A CITIZEN'S GUIDE

TO

ILLINOIS AGRICULTRUAL

DRAINAGE PRACTICES AND LAW

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Protecting Illinois Streams

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EXECUTIVE SUMMARY

More than 87,000 miles of rivers and streams border and cross the lands of Illinois. Thousands of miles fall under the purview of drainage districts, which are charged with maintaining agricultural drainage. For decades, the construction and maintenance of extensive drainage systems has destroyed river ecosystems and degraded water quality. The economic and environmental costs of continuing historic drainage practices include loss of valuable agricultural land through channel instability, decreased biological diversity and productivity, diminished recreational opportunities, and degraded water quality. These are losses that can persist for years after construction and maintenance activities are undertaken.

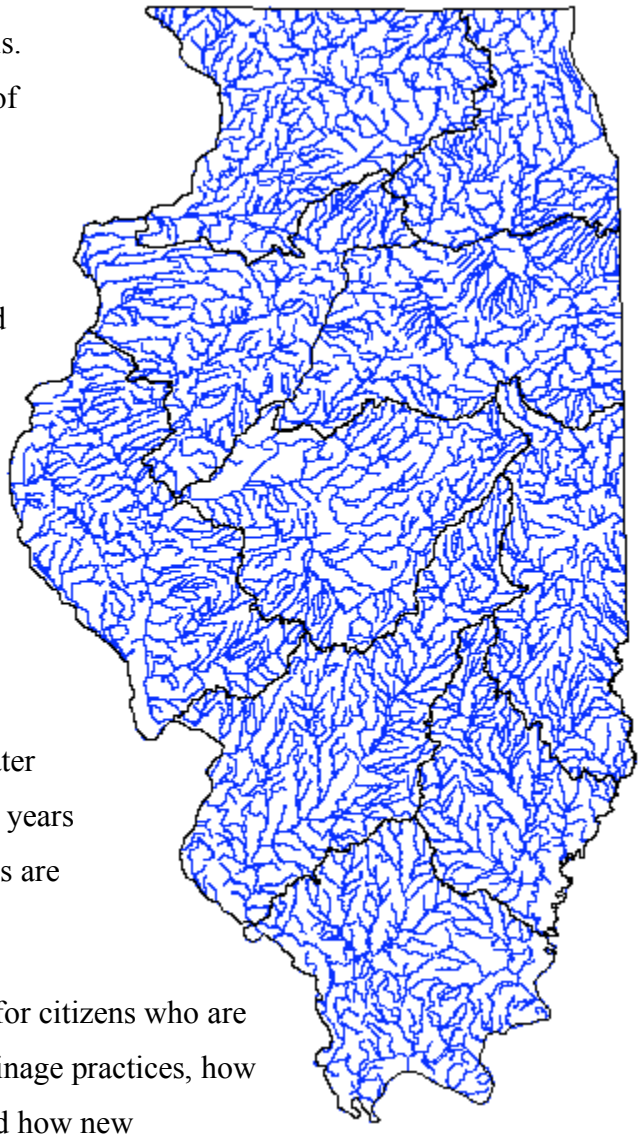

Figure 1 –Illinois rivers and streams

This guide presents a starting point for citizens who are interested in learning about agricultural drainage practices, how those practices impact river ecosystems, and how new maintenance approaches can be used to minimize environmental damage to Illinois' unique aquatic habitats as well as terrestrial stream corridor habitats.

INTRODUCTION – THE ILLINOIS LANDSCAPE

Illinois' thousands of miles of rivers and streams wind through forests, urban areas, high limestone bluffs and lowlands. These flowing waters are an ever-present feature of the agricultural lands that dominate most of the state. For many Illinois residents, home and community are defined by a landscape where fields stretch to the far horizon, where rivers, streams, and man-made drainage ditches form farmland borders or cut through crops of corn, soybeans and wheat.

Rivers and streams have played an integral part in shaping Illinois' agricultural economy. For the first settlers, they offered a form of natural drainage for lands that were often inundated with water. Later, as human-built agricultural drainage systems were put into place, existing streams offered a blueprint for drainage ditches or for extensions of drainage systems. Rivers and streams were enlarged, deepened and straightened to achieve the goal of quick, high capacity field drainage.

There is no question that successful crop production in Illinois requires adequate field drainage. However, in the late 1800's when Illinois' agricultural drainage systems were first built, there was no expectation or requirement to consider how stream channelization might impact riparian ecosystems.[1] In the years that followed, the establishment of new drainage systems and the maintenance of existing systems continued using practices little changed from earlier years.

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[1] As used in this handbook, "riparian ecosystems" includes a river's water, banks, and channel, as well as the aquatic and terrestrial life which live in, or are dependent upon, the water, soil and other natural resources within that river system. "Channelization" is the act of straightening and reshaping rivers or streams for the purpose of field drainage.

Like many other industries, however, agriculture has undergone tremendous changes in knowledge, technology and practice. In Illinois, changes in farming practices have at times resulted from the fact that those practices degraded or harmed natural ecosystems. For example, for years tillage was done at the same time of the year with the same equipment, which over time contributed to serious soil erosion, loss of soil nutrients, and excess sedimentation in rivers and streams. With the invention of tillage equipment that turns over a smaller amount of soil, and an increased popularity in "no till" practices, soil erosion and its resulting environmental impacts have been lessened.

Agricultural runoff has also affected the water quality of Illinois' rivers and streams, and degraded aquatic ecosystems. One answer to this problem has been the national conservation buffer initiative developed by the Natural Resources Conservation Service (NRCS). This initiative assists Illinois farmers in establishing buffer strips, which are intended to trap sediment, fertilizers, pesticides, and bacterial pathogens that would otherwise enter the rivers and streams adjacent to fields.

The negative effects of agricultural stream channelization on river ecosystems is an economic and environmental issue that has also been recognized by agencies such as the Illinois Environmental Protection Agency (IEPA), the Illinois Department of Natural Resources (IDNR), county soil and water conservation districts and researchers in agriculture, biology, geology and engineering. However, while some steps have been taken to promote and implement newer drainage practices to minimize disturbance of riparian ecosystems, traditional practices remain the norm.

In a state where 70% of the land is used for growing crops, adequate drainage is essential for crop success and for the health of the state's economy. However, equally important is ensuring that the economic and environmental benefits of those rivers and streams that co-exist with agricultural lands are not lost. Successful farming and a healthy environment are not mutually exclusive goals, but they cannot be achieved without a willingness to consider new information and approaches, and constructive discussion among farmers, landowners, drainage district commissioners, and others with environmental and technical expertise.

This drainage guide is for individuals who want to ensure that providing adequate agricultural drainage is not done at the expense of maintaining river ecosystem health. It gives a general background of how current agricultural drainage practices developed in Illinois, both as a product of history and of legal enactments. It summarizes the benefits and functions of river ecosystems, how those systems are impacted by current agricultural drainage practices, and what newer maintenance methods are available to lessen environmental impacts. The final section provides information on how citizens can not only learn more about their local drainage district and drainage commissioner activities, but also become active participants in drainage district decisions. Appendix D provides a summary of the legal rights and responsibilities of drainage districts and drainage district commissioners under Illinois' Drainage Code. Appendix E highlights relevant sections of the Illinois Open Meetings Act.

CHAPTER 1

HOW AGRICULTURAL DRAINAGE PRACTICES HAVE SHAPED OUR LANDSCAPE

The conversion of Illinois' land for agricultural use has had a profound impact on its landscape, its economic growth, its ecological resources, and the relationship between its people and the land. By conservative estimates, in 1820, 60% of Illinois' land area was grassland; the remaining area was either open waters or forest. Wetlands accounted for 10 million acres of the state's land. Accounts of travelers and settlers who first arrived in Illinois in the 1800's reflect their amazement at the immensity of the prairie and forests they saw before them. The prairie lands were often compared to an ocean: vast in size, with broad vistas of tall grasses moving like sweeping waves.

Figure 2 – Illinois landscape

For the many settlers who wanted to make a living from the land, the prairie terrain they met proved a formidable obstacle. Prairie soils were composed of heavy, rich loam[2], and were subject to seasonal or even permanent wetness. This characteristic wetness resulted from the fact that these lands were once glacial; at the time of frontier expansion the soil had not yet had enough time to develop its own natural drainage. In West Central Illinois, Mason County's North Quiver Swamp, so named at the time because stepping on the wet, peat-rich soil caused it to quiver, exemplifies the soil conditions with which early farmers had to contend. During some years, the combination of these wet soils with heavy rains created

[2] Loam is a term used to describe soil that is a mixture of clay, silt and sand. The characteristics of loam soil are midway between those of clay and sand; it drains well, but does not dry out too quickly, and contains enough soil air for healthy root growth. The high level of organic matter in prairie soils meant that they could support dense growth of grasses and other plants, which contributed to the difficulty in initially breaking or plowing the soil plant crops.

even more difficulties, with the result that it was not unusual for crops to fail three out of four years.

John Deere's 1837 invention of a plow that could rip through the heavy, wet prairie soils was a first step towards achieving crop success. However, it also provided the political push for large-scale drainage of the land, which allowed the rapid conversion of Illinois' prairies and forests to agricultural fields. The federal government offered the first impetus for man-made drainage systems in Illinois with the passage of the 1850 Swamp Lands Act. The Act gave millions of acres of wetlands to fifteen states, including Illinois, for the purpose of converting it to agricultural use. The grant of these lands to states was under the condition that proceeds from their sale be used to build drainage systems needed to reclaim the land.

Figure 3 – Early Illinois dredging using horses

In 1879, the Illinois legislature passed the Farm Drainage Act and Levee Act, which authorized the formation of quasi-governmental entities called drainage districts, whose purpose was to coordinate drainage efforts among landowners. These drainage districts, acting through drainage commissioners, could tax landowners in order to pay for constructing large drainage systems. Improvements in excavating equipment, from horse-

drawn machinery to steam-driven dredges and ditchers, meant that work on drainage systems could continue on a twenty-four hour basis. Some equipment had the capacity to excavate drainage ditches thirty-five to sixty feet-wide, and eight to ten feet deep. In many cases, these "ditches" were dug following the path of already existing rivers and streams.

Stream channelization was the first action taken by pioneer farmers to drain agricultural fields. Next, farmers installed subsurface drainage pipes in fields, typically placing the perforated pipes at a depth of three to six feet. Up until the 1970's, drainage pipes were made of sectional pieces of concrete or clay called "tiles." Although most pipes today are made of perforated polyethylene tubing, which comes in large rolls, they are still often referred to as "tiling" or "tiles."

Illinois' "drainage boom" continued into the early 1900s. Since that time, new drainage systems have been completed, and additions have been made to existing ones. Currently, Illinois has 9,795,000 acres of artificially drained cropland, the largest amount of any state. In fact, one United States Department of Agriculture report estimates that 85% of Illinois croplands are drained by means of subsurface drains.

Figure 4 – Early Illinois dredging using dredgers

Historically, agriculture has been, and will be, an essential part of Illinois' economic success. However, achieving agricultural success has come at a price. The transformation of Illinois' prairies, wetlands and forests to agricultural use has meant the loss of habitat for plants and animals, extinction of species, and the degradation of river and stream ecosystems. In its 1994 report, "The Changing Illinois Environment: Critical Trends," the Illinois Department of Natural Resources acknowledges the scope of change resulting from such drastic land transformations, stating that "agriculture has been the dominant influence on the flora, fauna, and quality of terrestrial and aquatic habitats in Illinois since the early 1800s."[3]

We are at a crossroad in Illinois with respect to our rivers. Figure 6 demonstrates the effect drainage practices can have on our natural environment. While we are not going to return to a landscape that settlers saw in the 1800's, we can use new technology and information to ensure that all river functions are protected, and that the need to provide drainage does not override the other critical benefits our rivers provide. As one University of Illinois Extension publication states, "channelization sounded like a good idea at the time," but it is "an idea whose time has gone."[4]

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[3] Illinois Department of Natural Resources, The Changing Illinois Environment: Critical Trends, vol. 3, Ecological Resources. (Springfield: Illinois Department of Natural Resources, 1994), 78.

[4] The University of Illinois Extension, 60 Ways Farmers Can Protect Surface Water. (University of Illinois at Urbana-Champaign, 1997), 127.

Figure 5 – Boys playing in a healthy, naturally flowing river

Figure 6 – Riparian ecosystem altered by drainage practices

CHAPTER 2

RIVER ECOSYSTEMS: FUNCTIONS AND BENEFITS

Illinois' thousands of miles of rivers and streams are the lifeblood for the state, its citizens, and our fish and wildlife. They serve a great variety of functions and are depended on by users ranging from industry and municipalities to anglers and canoeists. The benefits provided by rivers and their ecosystems range from utilitarian to the aesthetic and include:

- Water supplies for human consumption and industry
- Floodwater conveyance
- Drainage for agricultural lands
- Power generation
- Commercial navigation
- Desirable setting in which to live and raise a family
- Recreational opportunities such as fishing, boating, and birding
- Essential habitat for aquatic organisms and plants
- Habitat corridors for birds and mammals
- Beautiful areas where people can interact with nature

In thinking of rivers, we tend to focus on how we use and benefit from their water, yet, protecting a river's ecosystem means protecting everything that depends on its waters. Like any living system, river and stream ecosystems also support a variety of complex and interconnected organisms. For example, trees and vegetation adjacent to rivers provide needed habitat corridors for birds and mammals. The living communities that lie beneath the surface of Illinois' rivers are also numerous and varied: 188 native species of fish swim its

waters, and share habitat with freshwater mussels, amphibians and reptiles, insects and aquatic plants.

The large-scale conversion of prairies, wetlands and forests has resulted in huge losses of habitat for many native species. The challenge in this changed landscape is to minimize loss and degradation of the habitat that remains in order to maximize survival for those birds and animals dependent on it.

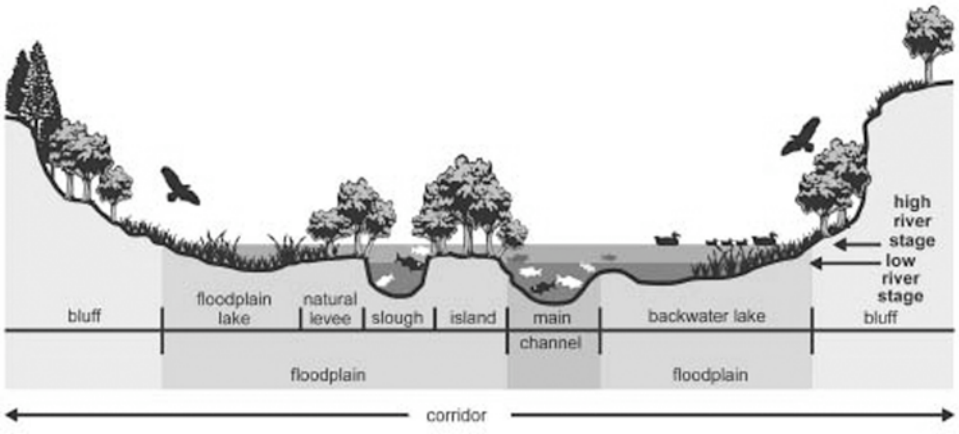

Figure 7 – Common features of a river corridor
(Image from Farm*A*Syst website at http://www.soil.ncs.edu/assist/Stream/)

Specifically, fish and other aquatic organisms require varying water temperatures. In addition to providing habitat corridors for birds and mammals, trees and grasses provide shaded areas and cool water temperatures preferred by certain fish species such smallmouth bass and blacknose dace. By regulating the amount of sun that reaches the water, trees may also prevent the overgrowth of some aquatic plants, such as algae, which use large amounts of oxygen that are needed by other organisms.

Trees and other bank vegetation are also important for the riparian food chain. When leaves from the trees fall into the water, and when terrestrial grasses are flooded, they break down, forming detritus. Detritus is a food source for insects, which in turn provide food for fish and amphibians, which are then consumed by larger fish and mammals. Riparian vegetation aids river systems in several ways, including recycling of nutrients, trapping sediment, and intercepting agricultural water runoff that is typically polluted with nitrogen and phosphorous.

Unlike river corridors that have been channelized, natural riverbanks and bottoms vary in their shape, soils and substrate materials. As with other components of riparian ecosystems, this diversity is important for maintaining healthy populations of aquatic organisms. Mollusks such as freshwater mussels require a stable river bottom that contains gravel or sand. The varied banks and bottoms of natural streams also serve differing needs of fish. Irregular bank areas provide protective environments for nurseries as well as for adults hiding from predators. Changes in water flow, such as riffles produced by graveled or rocky bottoms, or eddies caused by deeper troughs cut out from the bottoms, are necessary to support different species of fish.

Healthy and varied riparian environments are needed for reproductive success in several species. For example, while trout-perch spawn over gravel bottoms, starhead topminnows need areas of dense aquatic vegetation for spawning, and the mottled sculpin lays adhesive eggs to the underside of a flat rock. Forty-four of Illinois' identified species of reptiles and amphibians have larval stages lasting from a few months to several years that are water dependent. Almost all of these species deposit their eggs in water.[5]

Maintaining healthy populations of some aquatic species also ensures reproductive success for others. Some species of freshwater mussels, such as the plain pocketbook, use fish in part of their reproductive cycle. Extending parts of their tissues to act as lures for fish, these mussels then release larvae that attach themselves to the host fish to complete the larval stage of their life cycle. After reaching maturity, mussels benefit the river ecosystem by filtering out nutrients and toxins from the water.

Finally, ensuring the continued viability of our river and stream ecosystems may provide future benefits, some of which are not now known. As with rainforest flora and fauna, river organisms offer a means for understanding and studying some of our more challenging medical problems. Studies of fish have been included in research on neurobiology, aquatic toxicology, endocrinology and biochemical and genetic adaptation.

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[5] Ibid., 204.

Mollusks, because they do not contract cancer, are being studied to see what provides their natural immunity.

Figure 8 illustrates just a few of the characteristics of a riparian environment — habitat for birds and mammals, riffles and pools of water where fish breed, woody debris that provides nutrients, and a point bar that helps direct the flow of water:

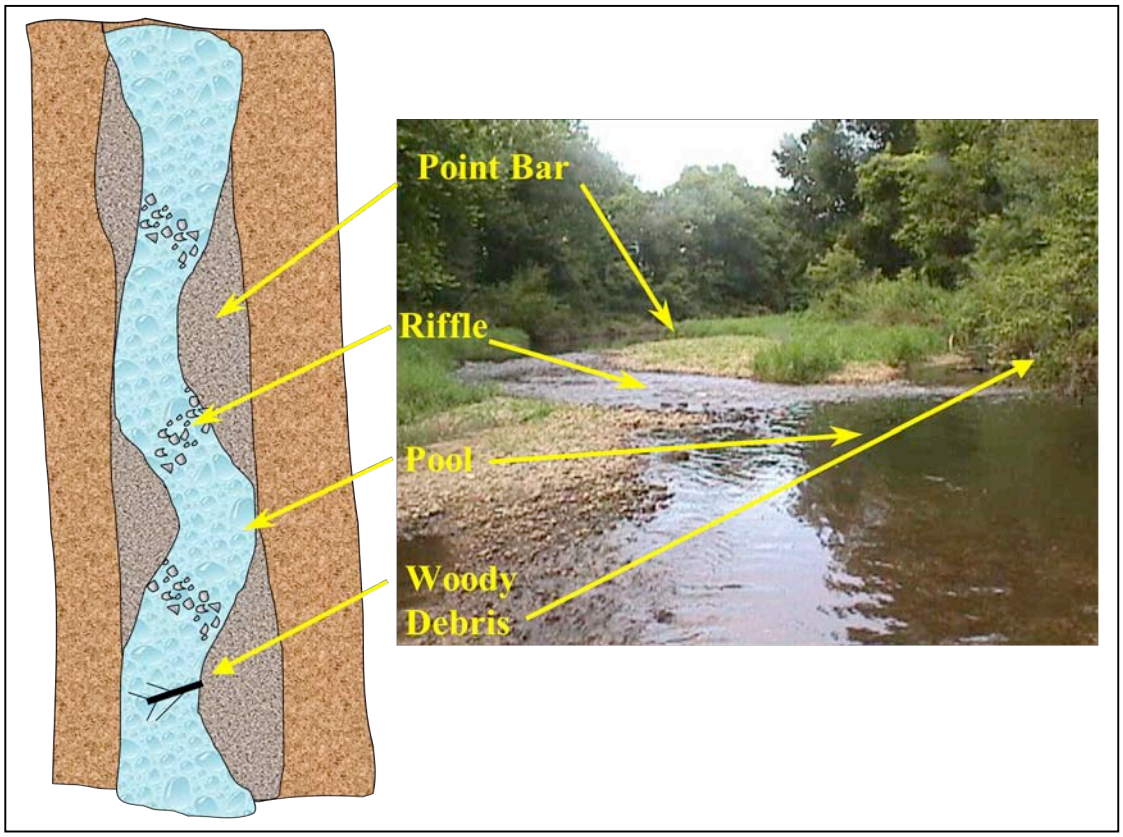

Figure 8 – Example of riparian environment

CHANNELIZATION AND THE IMPACTS ON RIVER ECOSYSTEMS

Understanding the Dynamics of River Systems Geomorphology

A critical examination of current drainage maintenance practices and their environmental impacts must take into account the fact that rivers and streams are dynamic ecosystems that, when disturbed, will attempt to return to a state of equilibrium.

The science of fluvial geomorphology explains the processes that shape rivers and the relationships between the components involved in these processes. The physical "inputs" of a stream or river are water, sediment, and organic debris, such as fallen trees and leaf matter. How these inputs move and arrange themselves within a river depends on what enters the river (whether it's water, sediment, or woody debris), the river's channel shape, and the "valley type" within which the river is located (the geology, soils and vegetation in the area surrounding the stream).

The shape of the river channel itself is developed and maintained over time by the combined action of water, sediment and debris that first drain into the channel and then move within it. A balanced or stable river or stream is able to carry water, sediment and debris, even during high water events, without changes occurring in the depth, length, bottom width, or bank slope of the channel. What causes a river to become unbalanced, or in a state of "disequilibrium," are drastic changes in: 1) the quantity of water, sediment and debris entering the river; or 2) the existing shape of the river channel.

Rivers in disequilibrium make "adjustments" in order to reestablish a balance: examples of adjustments are channel aggradations (sediment buildup), degradation (scouring), bank erosion, and changes in stream course. Dredging for drainage maintenance is a catastrophic event for a river channel; in response to that event, the river will make adjustments. While drainage managers could work with stream dynamics both in establishing and maintaining drainage channels, the current practice is to instead do repeated dredging. In the long term, this is neither the most practical nor economical response to ensure adequate drainage. At the same time, repeated dredging also has significant negative environmental impacts.

Studies of channelized streams indicate that the wider bottom and steeply banked slopes created in constructing a drainage channel are ultimately modified by river conditions as the river attempts to recover from these disturbances (Jayakaran et al. 2005, Ward et al. 2004, Landwahr and Rhoads 2002).[6] For example, the new, typically larger channel shape created by straightening and dredging a river increases the velocity of the water flow, which in turn increases the sediment carrying capacity of the river. Achieving a balance now between the inputs of water and sediment means the amount of sediment in the water needs to be increased. Sediments are added to the water through processes such as bank erosion or scouring of the river bottom.

When the sediment load increases to the point that the water's velocity is no longer sufficient to carry it, another adjustment is made by depositing the "excess" sediment in the channel. This adjustment creates sand bars along the bottom of the river or forms "benches" along the sides. These benches actually act as a floodplain within the channel, dissipating the energy levels of higher flows, and reducing the potential for bank erosion and shearing of bank toes (the bottom edges of benches).

Other features that develop subsequent to straightening and dredging are stream meanders and low flow, or inset, channels. The varying characteristics of a meander contribute to a diverse habitat that is more conducive to the varied needs of aquatic organisms. The inset channel is the "stream within a stream" that develops to carry the lesser, more typical sized flows within the stream. This inset channel, because it is formed as a result of its more typical lower volume flows, creates the most effective and efficient watercourse for carrying a stream's usual water volume. At times of higher flows, stable benches combined with an inset channel operate effectively to handle flows that are greater

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[6] Anand Jayakaran et al., "Formation of Fluvial Benches in Headwater Channels in the Midwestern Region of the United States," International Agricultural Engineering Journal, 14(4) (2005): 193-208; Andy D. Ward et al., "Designing Two-Stage Agricultural Drainage Ditches," Conference paper no. 701P0304 from ASAE conference, Drainage VIII, 21-24 March, 2004; K. Landwehr and B. L. Rhoads, "Depositional Response of a Headwater Stream to Channelization, East Central Illinois, USA," River Research and Applications, 19 (2003): 77-100.

in volume and velocity. Figure 9 illustrates some of the adjustments rivers make to obtain equilibrium:

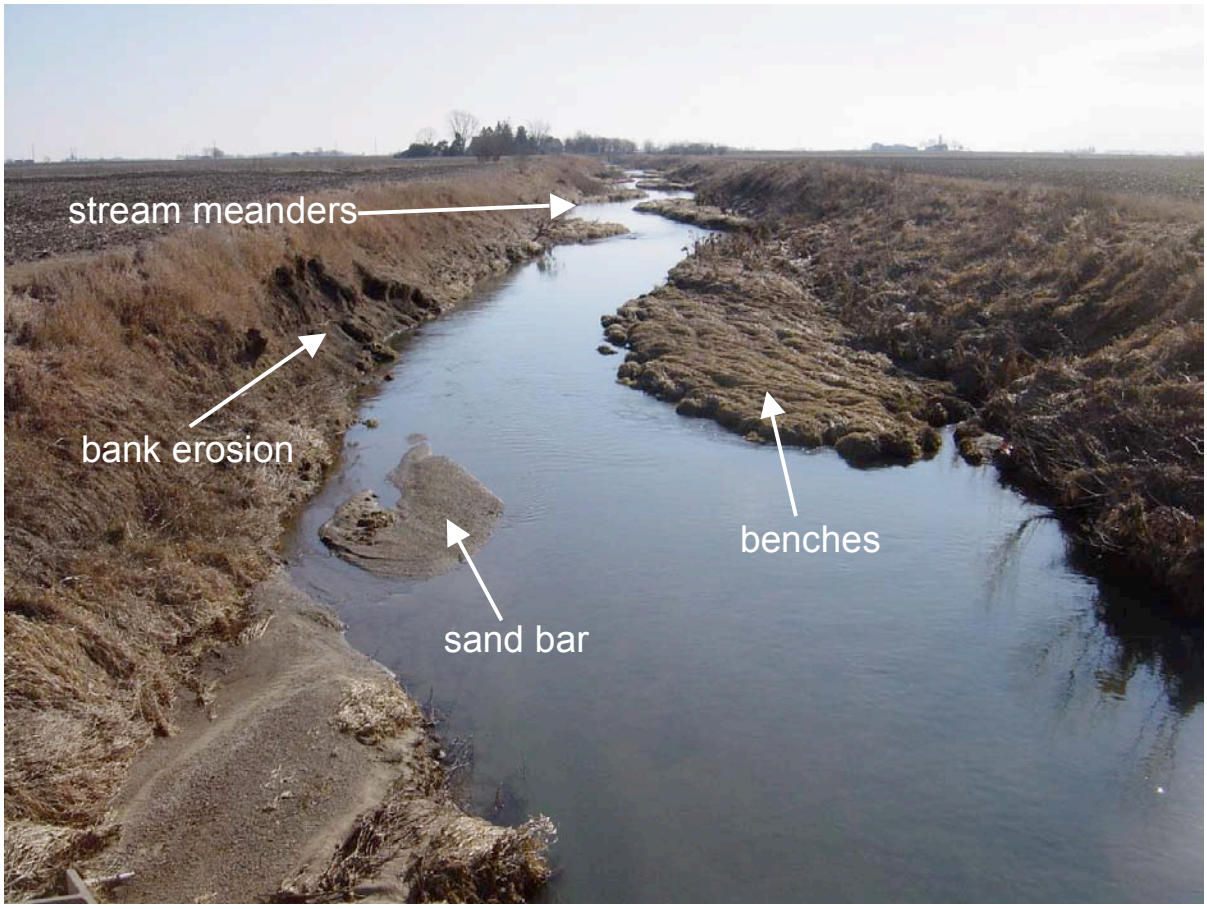

Figure 9 – River adjustments

The dynamic nature of river ecosystems creates a challenge for every person involved in managing their resources. Given that at least 23 percent of Illinois' rivers and streams have been modified by human activities,[7] it is important that farmers, as land stewards, and drainage commissioners, as legally responsible drainage managers, adopt resource management techniques that ensure their drainage activities do not cause significant negative environmental impacts.

[7] Rhoads and Herricks (1996) note that the estimate of 23% given in a 1993 study was a low approximation as it was based on a state database which does not include all of the smallest streams in the state, and on topographic maps which depicted channel straightening only, and did not include the more commonplace modifications resulting from maintenance activities such as deepening the channel and reshaping channel banks.

Geomorphology of a River

Watershed and River Corridor Management Activities

Land Use / Land Cover – changes in storm water and sediment runoff
Channel Modifications – changes in bankfull channel geometry & sediments
Floodplain Modifications – changes in bankfull and flood channel geometry

leading to changes ⇩ in the balance between

Sediment Supply, Sediment Size and Slope, Discharge

that when unbalanced ⇳ typically result in

Channel Adjustment and Channel Evolution – site and setting specific combinations of Degradation, Aggradation, Widening, and Planform adjustment processes as the channel evolves from balanced to unbalanced and back to balanced geomorphology.

That can be observed ⇳ through changes in

Channel Dimension, Pattern, Profile, Sediment Transport and Size Distribution evaluated using comparisons between reference and existing stream conditions.

Figure 10 – Geomorphology of a river

The Impact of Stream Channelization and Drainage Channel Maintenance on River Ecosystems

Illinois' extensive agricultural drainage systems created river instabilities from the time streams were first altered during the construction of drainage channels. Dredging existing river segments to form drainage channels destroyed the river's substrate habitat. River width, depth and bank slopes were radically altered as riverbanks were cleared and reshaped in an effort to create a straight channel with uniformly sloped banks.

Today, the primary goal of drainage channel maintenance is to minimize the amount of time it takes for water to drain off fields. After drainage systems were built at the turn of

the century, future maintenance of those systems became based on the same construction practices of reshaping the channel primarily by dredging, vegetation removal and regrading bank slopes. By disrupting the existing stable characteristics of the stream channel, these traditional maintenance practices result in increased sedimentation, erosion, and changes in water flow, all of which adversely affect the functions of and benefits provided by rivers and streams.

Drainage system maintenance typically involves using a trac-hoe to dredge the bottom of the waterway in order to remove accumulated sediment or sand bars that may have formed. Dredging thus removes the bottom layer of the waterway and releases sediment that will flow downstream. Removing the substrate of the stream removes habitat for bottom-dwelling organisms such as mussels and aquatic plants, as well as nesting sites for fish.

Increased sediment in the water makes it turbid (cloudy). Turbidity affects those species dependent on visual ability, such as mussels who send out "lures" to attract fish and fish that, in turn, are trying to escape from predators. By reducing the amount of sunlight in water, turbidity can impact the growth of aquatic plants: increased silt levels on the bottom of a stream inhibit a plant's ability to root and stay anchored in the water. Increased bottom sediment deposits also interfere with fish spawning and suffocate fish eggs already deposited in the stream.

Another common practice in drainage maintenance is the complete removal of existing vegetation growing on stream banks, whether that vegetation consists of shrubs or smaller trees. Trees along both sides of a river may also be clear-cut for several yards behind the bank's edge. Vegetation on the bank slope is sprayed with an herbicide or cut down; smaller trees may be cut level to the bank. Older, larger trees along the tops of the bank may also be removed, typically for large equipment access to the waterway.

While the removal of vegetation has the obvious effect of eliminating bird and mammal habitat, another very visible negative impact is bank erosion, which compromises bank stability. The loss of grass or tree roots to hold bank soils in place leads to bank failure and the loss of both riparian habitat and valuable farmland. Vegetation at water level helps

trap sediments, so its removal also allows more sediment to flow downstream, contributing to impacts caused by increased sedimentation.

Other impacts from vegetation removal result from changes in water chemistry and temperature. Without the shading provided by bank vegetation, water temperature increases, creating better conditions for algal growth. Excessive growth of algae depletes the amount of oxygen needed by aquatic organisms for survival.

Figure 11 illustrates a more natural stream with lush vegetation that provides wildlife habitat, shade, and food. This vegetation acts as a riparian buffer that feeds the stream while also providing drainage. Figure 12 is the same spot on the stream after it was channelized and stripped of protective vegetation through dredging and clear-cutting of trees along the banks. The contrast of the before and after stream conditions demonstrates how dredging can dramatically impact or destroy valuable riparian habitat and resources.

Figure 11 – Spoon river in East Central Illinois flowing naturally with lush vegetation

Figure 12 – Spoon river after channelization and dredging in April 2005

Loss of bank vegetation and trees on the upper portions of the bank drastically changes habitat. Fish no longer have shaded areas where they are protected from sun, or plant cover which protects them from predators; birds and other mammals no longer have a riparian corridor for nesting or cover, and may also have less food available from reduced numbers of aquatic animals and insects in the river.

Without riparian vegetation to absorb nutrients, higher concentrations of these substances remain in the water, affecting water quality and the health of pollution intolerant aquatic species. Finally, loss of bank vegetation means a loss of leaves and other organic materials that are the foundation of the aquatic food chain.

Dredging increases the depth of a channel, which results in lower water levels within the stream, and also contributes to a lower water table. The depth of the water table can be critical during dry, hot periods. Water levels that are too low have a negative impact on crops. Crop roots may not be able to grow deeply enough to reach the water they need for proper growth; the resulting increased soil temperatures could also affect crop plants' development. In response to this problem, some farmers in Illinois are working to help design structures that would be installed at the edges of fields near drainage waterways. These structures would help contain some of the water that would normally flow into drainage channels in order to prevent water table levels from dropping to critically low levels.

Low water levels have other impacts for humans and wildlife. As over half of the drinking water in Illinois comes from our rivers and streams, continued reduced water flow could create reductions in supplies relied upon by municipalities and other water providers. Water levels that are too low impact fish populations, particularly during August and September when critical minimum flows are needed for survival. Lower water tables also affect water temperatures, causing algal blooms as well as undesirable conditions for fish relying on cool water habitats.

Long Term Impacts of Habitat Loss

Research has shown that changes in flow structure can have a negative effect on fish populations. One study conducted on four streams in Piatt and Champaign counties concludes that habitat needs of fish are determined not only by water depth, but also by differing environments created by varied flow hydraulics. (Rhoads et al. 2003) For example, the varied flow created by an irregular bank creates riffles, eddies and pools that support a greater diversity of fish and other aquatic organisms. In addition, the rate of flow in a

waterway impacts the distribution of available food as well as the amount of energy an individual fish has to expend in order to feed.

Since the turn of the century about one in five fish, one in three reptiles and amphibians, one in five crayfish and more than half of the freshwater mussels species in Illinois streams have become extinct, or are threatened with extinction. In its 1991 report "Biologically Significant Illinois Streams," IDNR notes the need for developing a comprehensive approach to protecting the state's streams because "streams and other aquatic habitats are being destroyed at an alarming rate in Illinois."[8] Human induced activities such as drainage system construction and maintenance have contributed significantly to declines in river ecosystem health.

IDNR's 1991 report presents an evaluation of the state's rivers based primarily on the factor of aquatic biodiversity, which includes plant and animal diversity. Those rivers designated as biologically significant consistently include systems with areas of undisturbed riparian zones and high levels of species diversity. Factors listed by IDNR contributing to water impairment and loss of biological diversity include stream channelization and agricultural runoff.

In 1994, IDNR published a state-of-the-environment report entitled "The Changing Illinois Environment: Critical Trends." This report recommended statewide collection of data on a variety of ecosystems, including rivers and streams, in order to assess current conditions and monitor trends over time. The first report issued pursuant to this recommendation, entitled "Critical Trends in Illinois Ecosystems," was published in 2001 and contained findings from data collected from 1995 through 1999.

With respect to the conditions of the state's rivers, the 2001 report concluded that most Illinois streams had only fair to poor habitat quality and species diversity. Those river basins that ranked the worst in habitat typically were basins where: 1) agriculture was the

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[8] Lawrence M. Page and others, Biologically Significant Illinois Streams: An Evaluation of the Streams of Illinois Based on Aquatic Diversity (Center for Biodiversity Technical Report 1992(1)(Champaign: Illinois Natural History Survey for the Illinois Department of Conservation, 1991), 1.

predominant land use; 2) streams had been channelized; and 3) streams lacked natural habitat features such as wooded riparian corridors.

The harmful effects of channelization on stream quality and biodiversity are demonstrated in the graph in Figure 13 from the Illinois Department of Natural Resources' Critical Trends Assessment Program (CTAP) 2002 Report. The data displayed in the graph is from streams and rivers throughout Illinois and represent a small snapshot of problems in the stream ecosystems of Illinois. The CTAP "uses a 12-point quality scoring scheme developed by the USEPA (Barbour et al. 1999 and Plafkin et al. 1989) to measure habitat quality."

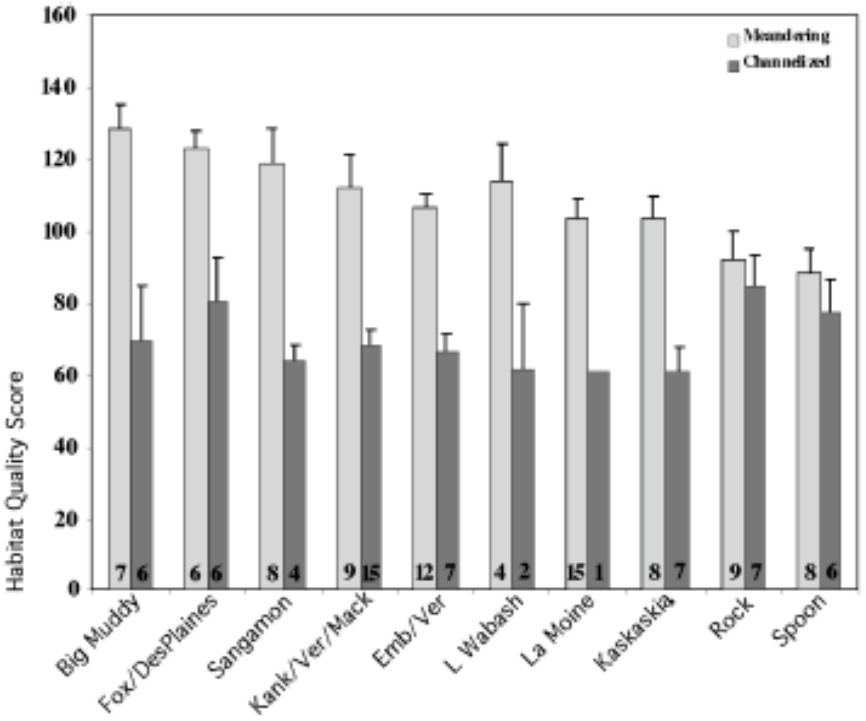

Figure 13 – CTAP stream sampling mean habitat quality + standard error for ISIS basins by channel type. Numbers in bars indicate sample size.

Section 303(d) of the Clean Water Act requires the Illinois EPA to assess water quality of Illinois streams and lakes and to issue a list of waters that are "impaired." Impaired waters are those water bodies that are so polluted that they cannot support their

"designated use."[9] The primary source of information for preparing the Section 303(d) list is the Illinois Water Quality Report. The 2006 Water Quality Report assessed 15,419 stream miles within the state; approximately 12% of these assessed miles were deemed impaired due to channelization.

The fact that our stream systems are being degraded provides a challenge for farmers, agricultural professionals, landowners and individuals concerned about our rivers and the many functions they provide: how do we provide adequate drainage while working with instead of against river geomorphology, while at the same time maintaining healthy river ecosystems? Responsible stewardship requires understanding the dynamics of river systems, how current agricultural drainage practices interrupt those dynamics and impact ecosystems, why these practices remain in common use, and what economically feasible, environmentally sensitive alternative practices are available.

[9] The six designated uses that may be assigned to a given stream segment or lake are aquatic life, fish consumption, indigenous aquatic life, public and food processing water supply, primary contact (swimming), and secondary contact (recreation).

CHAPTER 4

IMPROVING DRAINAGE PRACTICES

Drainage Practices Have Not Evolved With Other Agricultural Advances

During the drainage boom in Illinois, success for the farming community depended on how quickly a drainage channel could be dredged and how quickly that channel could drain a field. That drainage systems were integral to Illinois' economy is exemplified by the Illinois State Board of Agriculture sponsoring competitions in 1886 for manual ditch diggers, tile ditching machines, and dredges.

When the rush to construct drainage systems was at its peak, there was little, if any, awareness of the environmental costs of these systems. Whether a drainage channel was completely man-made or whether it was formed from existing rivers and streams, its significance was based on its usefulness to farmers. Loss of habitat, water quality, or flooding problems was impossible to imagine for those who had first encountered lands rich with wetlands, rivers and streams.

As drainage maintenance became necessary in subsequent years, maintenance practices continued to emphasize the utility of channelization to farmers, without regard for how these practices impact the other benefits and functions that rivers provide. Although many farming techniques have changed over time, drainage maintenance practices remain frozen in the past: to continue doing what has always been done pervades as the "best" way.

For drainage managers, the idealized version of a drainage waterway is a channel that looks as though it has just been dredged; smooth, flat, and wide-bottomed, with sloped banks bare of any vegetation, and a channel shape that is free of meanders. Features such as benches and meanders that exist in natural streams and that form in response to channelization and maintenance are viewed as obstructions to drainage, and need to be eliminated.

This ideal image of a drainage channel has also largely been adopted by those who conduct the business of drainage: drainage commissioners, engineers and excavators.

Through the years, excavating companies and engineering firms specializing in agricultural channel dredging have been created, and ongoing business relationships have been established with drainage districts. A core assumption of these relationships is that the current maintenance practices of straightening, dredging, and clear-cutting is the most efficient and economical way to improve drainage. Contracting maintenance work thus becomes a simplified process, which also makes it seem cost effective. New information and technology, however, demonstrate that alternatives to this traditional approach should be considered as they may be more cost effective and environmentally sensitive and should be considered.

The Case for Improved Drainage Practices

Changing current drainage practices will not be easy, yet there are several reasons why it makes sense to do so.

- First, we now have greater expertise and knowledge about river ecosystems and those factors that contribute to their health. Research on river systems and how they change over time demonstrates that the dynamics of these systems work towards achieving stability; a dredged channel will seek to return to its natural, meandering state, requiring dredging again and again. Re-dredging and other current drainage maintenance practices disrupt natural hydrological/water flow patterns, resulting in channel alterations and degraded habitat. (Rhoads et al. 2003, Urban and Rhoads 2003). Responding to these natural, inevitable channel adaptations by dredging results in a future "need" for repeated dredging. Instead, drainage managers should be looking for maintenance solutions that work with, not against, river hydrology and ecology.

- Second, land use patterns within the state continue to change, impacting agricultural communities as well as the natural river systems within those communities.

- Third, interest in protecting the wide range of functions that rivers provide is a growing concern among a broad spectrum of the public including anglers, municipalities, and homebuilders who depend on these natural amenities. These

groups want to know what activities are impacting their rivers and are becoming involved in decisions that could impact their interests.

- Fourth, since 1976, under the Illinois Drainage Code, drainage commissioners have had a legal obligation to protect environmental values in any activities in which they engage. Specifically, Section 4-15.1 states:

  In performing any of the duties and in exercising any of the powers provided in this Code, the commissioners shall use all practicable means and measures, including consideration of alternative methods of providing the necessary drainage, to protect such environmental values as trees and fish and wildlife habitat, and to avoid erosion and pollution of the land, water or air. (70 ILCS 605/4-15.1)[10]

- Fifth, information on implementing alternative, environmentally-friendly maintenance techniques is readily available to Illinois farmers and drainage managers. The University of Illinois publication "60 Ways Farmers Can Protect Surface Waters" contains sections on controlling streambank erosion without dredging and on the benefits of letting channels follow their natural course.[11] The "Indiana Drainage Handbook," published by the Indiana Department of Natural Resources (INDNR) decribes a number of targeted techniques for drainage maintenance (for example, there are over twenty repair options for the problem of eroding banks)[12] (see Appendix A). Ohio's Department of Natural Resources (ODNR) has a series of fact sheets on steam management that include topics such as selecting trees to "achieve

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[10] Unfortunately, the requirement of environmental oversight required by the drainage code has not been vigorously applied by Illinois courts. Typically a statement, unsupported by specific facts, made in a drainage district's petition that they have followed the mandates of Section 4-15.1 suffices as "proof" of meeting the section's provisions.

[11] Sections 24 and 25 of "60 Ways Farmers Can Protect Surface Water, online at http://www.thisland.uiuc.edu/60ways/60ways.html, under the link "Controlling the Flow of Water."

[12] The "Indiana Drainage Handbook," under the heading "Local Water Resource Project Guidance," can be downloaded from IDNR's website at: http://www.in.giv/dnr/water/publications/indexhtml.

environmental and economic benefits while maintaining drainage capacity." (Appendix B). Other topics include practices for reducing erosion, stabilizing banks, and assessing the need to remove woody debris.[13]

- Sixth, there are federal programs under the Natural Resource Conservation Service that provide technical and financial assistance for improving farmlands and farm practices; the benefits provided by these programs could include improving drainage channels using more environmentally-friendly techniques. (Appendix C)

- Finally, there is increasing interest among commercial stream restoration companies to perform projects to improve agricultural drainage waterways. Typically these projects involve larger segments of channels that have multiple and/or extensive damage. Stream restoration professionals use repair processes that are based on the principles of stream hydrology and ecology, and result in multiple benefits of improved drainage, water quality and habitat.

In summary, current drainage practices such as repeated re-dredging are inefficient as maintenance techniques because they ignore the realities of stream and fluvial processes in favor of taking whatever action is necessary to maximize channel capacity and water flow speed. Ultimately, these maintenance practices are also not economically cost effective, as they require the use of expensive equipment for excavation and dredging, to achieve a "benefit" that is short-term.

In contrast, alternative practices developed in the last few years are based on the principle that waterways serve many functions and provide many benefits, including the needed benefit of agricultural drainage. New technologies and understandings of river ecosystems have made it clear that the perceived view of the straight, deep channel as the only means of providing adequate drainage no longer holds true. Waterways need to be

[13] The ODNR Stream Management Guides can be downloaded from ODNR's website at: http://www.ohiodnr.com/water/pubs/fs_s/streamsfs.htm.

managed using methods that maintain and preserve stability of the channel and its existing habitats.

Application of Alternative Maintenance Techniques

Improving drainage maintenance practices requires two steps: 1) Careful assessment of the extent and type of problems currently contributing to poor drainage; and 2) Correction of identified problems using specific and targeted measures.

Citizens concerned about river ecosystems should advocate for this more targeted approach when drainage projects are being considered.

1. Careful Assessment of Drainage Problems[14]

Assessing drainage problems first requires identifying whether and where there is a need for maintenance: is the current level of drainage adequate for successful crop production? If not, there needs to be thorough assessment of the specific factors that may be contributing to poor drainage, including:

- ***a. Field conditions.*** Poor drainage may be caused by tile conditions in the field. What is the current condition and effectiveness of underground tile lines and surface drains in the field? What is the current condition and effectiveness of tile outlets? Are the locations of all tile lines, and locations and elevations of tile outlets known? How do changes in water levels within the channel impact tile outflow efficiency?

[14] E. Herricks and Bruce L. Rhoads, "Information Needs to Guide Decision Making About Drainage Channel Maintenance," (Urbana: University of Illinois, 2004). http://www.wq.uiuc.edu/needs.pdf.

Figure 14 – Example of drainage outlet

b. Drainage channel capacity. Channels may vary in their capacity at different points, which impacts overall water flow. For example, if a channel that is fairly large has a section downstream that is more narrow it will act like a dam, causing water to back up, and water levels to rise upstream. Drainage managers often assert a need for maintenance dredging based on the accumulation of large amounts of woody debris in the channel, which form logjams. However, logjams are often associated with bridge crossings, as the bridge pilings both narrow the channel and create obstacles against which debris collects. Removing these logjams is an easier and less environmentally destructive approach.

Figure 15 – Example of logjams

c. Bank erosion and channel capacity. A thorough inventory of a channel's bed and banks will reveal the location and extent of bank failures. What are the probable factors causing the erosion? Are the causes internal or external to the bank? For

example, the slope of a channel bank may be too steep, or an artificial levee along the bank may have a section that has collapsed or eroded, thus causing erosion within the channel.

d. ***Short-term vs. long-term and local vs. system-wide responses.*** How does the channel respond over time to maintenance? What is the tendency of the waterway to develop benches, bars or other depositional features after maintenance? What will be the level of flooding, sedimentation or erosion in upstream tributaries or downstream areas that will result as the waterway adjusts to the altered conditions produced by drainage maintenance activity?

e. ***Environmental quality, protecting environmental values.*** What types of flora and fauna are present in the channel and on the banks? Are there any threatened and endangered species living in the waterway? What is the connection between organism abundance and diversity to the existing channel habitat? What is the current water quality? Is the channel part of a river system that has been designated as "biologically significant" by IDNR? Are there any wetlands adjacent to the drainage stream?

2. Correction of Identified Problems Using Specific and Targeted Measures

The most important starting point for a maintenance plan is having a detailed inventory of the drainage system that includes observations about the types of drainage problems and how they relate to stream and water flow conditions. For example if there is an erosion problem, the type of treatment applied to fix the problem will depend on whether the erosion is confined to scouring the bottom or whether it is contributing to bank failure.

Good drainage maintenance strategies acknowledge channel features as assets and water dynamics as allies, so that the end result is a drainage system that works towards self-regulation and stability. Such a system will accommodate functional and ecological diversity. In the long run, such a system will also be less costly both from an economic and ecological standpoint than the current practice of repeated large scale dredging and clearing

of a stream. Finally, such a system will provide a more customized approach to handling drainage problems rather than using the same technique for all problems.

A variety of targeted approaches exist for specific drainage problems. The following assessments and treatment options are provided as examples of practices that have been or could be adopted successfully in Illinois:[15]

a. Problem: covered outlet pipes.

Figure 16 – Example of a covered outlet pipe

Solution: Sediment that covers tile outlets can be cleared away. To prevent future sedimentation of the outlet, stones can be placed immediately upstream of the outlet in order to increase the speed of the water flow immediately in front of the outlet. For outlet pipes less than eight inches in diameter that do not carry high velocity flow, outlet extensions could also be attached.

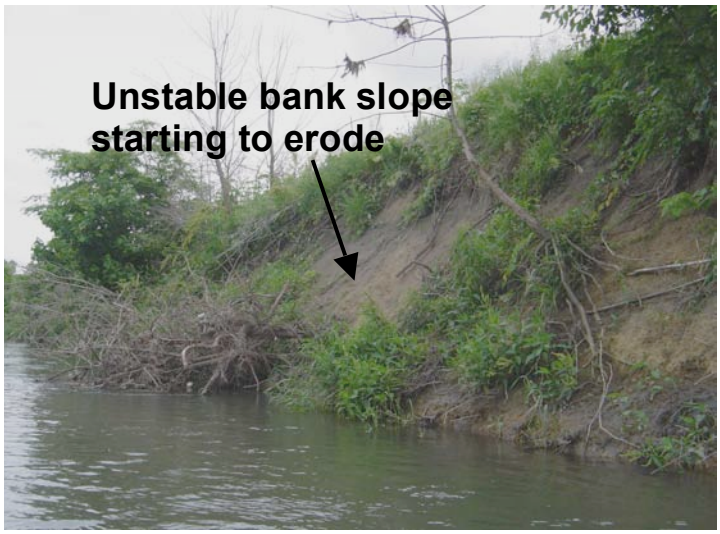
[15] This listing includes techniques that are currently used by the Hastings Drainage District. Some of these techniques are noted in "Streambank Stabilization in Illinois," a pamphlet jointly produced by the Illinois Department of Agriculture, Association of Illinois Soil and Water Conservation Districts and the University of Illinois Extension. www.agr.state.il.us/Environment/LandWater/index.html), and the "Indiana Drainage Handbook" (see footnote 7).

Figure 17 – Example of an outlet extension
(Image from Indiana Drainage Handbook and courtesy of Tipton County)

b. ***Problem: tile outlets below the water line.***

Solution: Consider raising the levels of the tiles instead of dredging to lower the channel bottom. Studies indicate that field tiles placed at shallower depths not only give greater drought protection, but aid in retaining more nitrates and other agrichemicals.[16]

c. ***Problem: eroding or unstable banks.***



[16] Studies by University of Illinois researcher Richard Cooke indicate that tile drains placed at shallow depth of 2 to 3 feet provide needed water to root systems during drought periods and also reduce the amount of nitrogen in tile effluents. For more information, visit http://www.wq.uiuc.edu/shallow/FlowandTransport.htm.

Figure 18 – Examples of eroding banks

Solution: Bank erosion problems are often "corrected" using the single step of re-shaping the bank to its former slope. This practice fails to address the hydrological processes that also contribute to erosion. As the photographs in Figure 18 demonstrate, different stream conditions and streambed contours create varying patterns of erosion. The best method for stabilizing eroded banks requires assessment of a stream's unique characteristics.

Some solutions to bank erosion are "structural," such as placing riprap on the affected bank. There are also a variety of maintenance options based on "vegetative" techniques (meaning they incorporate natural materials). Some of the advantages of vegetative techniques are they contribute to improved water quality and wildlife habitat, they absorb the energy from currents that leads to bank erosion, and they help retain water in the soil.

One of the simplest vegetative techniques is to re-grade the banks in the specific area where erosion is occurring to a more stable slope, and then seed them with native grasses that provide good erosion control. Eroded areas could also be filled, compacted and then seeded with native grasses. The bottom or "toe" area of the bank may also be stabilized using rock or woody material; this material will act to slow the flow of water and allow for sediment to be deposited in the problem area. In addition the added material will act to divert the flow of water to the opposite bank to lessen the erosive action of the water.

Another vegetative technique is branch packing, where layers of branches and soil are stacked or set into a bank that has been scoured out, or along a portion of a bank that is failing. The materials can be placed either above or below the water's surface, and can even be used in water that is fast and/or moderately deep.

Figure 19 – Branch Packing Technique
(Image Source: Indiana Drainage Handbook)

Creating vegetative geogrids is a technique similar to branch packing that can be used for repairing large areas of erosion, as well as banks with steeper slopes. Geogrids consist of branches or brush that is wrapped in geotextile material; a new bank is built by alternating the wrapped braches with layers of soil. The design and materials used for geogrids offer immediate bank stability as well as a medium for planting bank vegetation.

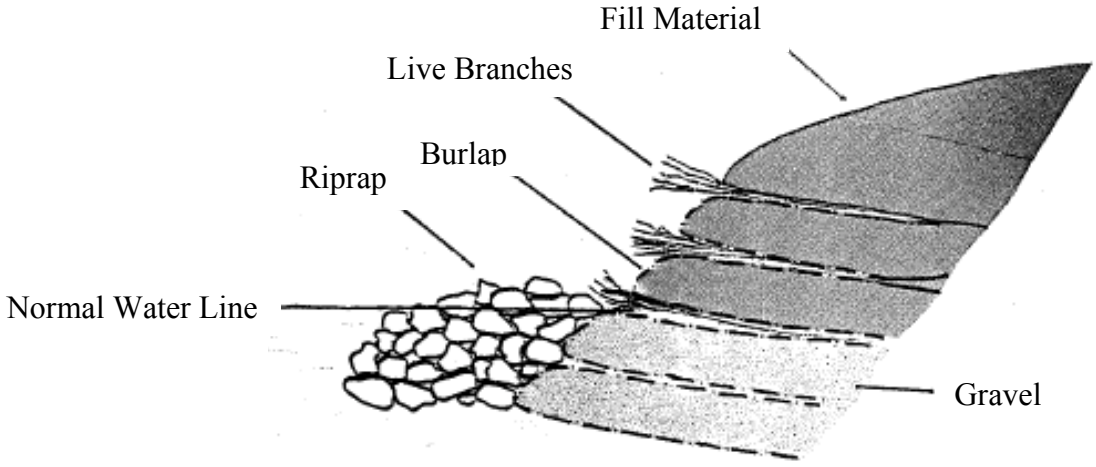


Figure 20 – Geogrid Technique
(Image Source: Indiana Drainage Handbook)

Banks can also be stabilized by installing "deflectors," which are materials placed from the bank of the stream into the current to direct flowing water away from the bank. The technique of using deflectors to stabilize eroded banks originated in stream restoration work; their success results from the fact that individual deflectors are designed to work with a particular stream's existing water and soil dynamics.[17]

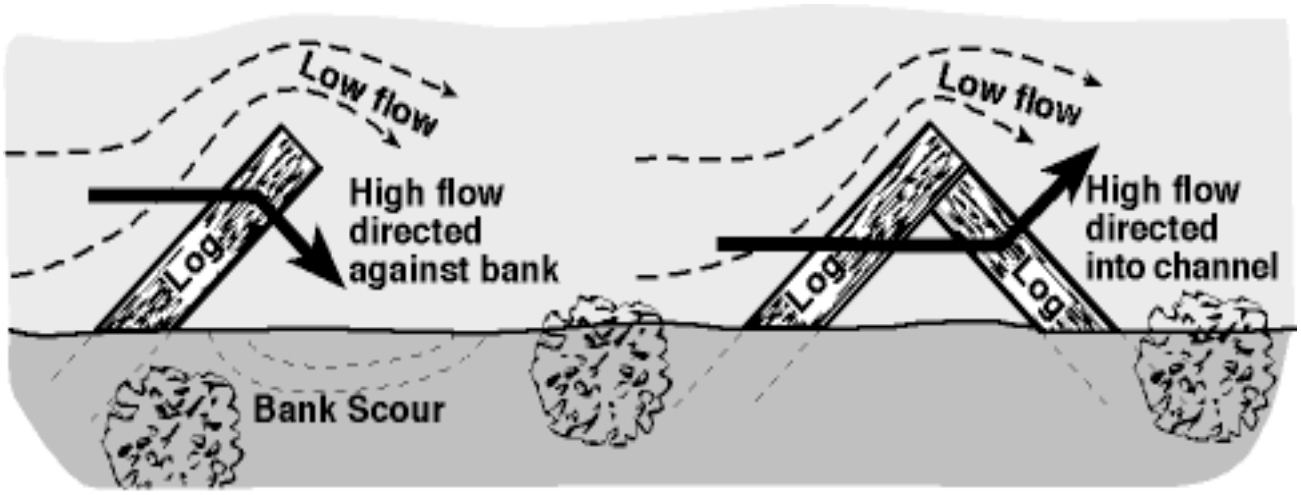


Figure 21 – Example of deflectors for stabilizing eroded banks
(Image Source: Ohio Department of National Resources)

For the "J-hook" deflector design, rocks are installed out ward from the bank in the form of the letter "J." The J-hook causes the water flow to slow near the bank, which allows sediment to be deposited away from the bank to prevent any more erosion. This sediment will eventually form a more stable bench area adjacent to the bank. The J-hook also adds a scour hole near the head stones, which helps maintain the depth of the channel and provides habitat for aquatic organisms.

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[17] Rosgen, D. L. "The Cross-Vane, W-Weir and J-Hook Vane Structures: Their Description, Design and Application for Stream Stabilization and River Restoration." Paper presented at ASCE Meeting, August 2001, Reno, Nevada. http://wildlandhydrology.com/html/references_.html.

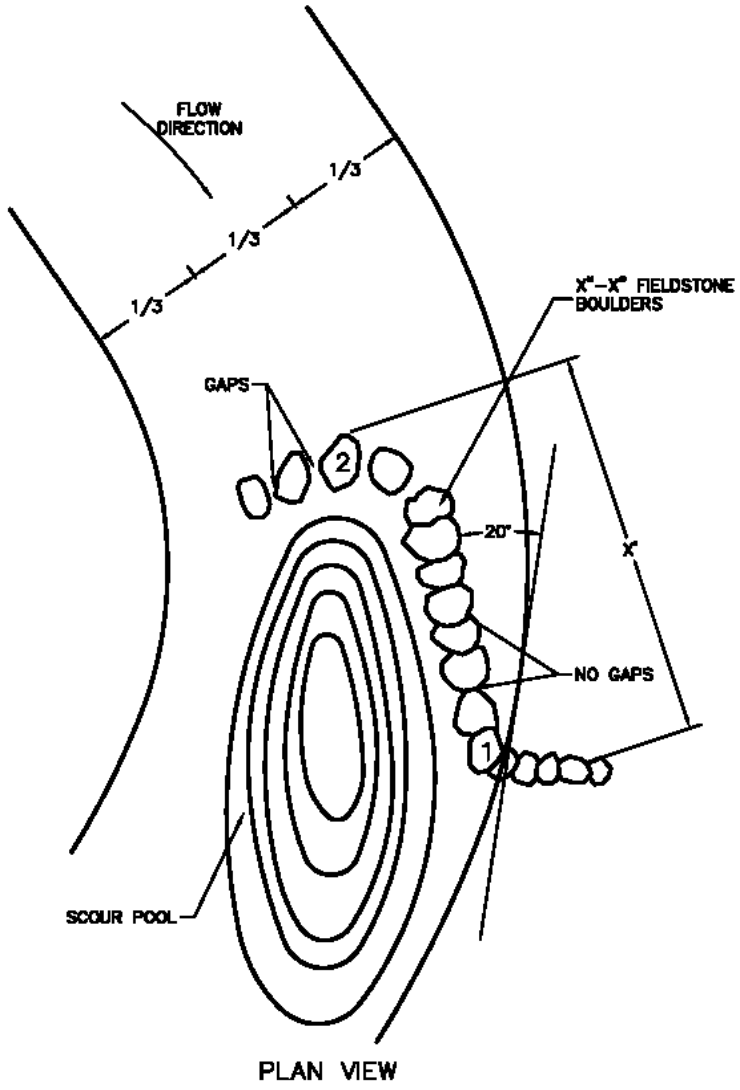

Figure 22 – J-hook plan view

Other deflector designs include cross-vanes (curved rock structures which stretch across a stream channel) and W-weirs ("W"-shaped structures which also are laid across a channel). Although rocks are the best material for creating deflectors, logs can also be used.

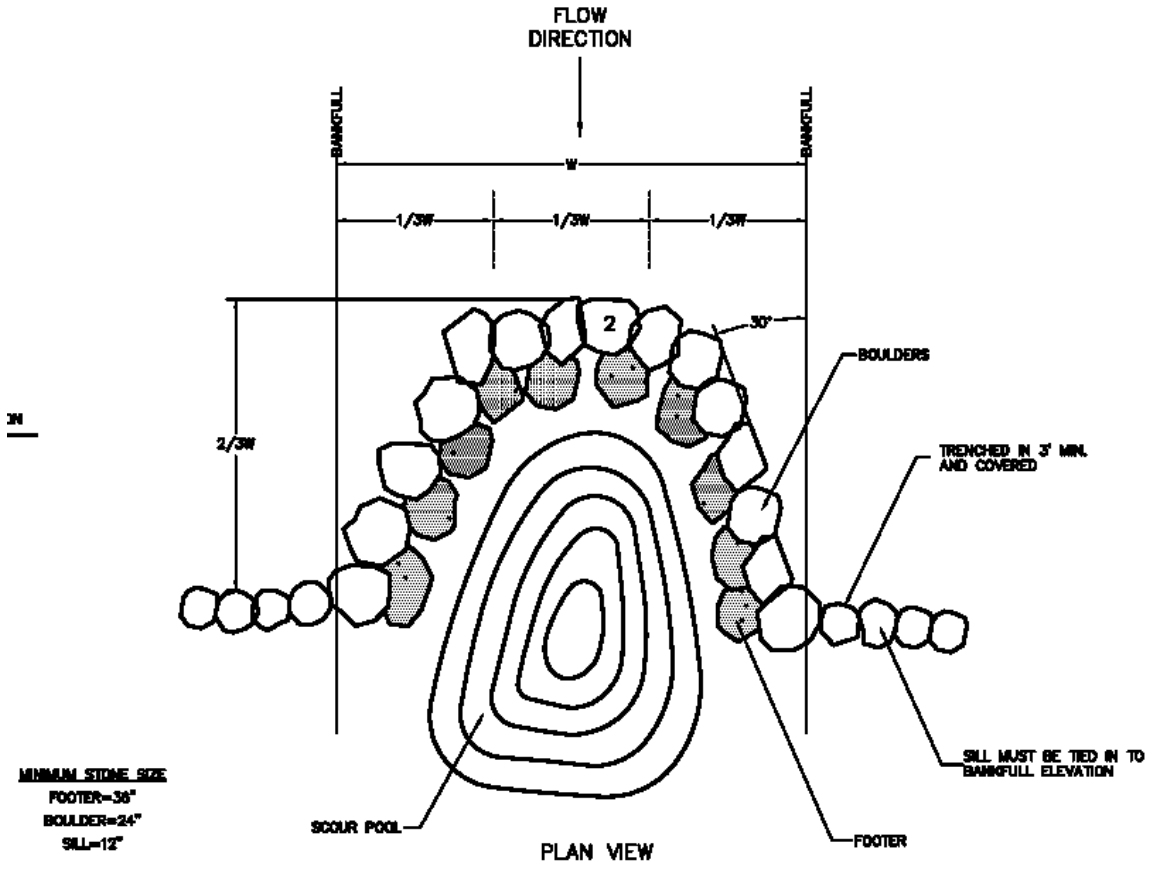

Figure 23 – Cross vanes plan view

d. ***Problem: bank vegetation.***

Solution: The type, location and amount of bank vegetation should be assessed individually to determine: 1) whether it impedes or helps drainage; and 2) what environmental value it is provides. If smaller shrubs or bushes are removed from the banks, they should be cut level and then sprayed with an EPA-approved herbicide to prevent re-growth. Healthy trees growing on the channel banks aid bank stability with their roots, preventing erosion and enhancing habitat. However, they may have branches that extend into the water and act as a drag on water flow. In this situation, it is not necessary to remove the tree; lower branches can be pruned or removed.

In Figure 24, trees have been cut at ground level and allowed to re-sprout many times, resulting in multiple low-lying branches that impede flood flows. If the trees were 'limbed up' (the low branches cut off) they would provide shade and bank stability, without significantly impeding drainage:

Figure 24 – Poorly trimmed vegetation impedes water flow

The decision to remove a tree should be the result of a careful, individual assessment that the tree creates significant drainage problems and provides negligible environmental value. If removing a tree is necessary, the tree should be cut level with the bank, and the trunk should be sprayed to prevent shoots from growing later. Attempting to remove the stump instead of cutting it will cause unnecessary erosion. If stream access is necessary for maintenance, trees should only be removed from one side, as recommended by the Army Corps of Engineers. In addition, maintenance area ingress points should be carefully planned to minimize the number of trees removed solely for equipment access.

Assessments of bank vegetation should not be limited to deciding whether to remove trees or brush; in some cases it may be beneficial to either replace a damaged or diseased tree or to plant additional trees or shrubs for the purpose of stabilizing banks, improving water quality and/or creating wildlife habitat. Native trees and

bushes should be planted as they are adapted to local soil and weather conditions. In addition, planning tree placement is important to avoid interfering with current drainage functions (such as the flow from outlet pipes). (See Appendix B).

e. ***Problem: existing benches.***

Solution: As already indicated, benches actually provide the benefit of bank stabilization, and act as a floodplain during larger flows. For these reason, drainage managers should give serious consideration to adopting a "do nothing" policy with respect to benches. If one segment of a channel requires extensive repair, and it is necessary to re-shape the channel, drainage managers should consider non-traditional channel shapes designed to mimic the changes created naturally by stream dynamics. Researchers at Ohio State University have developed a "two-stage" channel design that provides bank stability and also enhances water quality and habitat conditions.[18]

Figure 25 – Example of stabilized two-stage channel design

[18] Ward et al. 2004. See footnote 6.

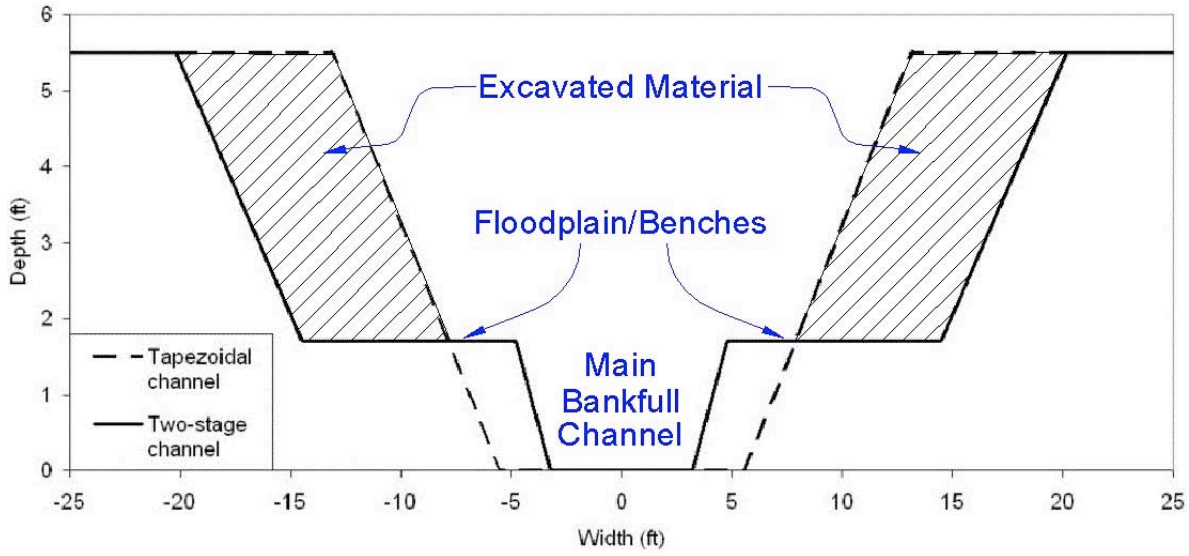

Figure 26 – Diagram of two-stage channel design
(Image Source: G. Erick Powell, Ohio State University)

f. ***Problem: frequent flooding.***

Solution: This condition presents an example of why drainage managers need to conduct thorough inventories of entire drainage channels, and not just segments of them. Flooding may be caused by a variety of factors, including what is happening on land upstream or downstream from the problem area. For example, if more drainage tile is being laid in fields upstream, or if an upstream segment is being dredged, the resulting faster water flows will impact downstream areas.

"Woody debris" (an accumulation of branches, logs and brush in a stream) is often blamed for drainage channel flow and flooding problems. As mentioned earlier, when a large enough quantity of woody debris creates a logjam, the cause is often structural (i.e. wood getting stuck against a bridge support). The best solution for repeated logjams may not be to re-dredge the channel, but to assess what is causing the logjam and try to correct that specific problem.

As in all maintenance decisions, the presence of woody debris needs to be assessed on an individual basis. The American Fisheries Society's publication "Stream Obstruction Removal Guidelines" contains pictorial examples of varying

woody debris accumulations and provides recommendations as to when removal is appropriate.[19]

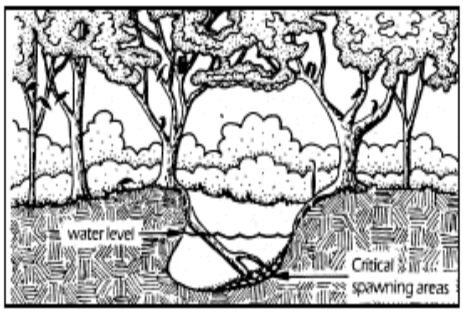

Figure 27 – Image showing Condition Five for assessing woody debris removal
(Image Source: Indiana Drainage Handbook, American Fisheries Society)

Condition Five of the Guidelines recommends that particular attention should be given to debris in waterways with "unique, sensitive, or valuable ecological resources;" under these conditions, decisions to remove logs "must be made on a case by case basis." If debris removal is necessary, "using hand-held tools is more acceptable than using heavy machinery."

The problem of woody debris is just one example of how conditions or activities upstream or downstream can have unintended consequences in other parts of a stream. As a part of their maintenance program, drainage managers are legally required to conduct regular inspections of all segments of a drainage waterway;[20] they should also inform themselves about activities occurring upstream or downstream of the channel.

The drainage maintenance techniques presented in this section are only a partial listing of alternative practices available to farmers and drainage managers. These alternative techniques can achieve the combined benefits of necessary drainage,

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[19] The "Stream Obstruction Removal Guidelines" can be ordered online form the American Fisheries Society's bookstore at: http://216.247.60.109/cgi-bin/hazel-cgi/hazel.exe or by calling 678-366-1411. The Indiana Drainage Handbook also has a copy of the guidelines on pages 5.4-2 through 5.4-6.

[20] 70 Illinois Compiled Statutes (ILCS), Section 605/415.

improved water quality and habitat protection. Maintaining agricultural drainage systems for long-term functional stability and environmental benefits can be done; however, to be truly effective, it needs to be the result of early communication and collaboration among the parties involved.

CASE STUDY

A TARGETED DRAINAGE MAINTENANCE STRATEGY: ACTIONS AND DECISIONS TAKEN BY THE HASTINGS DRAINAGE DISTRICT

(As reported by Charles Goodall[21], Hastings Drainage District Commissioner)

The Hastings Drainage District is a 5,000-acre upland district that owns two tile lines and maintains four and one half miles of drainage channel (the Goodall Branch of the Little Vermillion River in the southwest corner of Vermillion County). In the late 1980's a maintenance backlog had accumulated and costly end-to-end redredging of the channel was being planned. A petition requesting additional assessments to pay for the redredging was denied by the Vermillion County Court, in large part because landowners demonstrated to the court that there were less costly and more effective ways to achieve adequate drainage.

Subsequent to this court case, Goodall became commissioner for the Hastings Drainage District. He was interested in developing a problem-focused maintenance strategy that would correct channel problems (such as unstable banks) at a lower cost than traditional dredging, and also take into account other functions of the channel such as wildlife habitat and preservation of water quality. In addition, Goodall wanted to create a maintenance process that would include landowners during the planning stages. The plan was publicized so that landowners would know: 1) that the drainage district was taking action; 2) that the plan included new creative approaches, and how these approaches would correct the problems; 3) that the financial cost of the plan was a fraction of what it would cost to redredge the channel; and 4) that the plan would preserve channel stability.

The first step in developing this plan was to walk the length of the channel and take a detailed inventory of problems. The drainage district then hired a geomorphologist to assess the condition of the channel and suggest individualized maintenance options, which could be prioritized based on the severity of the problem.

In general, there were three types of conditions that were affecting the channel's ability to provide adequate drainage; excessive silt in certain parts of the channel, obstructions to the flow of water, and unstable banks. With respect to each type of problem, they devised a maintenance technique that addressed each individual source of the problem, and made corrections in a localized manner.

For example, they determined that excess silt was entering one section of the channel because of a failure, or "cut," in the berm adjacent to it. Because of this failure, surface waters containing silt were running directly into the channel. This problem was corrected by installing a short pipe under the berm that had one end in the field and the other end entering

[21] Charles Goodall is also a Prairie Rivers Network board member.

the channel. On the field side of this pipe, they dug a small basin, which acts as a water catchment area. Now when there is surface flow in this section of the field, the water first collects in the basin, which provides time for the silt to settle and collect in the basin. Once the surface flow increases to the point where water flows through the pipe, the water entering the channel is free/ almost free of silt.

Obstructions to water flow in a drainage channel can take many forms, from living trees and shrubs, to sediment bars, to woody debris. In developing their drainage maintenance plan, the Hastings Drainage District looked at each obstruction individually and first determined whether what appeared to be an obstruction really in fact did prevent adequate drainage. For example, a large cottonwood tree was growing along one side of the channel bottom. Typically under current practices, all trees within a channel are removed for maintenance. In this case, they first assessed the extent to which the tree actually impacted water flow. Then they assessed the value of the tree for other purposes, such as bank stability and wildlife habitat, and decided that the benefits provided by this tree were greater than any reduction in flow that might be caused by its trunk being in the bank (see Figure 28).

Figure 28 – Cottonwood tree that didn't need to be removed

Because of their invasive growth patterns, some mulberry trees were cut and the stumps sprayed because it was decided that in their particular location, they were less of an environmental asset and more of a liability to drainage.

Obstructions that were caused by the buildup of sediment were also assessed and treated on an individual basis. For example, in one section of the channel, water flow was impeded by a build-up of sediment on the channel bottom. Rather than dredging out the entire length of the channel and clearing its sides, they performed maintenance in a localized manner; only the excess sediment on the bottom was removed and removal was done only in the affected section of the channel.

Bank instabilities along the channel were also assessed and treated individually. The District was able to correct an erosion problem near a headwall by filling and compacting the washed out section. Placing a "net" of wood branches over the eroded area and then anchoring this net in place with metal rods treated erosion on another bank. Erosion along the bottom sections of the banks was corrected by placing rocks along the bank's edge or placing rocks in the water to deflect the water flow away from the eroded section.

Some maintenance remedies required cooperation of landowners. In one instance, topsoil was entering the channel from surface flows off of a field. By agreeing to construct and plant a grassed waterway across his field, the landowner helped the district reduce the amount of sediment entering the channel.

In adopting a targeted approach to drainage maintenance, the Hastings Drainage District has been able to provide adequate drainage at a cost that was twenty percent of the total requested by the District to perform a complete dredging of the channel. In addition, important environmental amenities and functions of the channel have been preserved.

CHAPTER 5

RESOURCES FOR CITIZEN ACTION

At this time, the concept of changing drainage maintenance practices is controversial. However, discussions have begun between members of farming communities, researchers, non-farming landowners and others interested in balancing the needs of drainage with protection of aquatic ecosystems. Some districts have promoted more targeted, environmentally sensitive drainage practices; several districts have worked with researchers to develop a better understanding of the relationship between stream dynamics and improved maintenance efforts. Workshops that include sessions on stream geomorphology and alternative maintenance practices, while held in a few counties, are infrequent. Keeping the topic alive means, in part, that citizens have to let drainage district commissioners know they are informed and interested in being active participants in decisions which impact the water resources depended on by so many.

Whether you live on a river or not, whether you are a farmer or not, it is important to remember that every person who lives within a particular drainage district can influence the fate of its water resources for the better. Here are some guidelines for actions you can take:

Learn About Your Watershed

Your watershed and the rivers and streams within it are precious natural resources – learn what makes them unique and worth protecting. IDNR has regional watershed assessments that provide a comprehensive inventory of resources, from flora and fauna to archeological sites. Booklets are organized by river basins, and include additional information on factors impacting natural resources, such as population growth, mining, and agriculture. The inventories can be viewed online at http://www.dnr.state.il.us/orep/c2000/assessments/. Some assessments can also be printed from the website; all may be ordered from IDNR's Clearinghouse by email clearing@dnrmail.state.il.us or by phone 217.782.7498. More specific river and stream information is contained in the 1991 report "Biologically Significant Streams of Illinois," listed in the bibliography.

Information about the Critical Trends Program, two volumes of the 1994 report (including Volume 2 on water resources), and the 2001 and 2002 reports are available online at http://www.dnr.state.il.us/orep/ctap. Most of these can be printed off the website and are also available from IDNR's clearinghouse.

The Illinois endangered species main website at http://www.dnr.state.il.us/espb has links to a list of state and federal endangered species, as well as a printable brochure. There is also a link to the state statutes dealing with takings of endangered species, as well as the permits required for possessing such species (for such purposes as scientific research or education).

Learn More About Drainage

As Illinois' only statewide river conservation organization, Prairie Rivers Network supports citizen education and involvement in all aspects of river conservation, including drainage and other issues. Information about drainage issues in Illinois can be found on our website at http://www.prairierivers.org.

The University of Illinois has a Water Quality website at http://www.wq.uiuc.edu with several useful tools for those interested in alternative approaches to drainage maintenance practices. The *Current Issues* link on the website has a printable version of "Information Needs to Guide Decision Making About Drainage Channel Maintenance." Its *Publications* link provides the text for "60 Ways Farmers Can Protect Surface Water," which includes low cost, targeted methods of preventing erosion and other drainage problems. Publications can be ordered by email acespubs@uiuc.edu or by phone 217.333.2007. The Water Quality website also contains an online "Illinois Drainage Guide" via its *Resources* link. This guide has sections devoted to conservation drainage designs that focus on the problem of reducing the amount of effluents such as nitrogen that flow into the drainage channel. Citizens who want to advocate for more environmentally sensitive approaches in their local drainage districts will find these resources very useful for making their case.

Vermont's Agency of Natural Resources has excellent fact sheets on geomorphology at http://www.anr.state.vt.us/dec/waterq/rivers/htm/rv_geoassess.htm. North Carolina State

University's Stream Restoration Institute also has links to public fact sheets on stream processes, as well as information on hydrologic research: the Institute's website is http://www.bae.ncsu.edu/programs/extension/wqg/sri. The University also offers "Farm*A*Syst" publications: publication number nine provides a worksheet for farmers to use in assessing the health of stream on their farms. These publications are at http://www.soil.ncsu.edu/assist.

Drainage fact sheets are available through Ohio State University's online extension service "Ohioline" at http://ohioline.osu.edu. The Ohioline also has drainage links to other Midwest states, including Illinois. Information on agricultural research, including drainage research, being conducted by Ohio State's Agricultural Research and Development Center is at http://www.oardc.ohio-state.edu. One study being done by Ohio State researchers is looking specifically at drainage channel restoration that incorporates naturalized fluvial features: information on this study is at http://www.ag.ohio-state.edu/~ncd/project.html. The University of Minnesota also has information on drainage at http://d-outlet.coafes.umn.edu.

Learn About Your Drainage District and Your Local Agricultural Community

Drainage Districts

If you live in Champaign County, the county's Soil and Water Conservation District (SWCD) has a map on its website to help you locate drainage districts in the county (http://www.ccswcd.com). The site also gives you drainage district commissioner names and the name of the district's attorney. Unfortunately, most counties do not have information as readily available for drainage districts. You may need to call your county's SWCD office. If they do not have the information, you can try your county's extension service, which is typically affiliated with a university or community college (in the Champaign County phone book, it's under the business white pages as "University of Illinois Extension").

By law, the circuit court clerk for the county in which a drainage district is located acts as a clerk for the drainage district. As the district's clerk, the circuit court clerk must keep a copy of the following available for public viewing at the courthouse: a list of the active drainage district commissioners with their addresses (this must be filed by the last day

in December), a map of the drainage district, copies of the district's annual financial reports (which must be filed by the last day in November), and copies of the district's request to levy annual assessments. Be aware that drainage district files may be considered part of a particular department (for example, in Champaign County, they are under the Probate section of the Civil Department).

Drainage files will likely span several decades, so it is helpful to let the clerk know if you are interested in looking at a particular year. Also, some parts of the file which may be large in size, such as engineering plans or maps, may be kept in separate drawers (the clerk may not know this).

One important item the court clerk is not required to keep are the minutes from drainage district meetings. This information is considered public and the district must allow access to minutes during reasonable times. Minutes may be held by one of the drainage commissioners, or by the drainage district's attorney.

Your Local Agricultural Community

There are several organizations that exist to support the farm community. It is worthwhile to stay informed about their activities and track what information they provide regarding drainage practices and related issues. The Illinois Association of Drainage Districts (IADD) was formed in 1995. IADD "supports and strives to maintain the integrity of Illinois Drainage Districts." Their website (http://www.iadd.info) contains sections on current events regarding drainage, pending legislation that impacts agricultural drainage interests, educational meetings, and the group's annual conference. This is a good resource for learning about issues of concern for drainage districts and about public meetings (some of which are free) that address topics relevant to all persons interested in drainage.

The Illinois Farm Bureau website (http://www.ilfb.org) has sections on current "hot" topics and legislative alerts. It also has links to institutes involved with agricultural policy, as well as a variety of national and state agricultural census information.

The Farm Service Agency, a part of the United States Department of Agriculture, offers conservation assistance to farmers through its Conservation Reserve Program. This

program encourages farmers to take voluntary actions on their land, such as planting tree and grasses, to lessen erosion, provide windbreaks, or improve water quality. Information on these programs can be found at http://www.fsa.usda.gov/il/.

Become Engaged in Drainage District Activities

One of the most important actions citizens can take is to attend all drainage district meetings as well as the annual meetings. As it is not always easy to learn when these meetings will take place, it may be necessary to call one of the commissioners or their attorney to ask for meeting specifics. Under Illinois' Open Meetings Act,[22] drainage district meetings are required to be open to the public. The Act further requires that the times and places of meetings must be convenient for the public, that public notice of the meetings must be given 48 hours prior to holding the meeting, and that written minutes of the meeting must be kept.

Getting commissioners with an interest in actively pursuing alternative drainage practices will be a long-term process that requires compliance with commissioner selection procedures in the drainage code. If you are a landowner within a drainage district that elects commissioners, electing a particular individual means you will have to get a majority of landowners in your district to: 1) support a new candidate; and 2) vote for that candidate. If you are in a district that appoints candidates, a majority of adult landowners who own a majority of land in the district may file a petition requesting the appointing authority appoint the candidate named in the petition; the appointing authority must appoint this individual unless there is "good cause shown" why the person should not be selected. The appointing authority (likely the County Board of supervisors) will have information on applications for candidates.

At drainage district meetings, the commissioners typically discuss outstanding bills and annual maintenance assessments, but they may also discuss maintenance or other larger drainage projects. Do not hesitate to ask questions, as these meetings are open to any

[22] The Open Meetings Act is in Chapter 5 of the Illinois Compiled Statutes (ILCS), section 120/1. The other provisions noted are at 5 ILCS 120/2.01, 2.02, and 2.06. (See also Appendix E for relevant sections.)

member of the public, not just landowners within the district. You have a right to be there and to have your questions answered.

The power of a drainage district is centered in its commissioners. By law, drainage commissioners have broad authority to make decisions about the need for drainage maintenance (these are summarized in Appendix D). They are the ones who decide what work needs to be done, how it will be done and who will do it. Thus, it is important to have commissioners who are interested in using targeted, environmentally sensitive maintenance practices.

CASE STUDY OF CITIZEN ACTION:
THE MILL CREEK VOLUNTEER MONITORING PROGRAM

In 1999, the Michigan State Drainage Board for St. Clair County initiated a proposal in St. Clair County for large scale dredging of a seventeen-mile segment of the South Branch of Mill Creek. Residents in the town of York and nearby areas opposed the proposed dredging project on the basis that it would result in significant environmental damage to the creek and its corridor, as well as increased flooding. The issue was not whether drainage maintenance was needed, but whether large scale dredging was the best technique.

After a series of legal actions, the original maintenance project proposal was amended: dredging would only be done on 1.75 miles of the creek; less expensive, more environmentally-friendly maintenance techniques would be used on the remaining 15.25 miles. However, this new proposal contained no criteria for determining which maintenance techniques would be used, and in which segments of the creek. Concerned citizens, partnering with the Michigan State Department of Environmental Quality, created the Mill Creek Volunteer Monitoring Project for the purpose of monitoring and assessing environmental conditions in channelized and non-channelized sections of Mill Creek. The results of their efforts were presented to a Technical Advisory Group, formed to advise the Drainage Board on appropriate maintenance techniques.

The Mill Creek story is not concluded, as a final decision has not yet been made on the maintenance project. However, as a result of the MVCMP's efforts, local officials, including the St. Clair County Drainage Commissioner, continue to oppose large scale dredging of Mill Creek. In addition, the MVCMP is now considered a legitimate source for data related to the environmental impacts of dredging on streams.

For more information on the Mill Creek Volunteer Monitoring Project, including their monitoring reports, go to http://millcreekmonitoring.org

Begin a Larger Discussion with All Stakeholders to Further Understanding and Collaboration

The previous suggestions provide a base of knowledge and a starting point for getting involved in the decision making process. One person can start the process, but getting others involved is essential; it means spreading the word. There are countless ways to do this; giving talks to local groups, writing letters to local papers, talking to your elected officials, inviting others to go with you to district meetings, drainage events and workshops (typically events such as the IADD's annual conference or SWCD workshops are open to any member of the public, although there may be a fee charged).

Also remember that there are other entities aside from drainage districts that can affect drainage practices. For example, your county board of supervisors may have the authority to make zoning decisions about riparian areas within agricultural communities. If your drainage district selects its commissioners on an appointment basis, the county board may also be the appointing authority for commissioners.

SWCDs in Illinois work very closely with the farming community. They have their own board meetings (open to the public), as well as workshops. These meetings are both a source of information about what is happening within the agricultural community, and a forum in which to raise concerns about drainage practices.

It is human nature to wait until a crisis becomes big enough for us to "see" or directly feel its impact before we take action. When we do take action, we are often reacting to symptoms of the problem instead of its cause. As you read this, our rivers continue to flow, their waters continue to be impaired, aquatic inhabitants continue to experience impacts from a variety of human activities, including outdated drainage practices. For those of us who love our rivers, we must be proactive in protecting them, for their sake and ours.

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APPENDIX A

EXCERPTS FROM INDIANA DRAINAGE HANDBOOK

Table 4.3c
Practice Selection Guide for Eroded Streambank Repair Activities

ACTIVITY	SITE CONDITIONS	APPLICABLE PRACTICES
Eroded Streambank Repair	Any	**Site Assessment/Preparation/Access:** Site Assessment (P101) Tree Preservation & Protection (P102) Temporary Wetland Crossing (P103) Temporary Diversion (P104) Silt Fencing (P105) Straw Bale Filter (P106) Clearing and Grubbing (P107)
	Design Channel Velocity < 6 ft/sec	**Vegetative Streambank Stabilization:** Live Stakes (P501) Live Fascines (P502) Branch Packings (P503) Tree Revetments (P504) Brush Mattress (P505) Vegetative Geogrids (P506) **Structural Streambank Stabilization:** Stone Riprap (P510) Concrete Retaining Wall (P511) Gabion Retaining Wall (P512) Timber Retaining Wall (P513) Sheetpile Retaining Wall (P514) Composite Retaining Wall (P515) **Combination Streambank Stabilization:** Live Cribwalls (P507) Lunkers (P508) A-Jacks (P509) Other Combination Protective Measures
	Design Channel Velocity > 6 ft/sec	**Structural Streambank Stabilization:** Stone Riprap (P510) Concrete Retaining Wall (P511) Gabion Retaining Wall (P512) Timber Retaining Wall (P513) Sheetpile Retaining Wall (P514) Composite Retaining Wall (P515) **Combination Streambank Stabilization:** Live Cribwalls (P507) Lunkers (P508) A-Jacks (P509) Other Combination Protective Measures
	Any (If overbanks are disturbed)	**Revegetation and Site Stabilization:** Mulching (P1101) Vegetative Stabilization and Seeding(P1102) Bonded Fiber Matrix (P1103) Erosion Control Blankets and Matting (P1104)
	Any	**Other Related Practices:** Debris Disposal (P1301) Permanent Maintenance Access (P1303)

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APPENDIX B

OHIO DEPARTMENT OF NATURAL RESOURCES

STREAM MANAGEMENT GUIDE #8

Trees along ditches? What was once seldom recommended is now considered a responsible approach to drainage management and, when done properly, very compatible with drainage objectives. Trees planted or maintained along ditches can: 1) save money, 2) meet environmental regulations, 3) improve water quality and 4) provide wildlife habitat.

SAVE MONEY

When constructing a new ditch or maintaining an existing one, clearing and grubbing costs can be reduced substantially by leaving at least one side vegetated. Leaving woody vegetation minimizes wind and water erosion' which affects crop yields and reduces the accumulation of sediment in the channel. Where one or both sides remain vegetated, shading inhibits nuisance cattail growth, thereby reducing dip-out or spraying maintenance costs. Ditch berms can grow marketable trees or firewood if selected and managed properly and provide income in later years. If land adjacent to ditches is already out of crop production and taxed at a lower rate trees are a bonus.

MEET ENVIRONMENTAL REGULATIONS

When ditch construction must meet environmental protection standards or require a Section 401 or 404 permit under the Clean Water Act, preserving or planting trees will help mitigate water quality and wildlife damages, often making permit issuance easier.

IMPROVE WATER QUALITY

Tree cover, especially on the south or west side of a ditch, shades the water, keeping water temperatures cooler which increases oxygen levels needed for fish and other aquatic life. Shading also controls nuisance algae growth, which often results in fish kills and other water quality problems. Tree leaves and leaf litter help reduce soil erosion and resulting sedimentation. Tree roots also provide some erosion control by protecting ditch banks from high velocity water.

PROVIDE WILDLIFE HABITAT

Upland and aquatic wildlife benefit from trees. Upland wildlife benefits from cover, food, access to travel lanes and greater number of species which habitat diversity supports. In-stream, leaf litter is the base of the aquatic food chain. Leaves are eaten by aquatic insects which in turn feed minnows and fish. Fallen branches provide cover for fish and smaller aquatic life. Undisturbed vegetation, like that found on one-sided construction, provides better wildlife food and cover than leaving selected trees growing among planted grass.

TREE USE

Trees are suitable for all drainage projects constructed under Ohio Drainage Law (Sections 61 31, 6133, 6135 or 6137 of the Ohio Revised Code), Conservation Works of Improvement (Section 1515 of the Ohio Revised Code), mutual group process, by developers or by individual landowners. With proper tree selection and maintenance, both drainage and environmental benefits can often be achieved.

The recommended width of woody vegetation on "berms" of natural or unmodified channels is two and one-half times the width of the ditch or fifty feet, whichever is less. However, for ditches constructed under Ohio Drainage Law, a minimum of four feet or a maximum of 25 feet width may be "constructed and maintained" and not subject to typical property taxes.

TREE SELECTION

When preserving trees along a ditch, protect those with hardwood, minimal branching, deep rooting and non-brittle characteristics. Where possible, protect trees and their adjacent vegetation from root and soil compaction from heavy equipment for a 10 foot radius around the trunk. When spreading dredged material near trees, never spread more than one inch of soil per year over the roots to avoid feeder root suffocation. The feeder roots are mostly within the tree canopy drip line. When planting trees, choose those that are suitable to the soil drainage and pH conditions. Dredged sediment and compaction from construction access may drastically alter pH and drainage conditions; soil testing may be helpful. Native trees may be a first choice for planting or preserving as listed below, but many other species may be suitable as listed in most county soil survey reports or nursery catalogs.

If future income is desired, select trees with expected high market value. If wildlife management is a goal, select a species with food and cover characteristics. The following table lists recommended trees in Ohio for use along drainage ditches. These trees can withstand periodic flooding and are less likely to cause maintenance problems. High market value trees like Black Walnut (Juglans nigra), White Oak (Quercus alba), Red Oak (Quercus rubra borealis), Sugar Maple (Acer saccharum), White Ash (Fraxinus americana), and Basswood (Tilia americana) are not listed since they are typically found on better drained soils or upland sites. The table also illustrates their suitability to different soil/climate conditions and desirable characteristics. Short lived, brittle and shallow rooted species like Willow (Salix species) are not listed, with the exception of Box Elder (Acer negundo) and Silver Maple (Acer saccharinum) which are common and less problematic trees.

Planted shrubs are fast growing and provide more immediate erosion control and habitat than planted trees. Shrubs may complement tree planting well by establishing a dense vegetative planting. Shrubs and bank erosion control species like Bankers Willow (Salix X cotteti) or Dogwoods (Cornus species)

have beneficial uses in ditch management, but are not covered in this publication.

TREE MAINTENANCE

Wooded ditch berms require maintenance. Regular inspections are needed, especially after ice storms to locate and remove damaged trees which may become water flow obstructions. When dead, leaning or other trees susceptible to breakage are removed, future maintenance costs can be reduced. While the listed species are not likely to cause problems, certain weather damages are not preventable. Trees should be kept away from subsurface drainage outlets so that roots do not plug the drainage pipes and outlets can be located for inspection and maintenance. Trees affected by insects or disease should be treated or removed before problems spread to other trees or they die, fall in and become obstructions.

Common/Scientific Name	Average Mature Height	pH Preferance	Specific Characteristics
			Highly Flood Tolerant Tress
American Sycamore *Platanus occidentalis*	100+'	6.6-8.0	Adaptable to many soils, streambanks, bottomlands, windfirm, long-lived, fast growth, urban tolerant.
Swamp White Oak *Quercus bicolor*	60-70'	6.0-8.5	Lowlands, stream edges, swamps, long-lived, fast growth, wildlife food, sprouts, timber, firewood.
Bur Oak *Quercus macrocarpa*	70-80'	4.6-8.0	Adaptable to many soils, very drought resistant, deep-rooted long-lived, sprouts, wildlife food, timber, firewood.
Pin Oak *Quercus palustris*	70-80'	5.5-6.5	Bottomlands or moist uplands, tolerant of urban stresses, moderately long-lived (100-150 years), firewood, wildlife food,sprouts, fast growth.
Bald Cypress *Taxodium distichum*	60-80'	6.1-8.5	Highly flood tolerant, grows on flooded, poorly drained to upland soils, extensive root system, very windfirm slow-growing, longlived, sensitive to drought and heat, loses leaves in winter, not native although widely planted in Ohio.
Red Maple *Acer rubrum*	50-70'	4.5-8.5	Adaptable to many soil types, some susceptibility to ice and snow damage, moderately long-lived (100-150 years), sprouts, resistant to herbicides, wildlife food, firewood, brilliant fall color
Silver Maple *Acer saccharinum*	60-80'	4.5-8.5	Bottomlands, streambanks, alluvial floodplains, moist sites, drought resistant, branches are somewhat brittle, susceptible to ice damage, can tolerate temporary flooding, sprouts.
Box Elder *Acer negundo*	30-40'	6.5-7.5	Adaptable to many soils, tolerant to drought and cold, short-lived (60-80 years), fibrous root system provides good erosion control, susceptible to wind/ice damage
Honey Locust *Gleditsia triacanthos*	70-80'	6.1-7.5	Alluvial floodplains, bottomlands, drought resistant, shelter-belt series, windfirm, used to pioneer strip-mine spoils, initially fast growing, thorns.
			Moderately Flood Tolerant Tress
Shellbark Hickory *Carya laciniosa*	80-100'	6.1-6.5	Bottomlands & alluvial floodplains, sprouts, long-lived, slow growing, some susceptibility to frost damage, wildlife food, firewood.
Green Ash *Fraxinus pennsylvanica*	50-70'	6.1-7.5	Bottomlands, strip-mine reclamation species, windfirm, alluvial soils along streams, wildlife food, firewood, sprouts, timber
Hackberry *Celtis occidentalis*	30-50'	6.6-8.0	Bottomland, limestone outcrops or soils, drought resistant, fast growing, long-lived (150-200 years), wildlife food.
Slippery Elm *Ulmus rubra*	60-70'	6.6-8.0	Moist, rich soils of lower slopes, streambanks, terraces, and bottomlands, moderately fast growing, fairly long-lived, sprouts. Dutch Elm disease, urban tolerant.
Black Tupelo (Gum) *Nyssa sylvatica*	40-60'	6.1-6.5	Adaptable to many soil types, alluvial stream bottoms, shade tolerant, wildlife food, wildlife den tree, moderately long-lived.
River Birch *Betula nigra*	60-80'	<6.5	Alluvial soils, stream bottoms, highly tolerant of acid soils, sprouts, firewood, most common in South/Central Ohio.

When trees are managed properly they can provide income, benefit water quality and wildlife, protect crops from wind erosion and beautify the landscape. For more information on tree selection or site suitability contact your local Soil and Water Conservation District (SWCD), ODNR Divisions of Forestry or Wildlife, Ohio State University Extension, or qualified private consultant. For more information on drainage laws and standards contact your County or City Engineer, City Manager, Township Trustee or SWCD.

TreeSource—Ohio's Greenprint for the Future— is a strong new partnership between state and local government, private businesses and citizen volunteers renewing Ohio's commitment to planting and nurturing trees across the state.

For more information on TreeSource, contact the Ohio Department of Natural Resources, Division of Forestry (614) 265-6694.

This Guide is one of a series of Ohio Stream Management Guides covering a variety of watershed and stream management issues and methods of addressing stream related problems. The overview Guides listed below, are intended to give the reader an understanding of the functions and values of streams. For more information about stream management programs, issues and methodologies, see *Guide 05 Index of Titles* or call the ODNR Division of Water at 614/265-6739. All Guides are available from the Ohio Department of Natural Resources. Single copies are available free of charge and may be reproduced. Please contact:

ODNR Public Information Center
1952 Belcher Drive Bldg. C-1
Columbus, Ohio 43224-1386
614/265-6605

The guides are also available on-line as web pages and PDF files so you may print high quality originals at your location. You will find the guides on-line at:

http://www.dnr.state.oh.us/odnr/water/pubs/onlnpubs.html.

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Prepared by the Ohio Department of Natural Resources, Dave Bergman, Division of Real Estate and Land Management, principal author. Input from staff of several ODNR divisions, state and federal agencies are used in the development of the Ohio Stream Management Guides.

Guides are available on-line at: http://www.dnr.state.oh.us/odnr/water/pubs/onlnpubs.html

APPENDIX C

FEDERAL AND STATE FARMLAND CONSERVATION PROGRAMS

In 1935, the federal Soil Conservation Act (SCA) was passed to provide assistance to farmers suffering from extreme soil erosion on their farmlands. The SWA authorized what is now called the Natural Resources Conservation Service (NRCS). Included in the NRCS mission goals are achieving productive, high-quality soils, improving and maintaining water quality and quantity, and providing healthy communities for humans and animals.[23] To achieve these goals, NRCS offers several programs that provide technical and financial assistance to farmers to enable them to conserve their farmlands.

NRCS' concept of "conservation" does not treat the soil as an isolated resource; its programs require participants to assess all resources on their land, including rivers, wetlands, plants, and wildlife. The goal of conservation measures put into place by landowners is not only to improve the productivity of farmland, but to protect the health and integrity of the watershed in which it is located.

Like the NRCS, the Farm Service Agency (FSA) originated from programs developed under the SWA, and is one branch of the United States Department of Agriculture (USDA). The primary mission of the FSA is to help farmers financially (preserving farm income by offering assistance with loans, debt adjustment, and achieving fair prices for farm commodities), but the agency also has a few resource conservation programs. One such program is the Conservation Reserve Enhancement Program (CREP), which is jointly administered by the FSA and the state of Illinois. The CREP program covers the Illinois River Watershed and seeks to protect both that watershed's water resources and environmentally sensitive habitat.

Although the NRCS and FSA programs are not designed specifically for improving agricultural drainage, they do provide a means for enhancing the benefits of newer drainage maintenance practices. They can also reduce the need to use older, less environmentally friendly drainage practices. For example, programs that reduce erosion from farmland to improve field productivity lessen the amount of sediment flowing into adjacent drainage channels, thereby reducing the need to dredge. When environmentally sensitive agricultural drainage maintenance techniques are used along the same waterway, water quality will be further improved.

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[23] A full list of the NCRS mission goals is stated in a Fact Sheet available at: http://www.nrcs.usda.gov/about/agency.html.

Below is a partial listing of NCRS and FSA programs available, and their website URLs:

The Conservation Security Program (CSP). The CSP, unlike other NRCS programs, does not require putting new conservation measures into place. Instead, CSP; 1) provides rewards to farmers who already have included stewardship practices into farmland management, and 2) offers incentives to those farmers who wish to exceed the minimum levels CSP recognizes for resource protection and enhancement. The program's particular focus is on maintaining soil and water quality; these are goals that can be achieved by implementing alternative drainage maintenance techniques discussed in this handbook. http://www.nrcs.usda.gov/programs/csp/

The Conservation Reserve Program (CRP). The CRP program is under the authority of the USDA Farm Service Agency (FSA). Farmers who enroll in the CRP agree to plant "resource-conserving vegetative covers" on a portion of their land. The CRP is designed to first prevent erosion, and second to improve water quality and enhance wildlife habitat by conserving "environmentally sensitive" land. The CRP differs from the CSP as it seeks participants who will establish new areas of protected land, as opposed to CSP enrollees, who already have land stewardship practices in place. http://www.nrcs.usda.gov/programs/crp

The Wetlands Reserve Program (WRP). Wetlands provide a variety of environmental benefits, including flood protection, improved water quality, recharge of groundwater and habitat for wetland-dependant wildlife. A primary concern of Illinois farmers is flooding of their fields; when flood events occur, a typical response is to "fix" the problem by dredging a channel. However, alternative maintenance techniques that incorporate principles of stream hydrology can achieve the goal of reduced channel flow with far less environmental damage. As a complement to these newer techniques, the WRP program offers additional means for achieving flood control and improved water quality. The goal of WRP is to purchase farmlands that have the greatest potential for successful wetland restoration; once purchased, an easement is created for the land but offer. Typically, these lands are marginally productive for agricultural purposes so the program provides a financial benefit for the farmer, as well as environmental benefits for the adjacent lands. http://www.nrcs.usda.gov/programs/wrp/http://www.nrcs.usda.gov/programs/wrp/.

The Environmental Quality Incentives Program (EQIP). Pursuant to the 2002 reauthorization of the Farm Bill, the EQIP program focuses on achieving environmental benefits that have been deemed "National priorities." National priorities include: 1) reducing soil erosion and sedimentation from unacceptable levels on agricultural land; 2) conserving ground and surface water resources; 3) reducing groundwater contamination; and 4) reducing non-point source pollution.[24] EQIP provides financial and technical assistance to farmers and ranchers to implement conservation practices that improve both agricultural production and environmental quality on the affected land. As a myriad of conservation practices can be

[24] From NRCS Fact Sheet "Farm Bill 2002: Environmental Quality Incentives Program," on website at http://www.nrcs.usda.gov/programs/eqip/ (link is "EQIP Fact Sheet").

implemented under EQIP, this program could also enhance the benefits achieved through using alternative drainage maintenance techniques. http://www.nrcs.usda.gov/programs/eqip/.

Wildlife Habitat Incentives Program (WHIP). The WHIP program offers financial and technical assistance to private landowners for the specific purpose of developing and improving wildlife habitat on their land. While improved agricultural production is not an objective of the WHIP program, establishing wildlife habitat along drainage channels at a minimum would provide drainage benefits including reduced bank erosion, reduced sediment input and stabilized banks and channel. http://www.nrcs.usda.gov/programs/whip/

Grassland Reserve Program (GRP). The goal of the GRP program is to protect and conserve grassland, pastureland and shrubland in order to maintain working grazing operations and enhance the plant and animal diversity of these lands. Landowners may either grant an easement or agree to rent sections of their property in exchange for limiting activities and developing restoration plans for the selected property. If the land selected is in a riparian zone, restoration and conservation efforts would enhance the benefits of improved water quality and aquatic habitat achieved through newer, environmentally sensitive drainage maintenance techniques. http://www.nrcs.usda.gov/programs/GRP/

Illinois Conservation Reserve Enhancement Program (CREP). This state-level program, administered by the FSA, offers private landowners in the Illinois River Watershed financial incentives and technical assistance for enhancing wildlife habitat. The particular objectives of CREP are to improve water quality by reducing stream sediment and nutrient inputs, and to enhance habitat used by threatened and endangered species. Farmers who choose to take environmentally sensitive land out of production have the potential for achieving the drainage benefits mentioned in the WHIP section. http://www.ilcrep.org/.

APPENDIX D
SUMMARY OF KEY PROVISIONS OF ILLINOIS' DRAINAGE CODE

The Illinois Drainage Code, contained in Chapter 70, Sections 605/1-1 through 605/12-24 of the Illinois Compiled Statutes (ILCS), provides the rules that govern and guide decisions related to agricultural drainage, from the establishment of drainage districts to the authority and duties of drainage district commissioners. This section summarizes those provisions of the Drainage Code pertinent to understanding the organization and purpose of drainage districts, duties of drainage district commissioners, and the rights of district landowners. The full text of the Drainage Code is online at http://www.ilga.gov/legislation/ilcs/ilcs.asp.

a. Establishing Drainage Districts. County circuit courts have jurisdiction over all "matters and proceedings" related to the organization or operation of drainage districts. 70 ILCS 605/1-4. Drainage districts may be formed "to construct, maintain or repair drains or levees or to engage in other drainage or levee work for agricultural, sanitary or mining purposes." 70 ILCS 605/3-1. Drainage districts are formed by a process that begins with the filing of a petition in the circuit court of the county in which most of the land for the proposed district lies. The petition must be signed by at least twenty percent of the adult landowners who own at least one-fourth of the land in the proposed district or by more than one-fourth of the adult owners owning a major portion of the land. 70 ILCS 605/3-3. The process for approving the petition to organize a drainage district is similar to that for other drainage district activities requiring court approval (such as levying tax assessments). A hearing on the petition is scheduled, with notice being provided by the court clerk (typically by publication of the notice of hearing in a paper with circulation in the county where the hearing is to be held). Notice must also be mailed to all landowners in the proposed district, whose addresses are obtained from the county assessor's tax rolls. 70 ILCS 605/3-6. Only a landowner "situated" in the proposed district may file objection to the petition. 70 ILCS 605/3-8. The decision to grant or deny the petition is made by the court and issued in the form of a final court order. 70 ILCS 605/3-8.

Once a district is organized, its boundaries may be changed through: 1) requesting an annexation, or addition, of other lands to the district; 2) requesting a detachment of land from the district; 3) requesting a dissolution of the district; 4) requesting the consolidation of districts or formation of an outlet district (where a district is formed of lands already contained in two separate districts, or of lands both within and outside of current district). 70 ILCS 605/3-28 through 3-30, 8-1 through 8-13, 9-1 through 9-9.

b. Drainage Commissioners. For any newly formed drainage district, three temporary commissioners are appointed. They may examine the district lands for purposes of assessing or considering drainage systems, and shall also employ an engineer to consult with regarding the design and operation of a drainage system. 70 ILCS 605/3-9, 3-13, 3-14.

Commissioners must be adult residents of Illinois. While the statute says commissioners must also be landowners within the district they serve, this requirement may be waived. 70 ILCS 605/4-3. They must take an oath to perform their duties faithfully and without bias, and must also give a bond for the faithful performance of duties. 70 ILCS 605/4-4. Permanent commissioner's terms are for three years and begin the first Tuesday in September; the terms are staggered so that each year only one of the three commissioner's terms expires. 70 ILCS 605/4-1. Each district selects commissioners using either an appointment or election process. In the case of appointment, an "appointing authority" selects a commissioner. If a petition is filed by a majority of the district landowners who own a majority of land in the district requesting that a particular person be selected, the appointing authority must appoint that person unless "good cause" is given why that person should not be appointed. 70 ILCS 605/4-2. In those districts using the election process, each adult landowner is entitled to vote and has one vote. The candidate receiving the majority of votes is declared elected. 70 ILCS 605/4-5. Drainage districts may choose to change their method of selecting drainage commissioners. 70 ILCS 605/4-6, 4-8. For example, if a district uses the appointment process, it may change to an election process by filing a petition requesting this change which contains the names of 10

percent of the adult landowners. The petition also must state that the district will comply with the statutory requirements for holding elections. Although the petition only requires the names of 10 percent of landowners, a majority must actually agree with the change in selection process before the court will grant it. 70 ILCS 605/4-8.

c. ***Commissioners' Powers: The Authority to Tax Landowners.*** The most significant power granted to drainage district commissioners is the authority to levy assessments against all landowners within a drainage district. The granting of this authority is broad: assessments may be levied "in order to perform and carry out the duties imposed and powers granted by this Act or to perform or construct any work authorized by the court." 70 ILCS 605/4-18. More specifically, landowners may be assessed for construction or repairs of original, additional or repair work, for the performance of annual maintenance, to acquire needed rights-of-way or other real or personal property, and to pay incidental and current expenses for emergency work.

Typically, a district levies assessment for three purposes: to pay for an initial drainage system, to pay for annual maintenance costs (or increase the amount of the annual assessment), and to pay for projects which will cost more than what the district receives from its annual assessment (additional assessment). When a drainage district wants to increase its annual assessment or levy an additional assessment, it must file a petition with the court requesting permission to take such action. 70 ILCS 605/4-19. The petition must contain certain information, although the code does not require specific information regarding all aspects of a project. For example, information on the proposed work to be done and equipment to be used may be provided by "a general statement." 70 ILCS 605/4-19. Demonstrating the need for the project may be done by "a statement showing the necessity for or advisability of" either the levy or project, without requiring specific statements of need. Similarly, economic justification for a project is demonstrated by "a statement that the benefits to the lands…from the proposed work or the exercise of the power or powers proposed exceed the costs to such land" without requiring a more detailed financial breakdown.

The court gives notice of the hearing by publication in a newspaper of general circulation at least three weeks before the date of the hearing. Notice is also sent by mail to landowners within the district (using the county assessor's tax rolls). 70 ILCS 605/4-22. However, if a landowner does not receive the notice in the mail, he may not object to the petition for assessment solely on this basis. 70 ILCS 605/4-21

"Any landowner in the district or other party defendant" may file objections to the petition. 70 ILCS 605/4-23. To date, this provision has narrowly interpreted by Illinois courts with the effect that parties who may have an interest in the project and its impacts (such as landowners who live upstream or downstream from a district's boundaries) may not object to a project unless they also own land within the district seeking the assessment.

During the hearing, the court may hear evidence. Specifically the drainage code requires the court to determine whether the benefit to the lands of the "things proposed" exceeds the cost to the lands. It also requires that the court "consider environmental values and amenities;" in doing so it may hear testimony from "persons especially qualified by reason of training and experience in biological sciences, community planning, natural resource development, conservation, landscape architecture and similar fields." 70 ILCS 605/4-24. If the court decides to grant the petition, it must also make specific findings, including "the things which should be done," and "the method by which the things shall be done." 70 ILCS 605/4-24.

Once an assessment is approved, "no land or other property shall be assessed for benefits more than its just proportion of the entire assessment or in excess of the benefits thereto." 70 ILCS 605/5-1. Assessment amounts for each landowner are provided in an assessment roll filed by the district. There is a hearing on the assessment rolls that may occur immediately following the hearing on the assessment petition, and may not require any additional notice. 70 ILCS 605/4-24.

d. Other Powers and Duties of Commissioners. The general powers of the drainage commissioners include the power to "do all acts necessary for the purpose of

surveying, constructing, protecting, repairing and maintaining any drain, levee or other work of the district." 70 ILCS 605/4-4.14(a). Within the broad scope of these powers are the right to enter lands for inspection, employ engineers, lawyers and other employees as needed, use district funds for "any lawful purpose," and enter into agreements with any agency or office of the state of Illinois related to the use and control of drains and related structures or to the operation of fish preserves and wildlife refuges already established by law.

The drainage code requires the commissioners to inspect the drainage system annually to make sure it is in good working order. Any needed maintenance or alteration of the system may be made without court approval as long as the scope of the work does not constitute a "substantial or material alteration, enlargement or extension of the drainage system." 70 ILCS 605/4-15.

Many specific acts that commissioners may undertake require court approval. These include construction of additional drains, ditches or levees or others works determined to be needed, changing the method of construction, route, size, capacity or end-point of any proposed drain, levee or other work, leveling soil banks or excavated materials for cultivation or other lawful purposes, and purchasing equipment to be used for drainage construction, repair and maintenance. 70 ILCS 605/4-16.

All actions taken by drainage commissioners are subject to the requirement of consideration of environmental values. ILCS 70 605/4-15 expressly provides that commissioners "shall use all practicable means and measures, including consideration of alternative methods of providing the necessary drainage, to protect such environmental values as trees and fish and wildlife habitat, and to avoid erosion and pollution of the land, water or air." While attempting to include environmental impacts of projects into the decision process, the actual protections given by Section 4.15 are tenuous. The provision does not require a specific statement or showing by commissioners of what alternatives have been considered. It also does not forbid activities that may harm the environment, but merely requires commissioners to take

whatever "practicable means and measures" that are available to them to protect environmental amenities such as trees, wildlife and clean water.

Drainage district commissioners are considered officers of the court and as such, when they file a petition with the court, the information within the petition "shall be presumed to be correct." ILCS 70 605/4-34. However, this does not prevent parties in opposition to the petition from presenting evidence that proves the information in the petition to be incorrect or inaccurate.

e. Meeting and Documentation Requirements. The clerk of the county circuit court in which a drainage district is located is the clerk of the district. 70 ILCS 605/4-35. The court clerk maintains the "Drainage Record." This record includes those items drainage commissioners are required to file, as well as any court decisions, orders, or other formal records pertaining to the district that are required to be recorded by the court. The County Treasurer of the county in which the district is located is the treasurer of the drainage district. 70 ILCS 605/4-36. However, the commissioners may also appoint an individual as district treasurer without court approval. 70 ILCS 605/4-38. Any individual so appointed must be a resident of the state of Illinois, and must be bonded for the performance of his duties.

Drainage commissioners must hold annual meetings every November in the county where the drainage district is organized. 70 ILCS 605/4-12. Notice of the place, date and time of this meeting must be made at least once by publication. Other meetings may also be held after being called by the chairperson or by any two commissioners. There is no notice required for these additional meetings. Whether preceded by notice or not, all commissioner meetings are open to the public, and the commissioners must make meeting minutes available to the public for inspection at reasonable times.

Each year before the last day in November, the commissioners must file a financial report with the court providing the total funds on hand, the amount of money collected, and the amount of money paid out from the district's funds since the prior year's report. 70 ILCS 605/4-32. The report must also provide an itemized

statement of outstanding and unpaid notes, bonds and orders. The court clerk must publish a notice of the filing of the financial report, and if any drainage district landowners object, a court hearing on the financial report will be held.

A list of the active drainage district commissioners must be filed with the clerk of the circuit court prior to the last day in December. 70 ILCS 605/4-32.1. The list must provide the addresses of the commissioners and also indicate the chairperson. Commissioners must also file with both the circuit clerk and the county clerk a map that shows the drainage district's boundaries and location of "all works of improvement." 70 ILCS 605/4-33.1.

APPENDIX E
EXCERPTS OF THE OPEN MEETING ACT

The Open Meetings Act is in Chapter 5 of the Illinois Compiled Statutes (ILCS), section 120/1. It provides the rules that govern the accessibility of the public at meetings held by public bodies. This section summarizes those provisions of the Open Meeting Act pertinent to understanding your rights in attending meetings held by drainage districts. The full text of the Open Meeting Act is online at http://www.ilga.gov/legislation/ilcs/ilcs.asp.

(5 ILCS 120/1) (from Ch. 102, par. 41)

Sec. 1. Policy. It is the public policy of this State that public bodies exist to aid in the conduct of the people's business and that the people have a right to be informed as to the conduct of their business. In order that the people shall be informed, the General Assembly finds and declares that it is the intent of this Act to ensure that the actions of public bodies be taken openly and that their deliberations be conducted openly.

The General Assembly further declares it to be the public policy of this State that its citizens shall be given advance notice of and the right to attend all meetings at which any business of a public body is discussed or acted upon in any way. Exceptions to the public's right to attend exist only in those limited circumstances where the General Assembly has specifically determined that the public interest would be clearly endangered or the personal privacy or guaranteed rights of individuals would be clearly in danger of unwarranted invasion.

To implement this policy, the General Assembly declares:

(1) It is the intent of this Act to protect the citizen's right to know; and

(2) The provisions for exceptions to the open meeting requirements shall be strictly construed against closed meetings.

(Source: P.A. 88-621, eff. 1-1-95.)

(5 ILCS 120/1.02) (from Ch. 102, par. 41.02)

Sec. 1.02. For the purposes of this Act:

"Meeting" means any gathering of a majority of a quorum of the members of a public body held for the purpose of discussing public business.

"Public body" includes all legislative, executive, administrative or advisory bodies of the State, counties, townships, cities, villages, incorporated towns, school districts and all other municipal corporations, boards, bureaus, committees or commissions of this State, and any subsidiary bodies of any of the foregoing including but not limited to committees and subcommittees which are supported in whole or in part by tax revenue, or which expend tax revenue, except the General Assembly and committees or commissions thereof.

(5 ILCS 120/2.01) (from Ch. 102, par. 42.01)

Sec. 2.01. All meetings required by this Act to be public shall be held at specified times and places which are convenient and open to the public. No meeting required by this Act to be public shall be held on a legal holiday unless the regular meeting day falls on that holiday.

(Source: P.A. 88-621, eff. 1-1-95.)

(5 ILCS 120/2.02) (from Ch. 102, par. 42.02)

Sec. 2.02. Public notice of all meetings, whether open or closed to the public, shall be given as follows:

(a) Every public body shall give public notice of the schedule of regular meetings at the beginning of each calendar or fiscal year and shall state the regular dates,

times, and places of such meetings. An agenda for each regular meeting shall be posted at the principal office of the public body and at the location where the meeting is to be held at least 48 hours in advance of the holding of the meeting. The requirement of a regular meeting agenda shall not preclude the consideration of items not specifically set forth in the agenda. Public notice of any special meeting except a meeting held in the event of a bona fide emergency, or of any rescheduled regular meeting, or of any reconvened meeting, shall be given at least 48 hours before such meeting, which notice shall also include the agenda for the special, rescheduled, or reconvened meeting, but the validity of any action taken by the public body which is germane to a subject on the agenda shall not be affected by other errors or omissions in the agenda. The requirement of public notice of reconvened meetings does not apply to any case where the meeting was open to the public and (1) it is to be reconvened within 24 hours, or (2) an announcement of the time and place of the reconvened meeting was made at the original meeting and there is no change in the agenda. Notice of an emergency meeting shall be given as soon as practicable, but in any event prior to the holding of such meeting, to any news medium which has filed an annual request for notice under subsection (b) of this Section.

(b) Public notice shall be given by posting a copy of the notice at the principal office of the body holding the meeting or, if no such office exists, at the building in which the meeting is to be held. The body shall supply copies of the notice of its regular meetings, and of the notice of any special, emergency, rescheduled or reconvened meeting, to any news medium that has filed an annual request for such notice. Any such news medium shall also be given the same notice of all special, emergency, rescheduled or reconvened meetings in the same manner as is given to members of the body provided such news medium has given the public body an address or telephone number within the territorial jurisdiction of the public body at which such notice may be given.

(Source: P.A. 88-621, eff. 1-1-95; 89-86, eff. 6-30-95.)

(5 ILCS 120/2.06) (from Ch. 102, par. 42.06)

Sec. 2.06. (a) All public bodies shall keep written minutes of all their meetings, whether open or closed, and a verbatim record of all their closed meetings in the form of an audio or video recording. Minutes shall include, but need not be limited to:

(1) the date, time and place of the meeting;

(2) the members of the public body recorded as either present or absent; and

(3) a summary of discussion on all matters proposed, deliberated, or decided, and a record of any votes taken.

(b) The minutes of meetings open to the public shall be available for public inspection within 7 days of the approval of such minutes by the public body.

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