5 CONCLUSIONS AND RECOMMENDATIONS

Humanity's use of resources often creates conflict with natural environments. The scale of this human disturbance can overwhelm the ability of an ecosystem to recover its biogeochemical structure and functions. For example, human agricultural development of Illinois River floodplains, including levee construction, tile drain installation and draining wetlands, inevitably degrades wildlife habitat and disrupts nutrient cycling (Section 2.1.1). In response, other human endeavors, such as TWI's Hennepin Levee District (HLD) floodplain restoration, are initiated to ameliorate the consequences of human activity and to create a balance between human needs and natural ecosystem health (Section 1). The purpose of this project was to analyze TWI's floodplain restoration, particularly how TWI could accommodate the potential recreational, educational, economic, and political uses of the restored HLD.

Restoration

Rehabilitating and recreating the natural structure and functions of the floodplain (e.g., hydrology, vegetation, and habitat) is crucial to restoration. Of these functions, hydrology is the most critical factor. Optimally, to reverse all human impacts and to return the HLD floodplain to its historic hydrologic condition, the agricultural levee should be removed entirely, thereby allowing the Illinois River to reconnect to the floodplain. However, the complete removal of the levee is not part of TWI's agenda and is likely a political and physical impossibility. Instead, TWI will retain the levee and the pumping system, thereby allowing for water level manipulation. TWI will also create a levee breach to simulate the historic hydrologic interaction between the Illinois River and the Hennepin floodplain. Section 4.1 incorporates TWI's ability to manage the water level in the HLD into the proposed restoration plan. It includes schematic designs for enhancing water quality and diversifying wildlife habitat. For example, Figure 4.1.3-1 illustrates one habitat configuration designed to increase the biodiversity of the floodplain (Section 4.1.3).

Water level management will also be an important factor in the creation of recreational and educational uses at the site. Although uses such as hiking, biking, and

canoeing will impact the ecosystem, the proposed restoration plan minimizes those impacts while providing amenities for educational and recreational uses (Section 4.2 and 4.3). Some strategies to this end include designing circulation routs to avoid habitat fragmentation, providing visual access, and managing seasonal use of the site to minimize damage.

Environmental Education

Humans possess the unique ability to craft landscapes to meet the needs and desires of society. Often, landscape changes are made without full consideration of the impacts on natural ecosystems. Unless people become aware of the impact humans have on the environment, the need for restoration projects may never end. Through environmental education, we may be able to reconsider our activities and lessen humanity's impact upon the natural world.

The HLD restoration project creates a wonderful opportunity for environmental education (Section 3.2). Distributing relevant curricular materials and providing support for area educators and other interested parties will help to further this goal. The education program developed herein includes the curriculum guide *Learning in Wetlands* (Appendix 5). This guide, distributed to area teachers in December 2000, suggests activities to prepare for, and follow up, visits to the restoration area.

The interpretive trails, meant to facilitate environmental education, meander around the floodplain and are designed to provide physical access to all people (Sections 4.2 and 4.3). Three trails are planned (Figure 4.3.1-1): a trail emphasizing wetland ecosystems; a trail emphasizing the history of the HLD; and an archeological/ethnobiological trail. Interpretive materials (located on signs along the trails) provide information about the site's natural and cultural heritage and will enable visitors to expand their understanding of, and appreciation for, the floodplain.

In addition to curricular education and on-site interpretation, the restoration process can benefit from an involved community. Children who learn about the project at school may share information about the project with their parents. The education and interpretation goal of this project is to instill ownership of the restoration site, its history, and its ecology in the Hennepin and Putnam County residents. Community support and future stewardship of the land can be encouraged through public awareness (e.g., through

informational meetings or special events) as well as the educational programs discussed above.

Nutrient Removal

Through monitoring the hydrologic input and outputs at the site, TWI will accumulate valuable data about these processes. Our estimates (Section 3.3.2) indicate that denitrification at the restored Hennepin floodplain can remove 494 tons of the excess nitrogen (nitrate) effluent from the Illinois River Basin. Figures 4.1.2-1 and 4.1.2-2 diagram the water movement through the floodplain and the detention ponds that will facilitate denitrification. Furthermore, simply removing the land in the HLD from production will result in a reduction of an additional 20 tons of nitrogen. TWI will also collect data about the capacity of the HLD floodplains to sequester sediment, carbon and phosphorus, and to store floodwater. The HLD restoration can serve as a test case for using floodplain restoration specifically for nitrate removal and more generally for water quality improvement. After TWI collects, analyzes and disseminates the data, restoration advocates can use this information to create more persuasive arguments for restoring floodplains in Illinois.

The nitrogen removal capacity of the HLD forms one portion of the nitrogen farm idea as conceptualized by Hey. For a nitrogen farm to create profits, however, a watershed-based trading market must be developed in Illinois. From the estimates of nitrate reduction costs shown in Section 3.3.3, a trading market is most likely to form between municipalities operating wastewater treatment facilities and an HLD-type project. A trade involving a floodplain or wetland with a discrete outflow, like the TWI project, would be a point/point trade. In contrast, wetlands restored along natural portions of the river may qualify as nonpoint sources and require the application of a trading ratio (Section 2.2.3).

The amount of nitrate effluent exiting a wastewater treatment plant can be determined relatively easily. The respective annualized cost differential between reductions by municipalities ($36,000/ton of nitrate removed) and reductions by the HLD project (~$560/ton with government subsidies or ~$2,600 unsubsidized) suggests that urban point sources can achieve economic savings by investing in floodplain restoration. A hypothetical trade (e.g., selling nitrogen removal credits for ~$17,000 per ton of nitrate removed) between the HLD (seller) and a treatment facility (buyer) could generate annual revenues of

~$7.0 million for TWI and annual savings of ~$9.5 million for the treatment facilities (Section 3.3.3). Clearly, the cities along the Illinois River that contribute their sewage effluent to the Illinois River and floodplain/wetland owners could gain from this economic partnership. TWI could recover its investment in the HLD from the sale of nitrogen removal credits to municipalities within a few years, according to our estimates (Section 3.3.3).

In contrast, the relatively small, annualized cost differential between farmers ($800/ton of nitrate removed) and the HLD project (~$560/ton subsidized or ~$2600 per ton unsubsidized), suggests that a watershed-based trading market between these two entities is unlikely. The costs involved in estimating an individual farm's contribution to the level of nitrate in the basin are prohibitively high. Therefore, natural resource managers and policy makers are unlikely to support this option. Furthermore, agriculture is a major industry in Illinois and widespread regulations are politically unlikely without outside pressure.

Developing a watershed-based trading market will require knowledge of the costs of reductions, the infrastructure to market the credits and a means to pass information from sellers to buyers and vice versa. These features create added expenses in the establishment and maintenance of the trading market. However, while the high cost-differential suggests that trading would work, the political will behind the creation of a trading program in Illinois may be absent. Even if the foundation of watershed-based trading market is created, the NDPES permitting system needs to be changed to allow for in-stream treatment of point source effluent. An external force such as multi-state pressure to address the Gulf of Mexico hypoxia issue, or a serious threat to human health from high nitrate levels, is required to spur the state to act. With no clear economic damages from the Gulf of Mexico hypoxia at present, Illinois is unlikely to change its nitrate effluent policy. TWI's efforts may be better directed towards creating well-documented examples of functioning nitrogen farms in preparation for changes in the political landscape.

In the absence of a watershed-based trading market, Scenario 3 (Section 3.3.3) also implies that a wastewater treatment facility could opt to invest in floodplain restoration directly. As shown in Scenario 2, the annualized costs of obtaining, restoring, and operating the floodplain for twenty years without government subsidies equal approximately $1.3 million. To achieve an equivalent quantity of nitrate reduction over twenty years from in-plant technology upgrades would cost the facility $17.8 million annually. Therefore the

treatment facility could invest in floodplain/wetland restoration to remove nitrogen at a considerable cost savings over the technology upgrades. Unfortunately, current Illinois NPDES permitting laws does not allow a wastewater treatment facility to treat its effluent off-site (Section 3.4.2). However, the variance in the NPDES permit granted to the Illinois American Water Company, for the Piasa Creek Project, sets a precedent for other relationships between treatment facilities and nonprofits engaging in watershed restoration (Section 3.4.2).

Balancing Perspectives

Natural floodplain functions such as floodwater abatement, wildlife habitat, and water quality improvement were TWI's impetus for the HLD restoration (Section 1). Additional considerations included scientific research and on-site educational and recreational use by local Illinois residents and visitors. These uses, while all potentially beneficial, may not all be compatible. For example, TWI could opt to maximize the nitrate removal capacity of the floodplain by continuously pumping Illinois River water through the floodplain throughout the year (Section 2.2.1 and 3.3.2). However, this level of artificial water manipulation will likely preclude the reestablishment of many wildlife species. To manage for biodiversity, the floodplain will need to experience hydrologic cycling throughout the year including peak water levels during the spring Illinois River flood season. Furthermore, allowing the ecosystem to continuously change will allow visitors to see a dynamic natural floodplain with a changing mosaic of wildlife species. In contrast, making biodiversity a priority over nutrient removal may significantly reduce the rate of nitrate removal in the HLD. Both management perspectives have costs and benefits. Nitrate removal may provide direct economic benefit, while allowing for natural cycling creates richer habitat and different kinds of opportunities.

We are not in a position, as a society, to value floodplain restoration strictly for the sake of restoring the ecology of floodplains. TWI will need to find the balance between maximizing the benefits of restoration, while creating sufficient revenue to maintain the property, and make floodplain restoration attractive for other sections of the Illinois River. Currently, TWI is dependent upon Federal and State agricultural subsidies for the HLD restoration. It is important to realize that these agricultural subsidy programs may not always be available. Therefore, TWI is considering other sources of income, such as

watershed-based trading. At this time, however, watershed-based trading in Illinois looks to be politically unfeasible.

Does the success of one restoration have the power to change how floodplains are perceived in Illinois? Can the HLD project be the first link in a chain of restorations along the Illinois River? TWI's most important contributions to turning these questions into affirmations are: the collection of sound scientific data on the nature of restored floodplains along the Illinois River and a careful balancing of the different values of a floodplain. While human use altered the landscape, human effort can help to bring back the natural functions. The goal here is the creation of a new landscape that merges human use and ecological integrity, with sellable aspects that broadly reach into different facets of human culture.