SWCC), per ORC §1515.02. The SWCC is administratively located within ODNR. SWCDs are political subdivisions of the state, and are organized for all 88 counties. Their primary function is to assist the agricultural community with conservation practices.
- **Michigan** — The principal agencies for agricultural runoff and BMPs are the Water Resources Commission (WRC), the MDNR. Office of Land Use, the Michigan Department of Agriculture (MDOA), the Michigan Soil Conservation Committee (MSCC), the county Soil Conservation District, and the county Drain Commissioner. Statewide soil erosion and sedimentation control rules are promulgated by the WRC, with the assistance of MDOA and are to include “provisions for the review and approval of site plans, land use plans or permits relating to erosion control and sedimentation control”. (§282.105)

²⁵ Ohio Administrative Code, 1501:15-5-01(B)(26)

The administration, such as the issuance of permits, and enforcement of the Act is carried out at the local level. Each county board of commissioners is to designate a county agency from among the Drain Commissions, Road Commissions or Building Inspectors, to perform this function in unincorporated areas (§282.106), while the governing body of a city, village or charter township may designate a local agency to perform this function within its boundaries (§282.197). The issuance of permits is governed by §282.109.

For the most part exceptions remove agriculture from the Act's regulatory scheme. Normal tilling, planting and harvesting of agricultural crops of five acres or less is excepted. Agricultural practices conducted on land five acres or greater is also excepted from the Act when they are carried out in accordance with a current conservation plan. A formal conservation plan may be waived if the board of the local SCD determines that current agricultural practices are being effectively controlled to meet the requirements of the Act.

The MSCC is made up of seven members: the Director of the Department of Agriculture, the Dean of Agriculture at Michigan State University, the Director of Natural Resources, and four "practical farmers appointed by the governor from among directors of several districts (§284.4). The MSCC may employ an administrative officer and other required experts, agents, and other employees. Among MSCC's powers are the following: 1) to offer assistance to local SWCDs in carrying out their powers and programs; 2) to keep such directors informed of experiences and activities of other districts and to facilitate the interchange of advice, experience and cooperation; 3) to approve and coordinate programs of the SWCDs; and 4) to secure cooperation and assistance of U.S. and state agencies in the work of SWCDs and to formulate policies and procedures relative to extending aid in any form from federal or state agencies to such SWCDs.

Policy Implementation: Best Management Practices

Agriculture is a vital part of our region's economy, lifestyle, and tradition. Much of the area is highly productive, classified as prime agricultural land. Productive farming in many areas requires drainage via field tiles and ditches. Protecting the environment while allowing a prosperous farm community requires stewardship and careful management.

Agricultural runoff is caused by precipitation which erodes soils and carries nutrients, pesticides, and herbicides away from their point of origin and throughout the watershed. During large storms, the runoff to surface water and infiltration to ground water increases and so does the rate of pollutant movement. Agricultural environmental programs recommend a series of "Best Management Practices" (BMPs) designed to meet Clean Water Act goals. BMPs are implemented through technical assistance, educational outreach, and voluntary incentives.

Water management practices include ditch maintenance, outlet protection structures, subsurface tile drainage, contour farming, diversions, and grassed waterways to collect and dispose of excessive runoff water at non-erosive velocities. These practices have been and continue to be an important part of erosion control in Northwest Ohio, where drainage is necessary for productive farming.

Best Management Practices for Agricultural Pollution Abatement, are summarized below. Not all of these practices will be useful in all areas of the TMACOG region. Selection of specific BMPs should be based on site and local conditions for each watershed.

Michigan Department of Agriculture, as discussed earlier, has established Generally Accepted Agricultural and Management Practices (GAAMPs) for farms and farm operations. This Plan incorporates

by reference the three categories GAAMPs related to manure management, pesticide use, and nutrient use.

Conservation Tillage

Leaving crop residue on the surface before and during planting protects topsoil and reduces erosion. Pieces of crop residue shield soil particles from rain and wind. No-till and conservation tillage techniques that leave at least 30% residue cover are recommended practices. Where soil erosion by wind is a primary concern, the goal is to maintain at least 1,000 pounds of flat small grain residue on the surface (approximately 30% residue cover) during the critical erosion period. In our region conservation tillage is important because phosphorus attaches to fine silt and clay particles. Techniques that control erosion are therefore also effective in reducing phosphorus loading that ultimately reaches Lake Erie. Use of conservation tillage is recommended at the top priority for agricultural BMPs.

Nutrient Management

Managing the times, forms and rates of application can reduce nutrient runoff. This Plan recommends following nutrient application rates given in the *Ohio State University Extension Agronomy Guides, Bulletin 472* and *Extension Bulletin E-2567* (July 1995). Following the Ohio State University recommendations will ensure realistic yield goals and minimize nutrient transport concerns. Bray P-1 and Bray P-2 are common testing methods used to measure the amount of phosphorus in the soil. Bray P-1 determines the amount of readily available phosphorus that can be found in the soil. Bray P-2 measures the water soluble phosphates and other phosphates that become available later. Bray P-1 is the most accepted measure for agricultural phosphorus use recommendations.

To control nitrate levels, apply nitrogen as close as possible to the time the crop will utilize the nitrogen, using split applications as necessary. Fall application of nitrogen is discouraged. Plant grass cover crops to tie up excess nitrogen and other nutrients for recycling of nutrients to the next crop. Nutrient management techniques include soil testing fields to determine amount of nutrients needed, and variable rate application equipment (e.g., "Soil Doctor") to apply just the amount of nutrients crops require. Fall application of nitrogen fertilizer should be discouraged.

Comprehensive Nutrient Management Plans (CNMP) plans are highly recommended for livestock operations. A CNMP is a detailed, specific plan designed for a particular farm with guidelines set by NRCS, and may be prepared through County SWCDs. Manure and Nutrient Management is managing the sources, rates, forms, timings, placements and utilization of manure, other organic by-products, bio-solids, and other nutrients in the soil and residues. The goal is to apply manure to agricultural land at an agronomic rate, efficiently using its nutrients to supply soils and plants to produce food, forage, fiber, and cover while minimizing the transport of nutrients to ground and surface water and environmental degradation. The CNMP is a component of a farm's Conservation Plan. It is used in conjunction with crop rotations, residue management, pest management, conservation buffer practices, and/or other practices needed on a site-specific basis to address natural resource concerns and landowner objectives. A CNMP controls manure runoff applied to cropland, feedlot runoff from a livestock feeding operation, maximizes nutrients from manure, minimizes fertilizer purchase required, and address aesthetics and odor concerns.

Filter Strips

Vegetative strips along waterways trap a portion of sediment and other pollutants in runoff water that would otherwise flow into neighboring streams, carrying nutrients with it. The term "filter strip" usually refers to a grassed area between the field and stream. Its purpose is to remove pollutants from field

runoff water but not necessarily provide riparian habitat. Grassed filter strips should be at least 20 feet wide. They are recommended wherever possible on both sides of streams and ditches in agricultural areas.

Grassed Waterways

Grassed waterways are a BMP that reduce gully erosion by transporting concentrated runoff to a single outlet. They are used to provide surface drainage from fields. The drainageway is graded and shaped to form a smooth, bowl-shaped channel. The area is seeded to grasses. Runoff water draining from the field flows over the grass, rather than eroding soil. This technique minimizes sediment and nutrients in the runoff, and prevents gully erosion.²⁴

Riparian Buffer Areas

A riparian buffer filters sediment, nutrients, pesticides, and pathogens out of field runoff like a filter strip, but also provides habitat. Forested riparian areas especially absorb nutrients from field runoff water. Even narrow riparian forest strips on flat land are effective filters. A strip as narrow as 50 feet can remove a significant amount of nitrogen and phosphorus from surface and subsurface runoff. However, wider buffer zones are desirable for other benefits, such as wildlife habitat.

Riparian buffers play an important role in aquatic habitat as well. Forested banks help make streams suitable for fish and other aquatic creatures. Tree roots help stabilize stream banks and provide cover for fish and the macroinvertebrates that form the base of the food chain. Leaves that fall into the stream are the primary food source for small aquatic animals such as insect larvae. Branches overhanging streams also helps maintain proper water temperature to support aquatic life. In the summer, the shade keeps water temperature cool; cold water holds more dissolved oxygen, supporting more aquatic life.²⁵

Grade Control Structures

Grade control structures are earthen, wooden or concrete, or other outlet controls built across a drainageway to prevent gully erosion. They include low head dams, pipe drops, and rock chutes. They lower runoff from a higher grade to a lower grade over a short distance without gullyng.

Windbreaks

Rows of trees and shrubs protect fields from wind erosion and provide wildlife habitat. Multiple rows of coniferous trees or a combination of coniferous and deciduous trees are planted to protect a farmstead, field, or feedlot from wind and snow. One or two rows of shrubs are also beneficial. The established windbreak slows wind on the downwind side for a distance of 10 times the height of the trees. The tree rows also act like a snow fence. Field windbreaks can be planted to reduce wind speed in open fields. They should be planted on at least the north and west sides of the area to be protected.

Wetland Restoration/Enhancement

Wetlands filter out nutrients, chemicals, and sediment from runoff water, and help keep them out of ground and surface water. Restoration of former wetlands and oxbows and enhancement of existing wetlands are encouraged, especially along streams and in floodplains. Wetlands control and reduce pollutants from agricultural runoff, provide aquatic and riparian habitat, and can serve as flood plains to reduce flooding problems.

²⁴ *Conservation Choices: Your Guide to 30 Conservation and Environmental Farming Practices*; USDA Soil Conservation Service [now NRCS], 1994

²⁵ *Ohio's Streamside Forests*, Ohio DNR Division of Natural Areas and Preserves, 1991

Stream Protection

Stream banks should be stabilized and protected against scour and erosion by vegetative or structural means to reduce sediment loads and pollution. Vegetative means are preferred over structural means because vegetation provides habitat and some nutrient uptake in addition to protecting stream banks.

Livestock should be excluded from streams and stream banks to prevent soil compaction and loss of vegetation. In addition, livestock exclusion will prevent manure deposition in the stream.²⁶

Pest Management

- Agricultural pest infestation should be managed to reduce adverse effect on plant growth but be environmentally acceptable. The principles of an Integrated Pest Management (IPM) program should be applied.
- Use crop rotations, crop varieties resistant to target pests, and adjustment of planting dates to help control weed, insect, and disease problems.
- Minimize pesticide use; encourage point application rather than applying pesticide to an entire field.
- Agricultural pesticides are common in area streams. Among the most widely used chemicals are the herbicides Atrazine, Metolachlor and Alachlor. For the Maumee River, Atrazine exceeds the lifetime drinking water exposure level about 13% of the time²⁷ (mostly in the spring) and Alachlor 7%. For Metolachlor, exceedence rates are under 1%. These concentrations, which are likely to apply to other streams as well, are well within safety limits. To make sure that water supplies continue to be safe, efforts should be made to control and reduce pesticide use.²⁸
- Consideration of pesticide characteristics such as solubility, toxicity, persistence and adsorption is desirable. The relations to site characteristics such as soil and leaching potential, geology, depth to water table, proximity to surface water, and topography should be considered.
- Pesticides listed with a “groundwater advisory” on the label have been identified as having a significant impact on surface and groundwater. Application on soils with a high leaching potential or require additional management. Pesticides with groundwater advisories include Alachlor, Metolachlor, Atrazine, Cyanazine, Simazine, Metribuzin, and Clopyralid.²⁹

Cover Crops

A crop of close-growing grasses, legumes, or small grain is recommended for seasonal protection and soil improvement. This practice reduces erosion and nutrient runoff during periods when the major crops or their residue do not furnish adequate protection for the topsoil. Recommended crops include oats, cereal rye, winter wheat, alfalfa, sweet clover, red clover, crown vetch, sudan grass, and hairy vetch.³⁰

ODNR Cost Share Eligible Practices

Ohio Administrative Code 1501:15-5-13 enables ODNR Division of Soil and Water Conservation to provide cost share funding for eligible practices. The Division may offer to share the cost of establishing eligible best management practices up to fifteen thousand dollars per person per year. If

²⁶ Maumee RAP Recommendations for Implementation, 1991

²⁷ Data from Heidelberg College Water Quality Laboratory

²⁸ *Portage River: A Resource Worth Protecting*, TMACOG/Portage River Basin Council 1997

²⁹ Maumee RAP Recommendations for Implementation, 1991

³⁰ *Conservation Choices: Your Guide to 30 Conservation and Environmental Farming Practices*; USDA Soil Conservation Service [now NRCS], 1994

other public funds are involved in cost sharing to establish an eligible best management practice or practices, state funds can be used only to the extent that the combined public funds amount to no more than seventy-five per cent of the cost of establishing the best management practice or practices, or not more than fifteen thousand dollars per person per year, whichever is smaller. The maximum of fifteen thousand dollars of public funds per person per year limit may be waived by majority vote of the Ohio Soil and Water Conservation Commission.³¹

Eligible practices include but are not limited to:

1. Animal waste storage structures;
2. Settling basins and filter strips;
3. Critical area seeding and fencing;
4. Off stream watering and stream crossing stabilization;
5. Roofing and gutters;
6. Water diversions;
7. Grass waterways;
8. Water and sediment control basins;
9. Erosion control structures;
10. Wetland treatment facilities;
11. Composting facilities; and
12. Other practices as approved by the Ohio Soil and Water Conservation Commission.

Further details should be requested from ODNR: there are qualifying requirements. For example, cost share funds will be available only to owners and operators with a current operation and management plan.

o Cost Sharing and Technical Assistance Programs

The SWCDs, USDA, Ohio DNR, Ohio EPA, and Ohio Department of Agriculture cooperate and jointly provide conservation assistance to farmers through a number of programs. Each focuses on a specific aspect of non-point pollution control or habitat restoration. These programs use two techniques to implement their goals. One is providing technical expertise from professional staff who advise farmers on what BMPs to use, and how to use conservation that will help make farming profitable while protecting the environment. The second is providing financial incentives for participating in voluntary use of BMPs, known as cost sharing.³²

o Conservation Reserve Program (CRP)

The Conservation Reserve Program is a voluntary program for agricultural landowners. Through CRP, farmers can receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible farmland. CRP provides land rental payments to farmers who are willing to sign long-term contracts converting cropland to filter strips, riparian forest buffers, wetland restorations, or windbreaks. CRP and CREP (see below) contracts are administered by USDA Farm Services Agency (FSA) in close cooperation with USDA NRCS, Ohio DNR, and the county SWCDs. CRP is available in Monroe County as well.

CRP is administered by FSA, and program support is provided by NRCS, the OSU Extension, state forestry agencies, and local Soil and Water Conservation Districts.

³¹ Ohio Administrative Code 1501:15-5-13(A)

³² *Ohio Lake Erie Buffer Program Strategic Plan 2000-2004*; Lake Erie Buffer Team, a coalition of 21 cooperating organizations and agencies

- o **Conservation Reserve Enhancement Program (CREP)**

In all five Ohio counties in the TMACOG planning area, the State of Ohio offers an enhanced CRP program which provides increased incentives to install conservation buffer practices. CREP is a special program in Ohio available only in the Lake Erie basin. Practices include filter strips along watercourses, wildlife habitat along watercourses, wetland restoration, field windbreaks, and riparian buffers and tree planting. CREP enhances CRP by providing additional incentives and extending the reserve period.

- o **Northwest Ohio Windbreak Program**

The NW Ohio Windbreak program is an interagency effort of USDA, ODNR, and county SWCDs to assist land owners in establishing field windbreaks in the area, including the entire TMACOG region. Applications may be made through the County SWCDs or Ohio DNR Divisions of Forestry or Wildlife. The program provides cost share funds to landowners for establishing windbreak vegetation. It covers a total of 15 counties on a rotating basis. The program is available in Ottawa, and Sandusky, Counties in even years, and in Lucas and Wood every year.

- o **Wetlands Reserve Program (WRP)**

The Wetlands Reserve Program (WRP) is a voluntary program to restore and protect wetlands on private property. It is an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal agricultural land. Land owners can establish conservation easements or can enter into restoration cost-share agreements where no easement is involved. In exchange for establishing a permanent easement, the landowner receives payment up to the agricultural value of the land and 100% of the wetland restoration cost. The program is administered by USDA FSA with technical support from NRCS through partnerships with state agencies (OEPA, ODNR, MDEQ, MDNR), the Fish and Wildlife Service (FWS), and Ducks Unlimited.

- o **Clean Water Act §319 Non-Point Source Grants**

These non-point source grants are often called “319” because they provide cost share and funding and technical assistance through §319 of the Clean Water Act. Priorities and BMP policies were jointly developed by Ohio EPA and Ohio DNR through the Nonpoint Source Assessment and Nonpoint Source Management Program. Ohio developed its program through Ohio EPA *State of Ohio Nonpoint Source Assessment* (1990) and the ODNR/OEPA, *Ohio Nonpoint Source Management Program* (1992, revised 1993). This Plan support the goals and programs of the statewide Plan.

The program is a significant resource for the TMACOG region because it funds many educational, planning, and cost share projects. 319 is important to agricultural runoff by providing funding to prepare watershed plans, conduct nonpoint source educational programs, providing watershed coordinators, and cost share incentives to implement BMPs. §319 grants are available in Monroe County as well.

- o **Environmental Quality Incentive Program (EQIP)**

EQIP is a voluntary USDA conservation program for farmers and ranchers who face serious threats to soil, water, and related natural resources. It provides technical, financial, and educational assistance primarily in designated priority areas. Nationally, half of the funding for EQIP is targeted to livestock-related natural resource concerns and the remainder to other significant conservation priorities. The EQIP program provides technical, educations, and financial assistance to eligible farmers improve their property to protect the environment and conserve soil and water resources. Participants can take advantage of education in new conservation management practices, technical support, and cost-share assistance and incentive payments.

EQUIP is available in both Ohio and Michigan, with an emphasis on either state-identified priority areas or significant statewide concerns. In general, priority areas are defined as watersheds, regions, or areas of special environmental sensitivity or having significant soil, water, or related natural resource concerns. . No priority areas have been established in the TMACOG planning area. Priority areas are determined by a process that begins with local work groups. These local work groups-convened by local conservation districts-do a conservation needs assessment and, based on that assessment, develop proposals for priority areas. These proposals are submitted to the Natural Resources Conservation Service (NRCS) State Conservationist, who selects those areas within the State based on the recommendations from the State Technical Committee.

Cost-sharing may pay up to 75 percent of the costs of certain conservation practices, such as grassed waterways, filter strips, manure management facilities, capping abandoned wells, and other practices important to improving and maintaining the health of natural resources in the area. Incentives may be made to encourage a producer to perform land management practices such as nutrient management, manure management, integrated pest management, irrigation water management, and wildlife habitat management. Incentives may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the program incentive.

EQUIP focuses on designated priority areas, but can be used on other areas as well. In the program's first year of the program, 65% of the funds were used in priority areas. EQUIP contract applications are available at USDA Service Centers. The applications are accepted throughout the year.

Alternative Techniques and Technologies

Since 1980, when the first version of this chapter was completed, conservation tillage and many other techniques that are now standard BMPs have been developed and come into wide practice. New techniques and technologies could further improve soil and water conservation. It is this Plan's policy to encourage development and demonstration of new practices that may be effective in reducing nonpoint source pollution impacts or improving habitat. The examples below are given as examples, and are not intended to exclude other alternative techniques.

Wetland Reservoir Sub-Irrigation

Productive agriculture in northwest Ohio and southwest Michigan requires drainage to remove excess water, often using a tile system. Conventional practice is to drain the water to a river and ultimately Lake Erie. Tile drainage water can be a significant source of nitrates.

Sub-irrigation is an alternative practice that stores runoff water in wetland and reservoirs near the fields. During dry periods, water is pumped back through the tile system. The agricultural benefits are to aid crop production by reducing drought stress, and serving as a source of nitrate. The wetland and reservoir system can reduce the amount of sediment and nitrates that reach streams, and provide wetland habitat. Testing data from Iowa indicates a reduction of nitrates from drainage water from 40 to 98%.³³

Test data indicates sub-irrigation may be effective in reducing nitrate loadings. In 1997 Ohio tests, average nitrate-N concentrations in water sampled at subsurface drain outlets during February through May were roughly 50% lower when sub-irrigation had been used during the previous growing season than when it had not been applied.³⁴

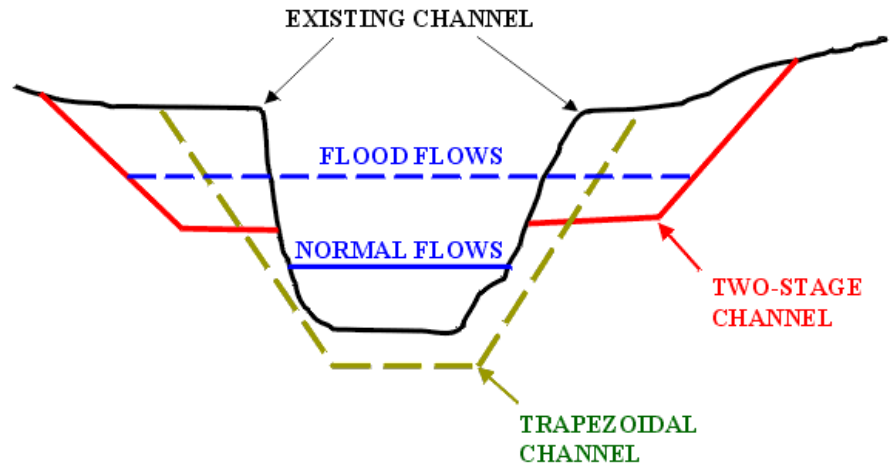
³³ *Reducing Nitrate in Water Resources with Modern Farming Systems*, page 9. Management Systems Evaluation Areas, 1999

³⁴ *Agricultural Drainage Bulletin 871*, OSU Extension; page 14, 1998

Natural Channel Design

Streams naturally tend to form channels based on the amount of flow, the grade, and how much energy the water has. A stream whose channel is straightened may erode its banks as it dissipates energy and seeks to restore a stable flow regime. The result can be sedimentation, requiring future sediment removal.

Research and demonstration projects are being conducted in Northwest Ohio on alternative stream channel designs that may be more stable and do not cause future sedimentation.



Two-Stage Channel

One such technique is the “two-stage ditch design.” Conventional ditch design is a trapezoidal cross-section with the stream at the bottom of the channel and straight sloping banks. The two stage design uses a wider bottom. The normal flow channel takes up only part of it; the rest is a floodplain “bench.” The stream may meander across this bench area, but during normal flow, the bench itself is dry. During high flow, the stream overflows onto the bench and may reach bank full flow.³⁵

The goal of research and demonstration of alternative channel designs is to identify designs that will provide drainage required for productive agriculture, but need less maintenance, and cause less erosion and sedimentation.

Implementation Activities

Program activities vary from one district to another follow similar approaches; specifics differ according to local need. Projects may be undertaken by the SWCD, by a group of SWCDs for a multi-county watershed. Where requested and feasible, TMACOG will work with the SWCDs to develop and help administer the project.

- **Develop Watersheds Plans**
 - a. Inventory BMPs used for each watershed, particularly conservation tillage, filter strips, riparian buffers, wetlands, and wetlands.
 - b. Inventory present water quality and use attainment status data from the current 305(b) report, and collect additional water quality data as necessary to adequately assess the chemical, biological, and physical integrity of the water. Note particularly whether water quality is impaired due to nonpoint source pollution (including hydromodification).

³⁵ Graphic courtesy of Finkbeiner, Pettis, & Strout, Ltd. Used by permission.

- c. Develop a plan for each watershed recommending specific BMPs and land use decisions designed to address nonpoint sources of impairment (including hydromodification).
 - d. Prioritize watersheds based on water quality use attainment status and TMDL schedule.
- **Educational and Informational Activities**
 - a. Demonstration plots & projects
 - b. Field days, tours, or farm visits
 - c. Information packages for local media
 - d. Educational meetings
 - e. Technical seminars
 - f. Pamphlets or publications on use of BMPs
- **Technical Assistance and Equipment Availability**
 - a. SWCDs help farmers implementing conservation tillage, buffer strips and other BMPs by providing technical assistance.
 - b. Provide new or innovative conservation tillage equipment for lease or demonstration so that farmers can gain experience with them before committing to purchase.
- **Develop and Implement Conservation Cost Share Projects**
 - a. Use the watershed plan and its selected BMPs to develop cost share programs.
 - b. Work with other SWCDs, river basin councils, and TMACOG as appropriate to implement projects on the watershed level.
- **Adopted Watershed Plans**

The following watershed plans have been developed and adopted by the SWCDs and are incorporated into this Plan by reference:

[None at this time]

