ENVIRONMENTAL DOCUMENTATION

CHAPTER 1--ENVIRONMENTAL SUSTAINABILITY PLANNING (PROGRAMMATIC)

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ABBREVIATIONS/ACRONYMS USED IN THIS CHAPTER

Ac	Acre	MMR	Monitoring, Modeling and Research
A&M	Avoid and Minimize Program	MRBA	Missouri River Basin Alliance
ALC	American Lands Conservancy	MVD	Mississippi Valley Division
BCR	Benefit-Cost Ratio	MVP	St. Paul Corps District
BO	Biological Opinion		
CAP	Continuing Authorities Program	MVS	St. Louis Corps District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	MVR	Rock Island Corps District
CFR	Code of Federal Register	NAAQS	National Ambient Air Quality Standards
		NAGPRA	Native American Graves Protection and Repatriation Act
CIA	Computer Inventory and Analysis	NED	National Economic Development
CRP	Conservation Reserve Program	NEPA	National Environmental Protection Agency
CREP	Conservation Reserve Enhancement Program	NER	National Ecosystem Restoration
CT	Collaboration Team	NGOs	Non-Governmental Organizations
DSS	Decision Support System	NMFS	National Marine Fisheries Service
D&LD	Drainage & Levee District	NPDES	National Pollutant Discharge Elimination System
DNRs	Departments of Natural Resources	NPS	Non-Point Source
DO	Dissolved Oxygen	NRCS	National Resources Conservation Service
DOD	Department of Defense	O&M	Operation & Maintenance
EA	Environmental Assessment	P&G	Principles & Guidelines
		P&S	Plans & Specifications
EC	Engineering Circular	PGL	Planning Guidance Letter
EFM	Ecosystem Functions Model	PL	Public Law
EIS	Environmental Impact Statement	RAS	River Analysis System
		RCRA	Resource, Conservation, and Rehabilitation Act
EMP	Environmental Management Program	R&D	Research and Development
		ROD	Record of Decision
		SIP	State Implementation Plan
EO	Executive Order	SMART	System-wide Modeling, Assessment, and Restoration Techniques Program
EOP	Environmental Operating Principles & Operating Guidance	Sq Km	Square Kilometer
EQ	Environmental Quality	TMDL	Total Minimum Daily Load
EQIP	Environmental Quality Incentives Program	TNC	The Nature Conservancy
EP	Engineering Pamphlet	TWI	The Wetlands Initiative
ER	Engineering Regulation	USACE	US Army Corps of Engineers
ER	Ecosystem Restoration	USEPA	US Environmental Protection Agency
ERDC	Engineering Research & Development Center	UMESC	Upper Midwest Environmental Science Center
FEMA	Floodplain Emergency Management Agency		
FDR	Flood Damage Reduction	UMIMRA	Upper Mississippi, Illinois and Missouri Rivers Association
FIP	Forestry Incentives Program	UMR	Upper Mississippi River
FONSI	Finding of No Significant Impact	UMRBA	Upper Mississippi River Basin Association
FPMA	Flood Plain Management Assessment	UMRCC	Upper Mississippi River Conservation Committee
FSA	Farm Services Agency	UMRCP	Upper Mississippi River Comprehensive Plan
GIS	Geographic Information System	UMRS	Upper Mississippi River System
GREAT	Great River Environmental Action Team	WRC	Water Resources Council
H&H	Hydrology & Hydraulics	WRDA	Water Resources Development Act
HEC	Hydrologic Engineering Center	UMRBC	Upper Mississippi River Basin Commission
HN	Head of Navigation	USFS	US Forest Service
HNA	Habitat Needs Assessment	USFWS	US Fish & Wildlife Service
HREP	Habitat Rehabilitation and Enhancement Project	USGS	US Geological Survey
ICA	Incremental Cost Analysis	WDNR	Wisconsin Department of Natural Resources
IDALS	Iowa Department of Agriculture & Land Stewardship	WHAG	Wildlife Habitat Appraisal Guide
IDNR	Illinois Department of Natural Resources	WES	Waterways Experiment Station
IDOA	Illlinois Department of Agriculture	WHIP	Wildlife Habitat Incentives Program
IEPA	Illinois Environmental Protection Agency	WLTP	Watershed Land Treatment

IFBF	Iowa Farm Bureau Federation	WNTF	Mississippi River/Gulf of Mexico Watershed Nutrients Task Force
IFMRC	Interagency Floodplain Management Review Committee		
IMP	Integrated Management Plan	WRP	Wetlands Reserve Program
IWR	Institute of Water Resources	YR	Year
KG	Kilogram	UMR-IWWS	Upper Mississippi River—Illinois Waterway System
KM	Kilometer	USC	United States Code
L&D	Locks and Dam		
LTRMP	Long-Term Resources Management Program		
MACT	Maximum Achievable Control Technology		

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CHAPTER 1--ENVIRONMENTAL SUSTAINABILITY PLANNING (PROGRAMMATIC)

1. INTRODUCTION.

1.1. Purpose and Scope.

The purpose of this chapter is to describe in detail the environmental planning component of the Upper Mississippi River Comprehensive Plan (UMRCP) Study. This effort was part of a much broader planning effort directed at developing an environmentally sustainable comprehensive flood damage reduction (FDR) plan for the Upper Mississippi River System (UMRS). The UMRCP study is being conducted pursuant to Sec 459 of WRDA 1999.

The overall purpose of the UMRCP study is to determine the advisability of federal participation in the implementation of systemic flood damage reduction (FDR) improvements along the UMRS. Per the authorizing legislation, the comprehensive plan is to be developed by means of structural and non-structural flood control and floodplain management strategies, and by various other methods: including habitat, nutrients, and sediments management. The legislation calls for recommendations on management plans and actions to be carried out by the responsible federal and non-federal entities, recommendations pertaining to construction of a systemic flood control project, and recommendations for follow-on studies. Consultation is to take place with appropriate state and federal agencies, and the study is to make maximal use of existing information.

Planning for this project was conducted using the 1983 Economic and Environmental Principles and Guidelines (P&G) for Water and Related Land Resources Implementation Studies. Under P&G, the objective of federal water and related resource planning is to "contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other federal planning requirements."

1.2. Study Area.

Section 459 defines the study area as including the Upper Mississippi and Illinois River basins, from Cairo, Illinois, to the headwaters of the Mississippi River. This 118 million acres region is referred to herein as the UMRS. This system includes 1,100 river miles, with a total river floodplain acreage of 2.6 million acres. The distribution of leveed floodplain as a proportion of total floodplain area is about: 3% north of Pool 13; 50% from Pool 14 through Pool 26; 80 percent in the Open River below St. Louis; and 60% of the lower 160 miles of the Illinois River.

The UMRCP Study reaches were defined based on factors of economics and hydraulics. However, it was at times useful to further subdivide the floodplain based on river geomorphology, similar to the subdivisions used for the UMRS-EMP HNA report. These units are identified in **Table 1**, along with their relationship to the UMRCP defined study reaches.

1.3. Environmental Study Constraints.

The environmental planning investigation was based almost entirely on existing data sources. For example, the identification of floodplain biological problems and needs were derived primarily from the UMRS-EMP (LTRMP & HNA) and FPMA reports. The identification of potential habitat restoration measures relied heavily upon the documentation of the UMR-IWWS navigation study and UMRS-EMP HREP reports. The work on watershed nutrients utilized the year 2000 Report entitled *Integrated Assessment of Hypoxia in the Northern Gulf of Mexico*, and the findings of the 2001 Report entitled: *Action Plan for Reducing, Mitigating, and Controlling Hypoxia in The Northern Gulf of Mexico*. Where actual data was absent, projections relied heavily upon "professional judgement".

Another constraint was that Sec 459 did not provide an authority for co-equal NED (FDR) and ER Federal objectives. The authority provides for a single-purpose FDR project with secondary purposes (including environmental) that must be tied to FDR. The environmental team did not accept arguments of the UMRS as a "Nationally significant ecosystem", or the Corps' concern regarding "environmental sustainability", as sufficiently equating to a Federal ER objective. On the other hand, the study authorization does provide latitude to recommend follow-on studies that could eventually lead to authorizations of a more environmentally comprehensive nature.

1.4. Definitions.

Adaptive Management. An iterative approach to decision making involving a cycle of planning, implementation, monitoring, research, and subsequent reexamination of decisions, plans and priorities, based on new information.

Biodiversity. The entire spectrum of life forms and the many ecological processes that support them.

Decision Support System. The working definition of the Upper Midwest Environmental Sciences Center (UMESC) for Decision Support System (DSS) is, "A spatially based computer application of data that assists a researcher or manager in making decisions." There is no one DSS; they are as diverse as the problems they help to solve. The types of DSS are limited only by the developer's imagination, and can range from a simple Web page to complex modeling applications. GIS tools fall into two categories, general purpose or specific purpose. General purpose tools (e.g. ARC/INFO and ArcView) have great functionality, but can be difficult for users unfamiliar with GIS principles. Specific-purpose tools are those that provide a user with specific functions in an easy-to-use format. Issues relevant at a watershed level are not limited to just hydrology and hydraulics, but include a range of issues related to water quality, sediment transport, groundwater/surface water interaction, climate change, ecosystem restoration, and economic and societal impacts. A DSS can help decision-makers by providing an integrated system of addressing these types of issues on a watershed or even on a basin-wide scale.

Ecosystem. An ecosystem is the complex of a community and its environment functioning as a distinct unit in nature. The UMRS eco-system totals more than 2.6 million acres of river-floodplain, including aquatic, wetland, forest, grassland, agricultural, and urban land cover and land use. Ecosystems are hierarchical, i.e. the complexity of nature can be best understood by approaching it in terms of a graded series of nested systems. Accordingly, commonly used spatial scales in the UMRS ecosystem are the river basin, watersheds, river reach, navigation pool, habitat area, and microhabitat. All levels of this ecosystem include plants and animals that transform inputs to produce outputs of nutrients, energy, and water. Today, most recognize that disturbances, both natural and man-made, have played an important role the existing health of this system.

Ecosystem Management. Numerous attempts have been made to define this term. The following definition by Christensen et al. (1996) appears to fit well with the prevailing understanding and philosophy on this subject, it is "…management driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem structure and function." The two themes common to most definitions of ecosystem management are: (1) management should maintain or improve ecosystems; and (2) ecosystems should provide a range of goods and services to current and future generations.

Environmental Objectives. Environmental objectives are incremental steps taken towards achieving a given environmental goal. They describe what we want to achieve, how much we want to achieve, when and where we want to achieve it. They also provide

a basis for determining management measures, for monitoring accomplishments, and for evaluating the success of management measures.

Environmental Project. A generic measure or collection of measures designed to address given environmental planning objectives for the river ecosystem. The Navigation Study workgroups, science panel, coordinating committees, state and other stakeholders worked to formulate and refine ecosystem alternatives to better and more efficiently meet the identified range of ecosystem protection and restoration opportunities. This included establishing and evaluating potential ecosystem measure performance (e.g. area of influence, cost per acre, etc).

Environmental Opportunity. A study related action that provides a reasonable chance for advancement or progress in solving an identified study problem. The UMRCP study provides an opportunity to explore various methods for habitat restoration. For example, locations for which FDR related construction and/or easements are required could open an opportunity for the implementation of future habitat management initiatives.

Eutrophication. The process by which a body of water becomes rich in nutrients. Excessive plant and algae growth are indicative of nutrient enrichment.

Floodplain. Land adjacent to a river, composed of soil from previous floods (alluvium), subject to varying degrees of inundation based on elevation in relation to the river.

Flood pulse. A seasonal rise in river levels, beyond bankfull, due to snowmelt and rain that triggers a complex variety of physical and biological processes that help maintain a healthy river ecosystem.

Geographic Information System (GIS). The Association for Geographic Information defines GIS as: "A system for capturing, storing, checking, integrating, manipulating, analyzing, and displaying data which are spatially referenced to the Earth." A simpler working definition is: "A computer-based approach to interpreting maps and images and applying them to problem-solving. The driver for this system is a constant need for timely information about human activities and expectations from the "real world."

Geomorphology. The geological study of the configuration and evolution of landforms. Fluvial geomorphology is the study of the development of landforms, streams, and rivers under processes associated with running water.

Hydrograph. A plot (line graph) of water levels or discharge for a given period of time, usually annual, used to present water levels for that time, or to present an average of many individual events.

Incentives. Anything that motivates people. In the context of the UMRCP, incentives would motivate people to adopt improved land-management practices to conserve biodiversity. In other words, it is any activity that can be initiated by a public or private entity or individual to help improve stewardship with an emphasis on land management.

Integrated River Management. Integrated river management is the functional union of many Federal, state and local river management activities to help better achieve systemic sustainability. The Federal activities being coordinated under the sustainability umbrella include: the navigation O&M, the EMP, the Environmental Continuing Authority Program (CAP; i.e. Sections 204, 206, and 1135), the WRDA 1999 Comprehensive Plan, the USFWS Refuge management, and the Illinois River Basin Restoration initiatives (Illinois River Ecosystem Restoration Feasibility Study and WRDA 2000, Public Law 106-541 Section 519, Illinois River Basin Restoration).

Measure. This term is here considered to be synonymous with the term "management action". A measure (or management action) being defined as "specific actions, tools, techniques or combinations of these used to meet defined objectives." Measures are implemented as specific projects whose detailed planning and design provide the information required to assess the benefits, cost-effectiveness, and the incremental justification of a project.

Mitigation. Mitigation includes avoiding, minimizing, rectifying, reducing or compensating for a project impact.

Modern Historic Condition. The modern historic condition is defined as previous levels of productivity, but not a higher level than would have existed under natural conditions in the absence of human activity or disturbance. The desired river state for environmental sustainability evaluation purposes is assumed to equate to the modern historic condition. The modern historic condition is the ecosystem condition that supported higher population levels 30 years ago (1970). It is the average prevailing habitat condition post-impoundment (i.e. midway between 1940 initial impoundment and the present).

Models. Models help to illustrate complex information in a simple manner. Models can be intuitive, verbal, symbolic, narrative, physical, and mathematical. Criteria including realism, relevance, flexibility, treatment of uncertainty, degree of development and consistency, ease of parameter estimation, regulatory acceptance, and resource efficiency should be considered in selecting models to use in UMRS management (Wilcox et al. 2002). Models need to usable and understandable by all parties, and easily adjusted to meet new circumstances and thoughts. Models used in the UMRS can be an aid to developing concepts, educating, simulating processes, testing hypotheses, forecasting future conditions, conducting planning, assessing the results of monitoring, and identifying additional information and research needs (Wilcox et al. 2002).

Navigation Pool. Terrestrial and aquatic habitats in the floodplain between two navigation dams.

Non-Structural Alternatives. FDR accomplished by some means other than major construction, for example, actions such as floodproofing, flood warning systems, and relocations.

Restoration. Restoration measures are those that recognize the importance of a fully functioning ecosystem. These measures restore a specified ecological condition that has been degraded.

River Ecological Health. A condition of well-being, defined by the river community based on the knowledge of how river ecosystems are structured, how they operate, and how they respond to human use. The six criteria proposed for assessing the ecological health of the floodplain reaches of the UMRS include hydrological, structural, and water quality; biological conditions; and the ability of a river to sustain itself and to recover from disturbance.

Structural Measures. FDR accomplished via the construction of structures, for example, levees and floodwalls.

Sustainability. The UMRCP has adopted the navigation study's definition for sustainability: "The balance of economic, ecological, and social conditions so as to meet the current, projected, and future needs of the UMRS without compromising the ability of future generations to meet their needs."

In general, ecosystem sustainability will be considered to be synonymous with habitat sustainability. It will be calculated as the difference in acreage between the modern historic condition (Year 1970) and the midlife of the project (Year 2025).

The current planning process provides the Corps with an opportunity to: 1) work collaboratively with other agencies/organizations, and 2) use best available scientific information and methods, to identify and evaluate innovative alternatives as environmentally sustainable solutions associated with flood damage reduction.

Systemic Goal. With the restructuring of the UMR-IWWS Navigation Study to include ecological sustainability, it became important to prepare a common vision for the system. In November 2001, the navigation study economic and environmental coordinating committees met to jointly prepare a common vision for the river system. This vision is: "To seek long-term sustainability of the economic uses and ecological integrity of the Upper Mississippi River System."

Turbidity. A measure of water clarity.

1.5. Environmental Sustainability Planning Process.

1.5.1. Environmental Requirements.

Table 2 provides a summary of the environmental requirements applicable to the UMRCP Study. Chapter 1, Attachment A includes a more detailed description of these requirements, along with a listing of applicable Corps planning Guidance Documents.

1.5.2. Environmental Operating Principles.

Technology has added to the quality of life; however, those capabilities have also created environmental impacts that potentially threaten our existence. Because survival is dependent upon sustained and balanced ecosystems, environmental concerns are becoming an increasingly important part of all Corps of Engineer's missions, decision-making, programs, and projects (Corps, 2002a).

In 2002, USACE published a doctrine referred to as the *Environmental Operating Principles and Implementation Guidance* (EOP). EOP describes ways in which the Corps' missions must be integrated with natural laws, values, and sound environmental practices. This doctrine of 7 principles (summarized in **Table 3**) is intended to result in an organizational culture change over time (Corps, 2002a).

1.5.3. Historical Perspective on River Management Studies.

Comprehensive basin planning has undergone a significant conceptual change during the past 40 years. Initially, it was characterized by a single-resource, single-agency, and non-public interactive focus. Overtime a general trend has evolved towards multi-resource considerations, greater inter-agencies collaboration, and an increased recognition of the need for public education and involvement. The tools for managing the river's resources have become increasingly sophisticated, as reflected by the development of the UMRS Flow Frequency Study, and the EMP program's HREPs, LTRMP and HNA.

Key prior studies reflecting the evolving nature of UMRS river management are summarized in chronological order in **Table 4**. **Table 4** indicates for each study, its purpose, planning approach, and degree of comprehensiveness (in terms of geographic scope, resources studied, amount of interagency collaboration, and public involvement). The following paragraph further describes these studies.

The 1961 *Basin Plan for the Upper Mississippi River* represents a time period when comprehensive planning was viewed as a single-resource, non-interagency collaborative, non-public involvement effort. It was essentially an economics analysis, with fish and wildlife resources regarded as a subcategory of recreation. By contrast, the 1972 *Upper Mississippi River Basin Study* showed the influence of the 1969 passage of NEPA. The list of significant resources included mention of fish and wildlife and water quality. In addition, a door was opened for the participation of other Federal and State agencies. However, the study was still clearly one of economics. The increasing influence of NEPA is again reflected in the mid-seventies in the *Upper Mississippi River, 9-Foot Channel Project, EIS* and the *Lock and Dam 26 (Replacement), EIS.* The listing of resources and their inventories fill many volumes. Public involvement on the replacement project was highly contentious, and the project was in the court system for many years.

The next effort of significance was led by the Upper Mississippi River Basin Commission (UMRBC, established by Presidential Order in 1972) and was documented in the 1980 *Upper Mississippi River Main Stem Level B Study* report. While working relationships during this period were somewhat adversarial, the organizational framework was substantial. Public involvement was extensive and utilized an informal meeting format, which the public and agencies found to be more conducive to a working relationship. The Level B Study was eventually engulfed by a larger study. Public Law 95-502 authorized the UMRBC to develop a Comprehensive Master Plan for the Management of the entire UMRS. Many of the components of the Level B Study were incorporated into the Plan of Study for the UMRS Master Plan. Noteworthy was Level B's use of the Principles and Standards (P&S) Code of Accounts format (National Economic Development, Environmental Quality, Regional Development, and Social Well Being). Level B also introduced the notion of achieving the greatest resource gains with minimum losses (i.e. tradeoffs), and the notion of a society of economic vitality as well as environmental integrity (i.e. environmentally sustainable development). The UMRBC studies and plans were guided and directed by the technical output of the *Great River Resource Management Study* (GREAT) completed between 1981 and 1982. The GREAT study provided vital information to the Level B study, but like the Level B study it was later merged into the UMRS Master Plan.

The *Comprehensive Master Plan for the Management of the Upper Mississippi River System* was completed in 1982. This was a truly comprehensive effort from all vantage points: geographic scope, resources considered, degree of collaboration, and degree of public involvement. The study led to Congressional authorization of a 600-foot second lock at L&D 26(R), and it spawned the UMRS-Environmental Management Program (EMP) that today is conducted as a continuing authority program. The effective organizational structure of the Master Plan was subsequently adopted (with minor modifications) for use under the UMRS-EMP. By now it should be evident to the reader, that the history of master planning on the river system has been characterized by stop and go efforts, some times with overlapping Congressional authorities, and the absence of a stable long-term organizational framework.

The St. Paul District's 1983 *Upper Mississippi River Land Use Allocation Plan* is a good example of master planning at a level where theory is transformed into every day practice. The Corps has been doing this kind of work for years under its continuing O&M authority and has incorporated provisions for periodic updates of the plan. To this day, an all resource encompassing comprehensive master planning effort at this level of detail, and with a mechanism for periodic updates is lacking for the UMRS. A more recent example of a state-of-the-art master planning effort interfacing with the Geographic Information System (GIS) is the St. Louis District's 1999 *Rivers Project Master Plan*. This effort is also important in that it attempted to consolidate an number of prior planning areas into a single more regionally comprehensive rivers project master plan.

Sharing the Challenge: Floodplain Management into the 21st Century, often referred to as "the Galloway report", was released in 1994. As a reaction to the Midwest's flood

of 1993, the U.S. Secretary of Agriculture established a review committee to take a fresh look at federal floodplain management policies. That committee issued a very comprehensive and thorough documentation of flood related problems and solutions. Among its many recommendations, were a call for EQ and NED as co-equal objectives, support for collaborative efforts, and for cost-sharing in floodplain management at all levels of government. The Corps' 1995 Report to Congress entitled *Floodplain Management Assessment* (FPMA) was conducted in collaboration with 4 federal agencies and 7 flood affected states. The report applied the Corps' planning process to study various alternative plans of change in flood insurance, floodplain regulation, flood hazard mitigation, disaster assistance, wetlands restoration, and agricultural support policies. The FPMA report reinforced the findings of the Galloway Report in areas where the Corps is uniquely qualified. A by-product of this effort was the development of the first UMRS systemic hydraulic computer model of floodplain storage parameters. The assessment validated the view that structural flood control measures have limitations, and floodplains are best managed through a combination of structural and non-structural measures that recognize the inherent risk of occupying flood hazard areas.

In 1995, as a component of President Clinton's National Performance Review, established an Interagency Ecosystem Management Task Force to foster the concept of a "sustainable economy and a sustainable environment" through ecosystem management. The study recommended an ecosystem approach to achieving resource sustainability. The approach was to be a goal driven, collaboratively developed vision of desired future conditions that integrated ecological, economic and social factors.

Melvin Price Locks and Dam, Design Memorandum No. 24, Avoid and Minimize Measures is an effort first documented in 1996 and continues to the present under the O&M authority of the 9-foot channel project. It was initiated as a measure to help reduce the potential environmental impacts of increased navigation traffic from the construction of the second lock at Mel Price L&D. Being in a continuing authority setting, the A&M program enjoys an efficient stream of planning, implementation and adaptive management using an established and fixed vehicle for coordination.

The *Report to Congress--An Evaluation of the Upper Mississippi River System Environmental Management Program* was completed in 1997. The intent of this report was to provide documentation on the first phase of the program's three major elements: Habitat Rehabilitation and Enhancement Projects (HREPs), Long Term Resources Monitoring (LTRM) and the Computer Inventory and Analysis (CIA). The LTRM and the CIA are jointly referred to as the Long Term Resources Monitoring Program (LTRMP). The program is a state-of-the-art example of ecosystem management theory transformed into reality. Both the HREP and the LTRMP components were well coordinated and yielded highly beneficial results. By 1997, the HREP's had restored/enhanced/protected 97,000 acres of habitat. The first phase of the LTRMP had done much to provide decision makers with the information (computer assisted data gathering, interpretation, and results dissemination) needed to maintain the UMRS as a viable multi-use large river ecosystem. The EMP during this phase was unprecedented in its level of inter-agency collaboration. Congress concurred by establishing the cost-

shared EMP as a continuing authority program with periodic status updates. Published in 1998, a background report to the Report to Congress was released and was entitled the *Ecological Status and Trends of the Upper Mississippi River System*. The objective of the report was to compare river health criteria with measured observations, and to convey this comparison via gauges that reflect stable, declining, or improving conditions. The trends analysis effort emphasized the need to document environmental trends and to monitor the ecological health as input to river management decisions. As an EMP phase 2 initiative, a report was released in 2000 entitled *Upper Mississippi River System Habitat Needs Assessment*. Its purpose was to provide the first generation habitat needs assessment (HNA) for the UMRS, with the intent of helping to guide the development of future HREPs. The document serves as a state-of-the-art tool for assessing habitat resource needs on a systemic basis. The tool goes a measurable distance towards addressing the cumulative effects of HREP projects and other river related activities.

The *UMR-IWW System Navigation Feasibility Study* was initiated in April 1993 to address the potential economic losses to the Nation for significant traffic delays at locks on the commercial navigation system between years 2000 and 2050. In 2001, the study was restructured to address the ongoing cumulative effects of navigation, and the ecosystem restoration needs, with a goal of attaining an environmentally sustainable navigation system, in addition to insuring an efficient transportation system for the future. The primary opportunities examined were to reduce or eliminate commercial traffic delays and improve the national and regional economic conditions while restoring, protecting, and enhancing the environment. The goal of the feasibility study was to outline an integrated plan to ensure the UMRS continues to be a nationally treasured ecological resource as well as an efficient national transportation system as designated by Congress in the 1986 Water Resources Development Act (PL 99-662). The final feasibility study report was released in September 2004, and the Chief's Report was released in December 2004. This was the first UMRS systemic study to address the issue of environmental sustainability.

In spite of the success of the EMP, a continuing authorization vehicle for a UMRS basin-wide multi-resource river master planning framework, with provisions for periodic updates, does not yet exist.

1.5.4. Modern Day Management Philosophy.

Historically, traditional conservation strategies have favored pieces of the puzzle (individual species) rather than the whole ecosystem. If ecological processes are to be maintained, consideration must be given to the larger landscape pattern and associated disturbances. Biodiversity can't be conserved only through a strategy of establishing reserves. Private lands support important components of biodiversity, and given the proper incentives, private lands could play a more substantial role in protecting biodiversity.

Two management approaches have gained widespread support in recent years. These are ecosystem management and adaptive management. Ecosystem management reflects the following: (1) it is holistic, integrating all elements of the ecosystem both biological and physical, (2) it is sustainable, i.e. with biological diversity, evolutionary potential, and productive capability being maintained, and (3) it is human-activities inclusive.

Due to the inherent complexities of ecosystem management, more and more ecosystem approaches are incorporating the concept of adaptive management (a practice-based approach involving project: installation, monitoring, and modification).

1.5.5. Environmental Planning Assumptions.

Table 5 lists various assumptions inherent to the environmental portion of the UMRCP Study, including the sources of documentation supporting the use of those assumptions.

1.5.6. Overview of Environmental Sustainability Planning Process.

The "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (P&G)(WRC, 1983) have been utilized to guide the development of the Upper Mississippi River Comprehensive Plan (UMRCP) planning report. The Federal objective in the planning process (as defined by P&G) is to contribute to national economic development, consistent with protecting the Nation's environment (pursuant to national environmental statutes, applicable executive orders, and other Federal planning orders, and other Federal planning requirements). In accordance with Sec. 459 of the Water Resources Development Act (WRDA) of 1999, the Federal objective for the UMRCP study is Flood Damage Reduction (FDR). While addressing this primary purpose, certain other purposes are to be evaluated to the extent that they relate to FDR. These secondary objectives include navigation project maintenance, watershed nutrients and sediments management, habitat management, recreation needs and other related purposes. The Corps' planning process has six steps as defined in P&G. The six-steps are (1) identifying problems and opportunities, (2) inventory and forecast of conditions, (3) formulating alternative plans, (4) evaluating alternative plans, (5) comparing alternative plans, and (6) selecting a plan. The following sections of the chapter address the environmental sustainability portion of that process.

2. IDENTIFICATION OF ENVIRONMENTAL PROBLEMS/ NEEDS/OPPORTUNITIES

2.1. Differing Perspectives.

Background information reviewed by the environmental team for its description of the UMRS environmental problems, needs and opportunities, included prior study reports, the minutes of UMRCP collaboration team (CT) meetings, and public scoping meetings. Prior reports included the Floodplain Management Assessment (FPMA, 1995), the

Interagency Floodplain Review Committee Report (Galloway, 1994), the UMRS EMP HNA Technical Report (HNA, 2000) and the LTRM Status and Trends Report (USGS, 1999). After reviewing this information, it became readily apparent that there are differing perspectives on how best to manage the future resources of the UMRS floodplain.

Realistically, a comprehensive floodplain plan that satisfies the expectations of all stakeholders is unattainable. However, a comprehensive plan study conducted within the legislated time and funding constraints, could reasonably identify and evaluate alternatives for FDR (consistent with protecting the Nation's environment) that give consideration to the expansion of existing programs, or newly authorized programs that promote floodplain restoration and a sustainable ecosystem. The problems and needs section of this report has been broadly written to capture the immediate study opportunities for FDR, and to provide a framework for discussing potential future follow-on study recommendations that are more encompassing in nature.

2.2. Environmental Degradation Overview.

Since the early 1800s, the upper Mississippi River ecosystem has been drastically affected by the loss of wetlands and other habitats. This was due to water pollution, land use changes (i.e. urban development, agriculture, forestry, and mining), navigation improvements (i.e. locks and dams, dikes, revetments, and dredging), and flood damage reduction improvements (levees, floodwalls, and reservoirs). Likewise, the Illinois River ecosystem has suffered a series of ecologically adverse events: Lake Michigan water diversion, floodplain drainage, water pollution, commercial navigation, and accelerated sedimentation. Pollution controls and environmental restoration projects have improved water quality on the UMRS, thus allowing some species to flourish. However, the disruption of the natural ecosystem has caused a loss in the abundance of populations of other native species, and has resulted in an increased number of species being listed as state threatened. The nature of UMRS habitat degradation is more fully characterized below, and generally follows a similar description found in the UMRS-EMP Habitat Needs Assessment (USACE, 2000), and UMRCP **Chapter 1**.

2.2.1. Habitat Loss.

Based on the findings of the HNA study, six habitat related problems were identified with relevance to the UMRS floodplain:

1. ***River/Floodplain Connectivity.*** Connectivity between the river and floodplain is important to the functioning of a healthy river ecosystem. Extreme floods rework alluvial deposits on the floodplain, thereby creating new habitats. Floods may have short-term adverse biological impacts, but the long-term effect is generally beneficial. A flood is the major way that exchanges of nutrients, organic matter, and organisms take place between the main channel and lateral floodplain areas. Thus, levees

prevent some environmental damages, but they also break an important link of floodplain ecosystem components.

The sequestering of the floodplain with extensive levee protected areas (in both urban and farm areas) has contributed to a less natural floodplain hydrology, and as a physical barrier to fish movement. Fish species are dependent on seasonally flooded areas for successful reproduction, and many require unobstructed routes to sheltered deep-water areas for over wintering.

2. ***Fragmentation.*** Natural habitats are well connected south of Minneapolis to Clinton, Iowa due to an abundance of public lands. Along the Mississippi River south of Rock Island and along the lower Illinois River these habitats are fragmented due to the more limited extent of public lands and due to the presence of an extensive flood protection system (with large-scale conversion of natural habitat to farmland and urban uses). In other reaches, the riparian forest is fairly contiguous--in a narrow band along the longitudinal gradient of the rivers.

3. ***Lost Diversity.*** Habitat diversity is defined as a measure of the different types of habitats, their size, and their relative abundance in a defined area. Like habitat fragmentation, habitat diversity has been greatly diminished by the flood protection system. The existing land cover diversity is highest along Minnesota, Wisconsin, and the northern parts of Illinois and Iowa. Pools 1 to 4, 14 to 19, and the Illinois River have moderate diversity, while Pools 1 and 15 are highly urbanized. Pool 18 and Alton Pool are highly agricultural and have incomplete data, while the highly agricultural Pool 20 and southward area has the lowest diversity scores.

4. ***Grasslands Loss.*** Historically, there has been a loss of grassland cover from Iowa to southern Illinois. The amount of this conversion and fragmentation represents the most significant change in many parts of the UMRS. Where farms and development are next to grassland patches, grassland patch connectivity has been highly reduced, and connectivity to other natural habitats has been reduced.

5. ***Marsh Loss.*** Because river marshes were not well mapped in the past, and because by nature they tend to be fragmented, marsh fragmentation is difficult to assess. Present day marsh communities are less abundant in southern reaches, where few backwaters exist, turbidity is high, and sediment quality is poor. Marsh habitats are more abundant, and widely distributed in northern river reaches.

6. ***Forest Loss.*** Forest is an important component of the floodplain for many species of amphibians, reptiles, birds, and mammals. However, the distribution and species composition of today's forests is different than in the past. In the northern-pooled reaches, trees are now more even-aged and lower in species diversity due to water impoundment and development displaced floodplain forests; however, these remaining forests do have a species composition similar to the past. In the southern pooled reaches, the lower Illinois River, and the Open River south to the Kaskaskia River, open forests and grassland-oak savannas joining dense riparian forests and grasslands were

eliminated, but riparian forests remain largely intact. In the Open River south of the Kaskaskia River, the floodplain was once almost completely forested, but was later cleared and leveed for crop production.

The LTRMP lists six indicators of river reach health. They are: 1) ability of system to support pre-disturbance native habitats and populations, 2) ability of system to return to a pre-disturbance state, 3) ability of system to be self-sustaining, 4) ability of river reach to function as part of a healthy basin, 5) ability of system to connect annual flood pulse between river and floodplain, and 6) ability of river to maintain ecological structure and processes in response to infrequent natural events (e.g. droughts).

In consideration of the above, the Corps perceives a need to evaluate potential FDR opportunities within the context of the ecological values of the UMRS. While accepting the existing man-made changes to the river, it should be considered which ecosystem values could potentially develop. This would establish a natural resources baseline condition against which maintenance and restoration plans can be developed and project effects assessed. There is a need to complete a comprehensive inventory and classification of natural resources within the UMRCP study area. Restoration needs to focus on the rehabilitation of river processes. A consistent approach should be developed to pro-actively set environmental targets, and evaluate the net benefits of policies and measures.

The current planning process provides the Corps with an opportunity: 1) to work collaboratively with other agencies/organizations, 2) to identify and evaluate ways to achieve environmentally sustainable solutions compatible with flood damage reduction. The ecosystem sustainability objectives/management actions developed in workshops held by the navigation study is an important first step in establishing a desired environmental state for the river. Environmental enhancement opportunities identified in various reports include such things as setback levees, buyouts, relocations, conservation easements, etc.

The UMRCP CT expressed the need for environmental sustainability considerations, including the assessment of habitat loss (e.g. wetlands) and water quality during the course of the study.

Public meeting comments showed strong support for the opportunity to restore and increase wetland and habitat areas, while increasing floodwater storage by way of structures removal, buyouts, easements, uplands land treatment, etc.

2.2.2. Water Pollution.

UMRS water quality has improved in response to a mandated treatment of domestic sewage (USACE, 1998). However, the river still receives a mixture of contaminants from agricultural, industrial, municipal, and residential sources. The biological consequences of these contaminants are not well known; the following illustrate the nature of the problem. Herbicide runoff could potentially impact the growth of

submersed aquatic plants. Fingernail clam populations, now in decline, may be sensitive to un-ionized ammonia during summer low flow conditions. Heavy metals accumulated in riverbed sediments could be a problem for aquatic life for decades to come, especially in sites downstream from metropolitan areas. Lack of suitable winter habitat (in terms of temperature, dissolved oxygen, and current velocity) may be a limiting factor for fish at some locations. The development of submersed aquatic vegetation in some areas appears to be hindered by inadequate light penetration caused by turbidity and suspended solids.

In addition to compliance with Federal environmental laws dealing with water quality, the UMRCP will look for water quality improvement opportunities identified during the course of the study.

The UMRCP provides a limited opportunity with regard to watershed nutrients control. Significant action on this item may be dependent on the level of non-governmental organization interest in sponsoring site-specific demonstration initiatives on the floodplain, that also have FDR benefits as well.

2.2.3. Erosion and Sedimentation.

Upland erosion and subsequent sedimentation in downstream areas are major causes of reduced water quality and habitat destruction in most Midwestern Rivers and streams. Sedimentation in the backwaters of the upper Mississippi River may well be the most significant problem in that river (UMRBA, 1982).

The UMRS has a total drainage area of 188,000 square miles. Average annual sediment yields are generally many times greater for the southern portion of the basin than the northern portion (USACE, 1969). Small bluff drainage areas in the southern area can have sediment yields several times greater than the regional average. The major source of sediments is sheet erosion with streambed and bank erosion contributing lesser amounts. As a result, fluvial sediment is predominantly composed of silts and clays with only small amounts of sands. Sediment related damages include: infertile overwash, swamping and increased inundation, and physical impacts to facilities themselves (USACE, 1969). Infertile overwash is the deposition of sand or other unproductive material on the floodplains during floods, thereby decreasing bottomlands productivity. Swamping damage is the result of sediment deposits impairing drainage in such a way as to raise the water table; thereby reducing crop yields in the adjacent lands. Increased inundation can result from a decrease in channel or floodway capacity by sediment deposits.

The sedimentation of drainage improvements is the damage to the facilities themselves, and is the cost of sediment removal. The cost of sediment removal from municipal and industrial water supplies is likewise damage. Damage to reservoirs is the loss of storage capacity caused by sediment accumulation. Sediment deposits in highway and road ditches, culverts and bridges increase the cost of maintaining these facilities. Damage to navigable streams is reflected in the cost of channel maintenance dredging. Sediment deposition in buildings during floods causes additional damage to the flooded structure.

The 1981 UMRS Master Plan identified sedimentation as the single most significant conservation concern in the basin. Sediment deposition results in a direct loss of fish and waterfowl habitat acreage over time. It also results in decreased water depth, leaving fish susceptible to temperature extremes during the summer and winter periods and to the effects of lake freeze over during the winter. Sediment also contributes to a soft bottom substrate in backwater areas, not conducive to plant anchorage, and contributes to high turbidity levels when agitated by wind generated waves. This increased turbidity results in reduced light penetration into the water column, causing reduced photosynthetic activity, and reduced plant production. Lost plant production results in food supply impacts to both waterfowl and fish.

The 1993 flood showed the value of installing flood-prevention measures and land-treatment practices on watershed agricultural lands. NRCS projects prevented many millions of dollars in damages during this flood event. Crop losses were less in areas with upland watershed treatment.

3. GOALS AND OBJECTIVES.

3.1. UMRCP Study Goals & Objectives.

The overall goal of the UMRCP was "to develop a comprehensive FDR plan that is supportive of the evolving long-term UMRS goal for economic and environmental sustainability. Objectives developed for the UMRCP study include: minimizing health and safety risks, reducing the damages and costs associated with flooding, and identifying environmental opportunities as part of any FDR plan.

It is the intent of this chapter to incorporate habitat, nutrients, and sediments management into a holistic framework that has flood damage reduction as its primary focus. It explores UMRS watershed environmental management opportunities that can be effectively coupled with flood damage reduction (FDR) actions. These environmental opportunities strive to consider both the human and the natural environment, and also consider regional long-term data collection, trends analysis, and adaptive management.

3.2 UMRS Environmental Goals & Objectives.

3.2.1. UMRCC Ecosystem Management Goals.

In 1994, the UMRCC adopted Grumbine's ecosystem management goals, they are (1) maintain viable populations of native species in situ, (2) represent all native ecosystem types across their natural range of variation, (3) restore and maintain evolutionary and ecological processes, and (4) integrate human use and occupancy within these constraints. In 2000, the UMRCC expanded their list of goals to include: (1) improve water quality for all uses, (2) reduce erosion and sediment impacts, (3) restore natural floodplain, (4) restore natural hydrology, (5) increase backwater connectivity with main

channel, (6) increase side channel, island, shoal, and sand bar habitat, (7) minimize or eliminate dredging impacts, (8) sever pathways for exotic species introductions/dispersal; and (9) improve native fish passage at dams.

3.2.2. UMR-IWWS Navigation Study Ecosystem Management Objectives.

The UMR-IWWS Navigation Study has taken the initiative to define specific baseline ecosystem sustainability objectives for the UMRS that may be used across Federal management activities. For that purpose, the study held four two-day workshops in November 2002. The workshops were conducted in Peoria, Illinois; St. Louis, Missouri; La Crosse, Wisconsin; and Moline, Illinois. The 142 workshop participants were a diverse group representing: 6 federal, 7 state, and 15 non-governmental organizations. The main purpose of the workshops was to have the participants collaboratively review, refine, and add to a database of specific, quantitative, and local to regional scale UMR-IWW environmental objectives obtained from previous study efforts. The workshop participants were asked to utilize UMRCC goals as a framework for setting specific objectives. The groups were tasked to apply the "SMART" criteria to each objective, by making them: (1) specific, (2) measurable, (3) achievable, (4) results-oriented, and (5) time-specific.

The Navigation Study documented the workshop's reach-specific objectives in its September 2003 Environmental Report #50. **Table 6** indicates in summary fashion the number of site-specific ecosystem objectives identified by the workshops by UMRCP study reach, and **Chapter 1, Attachment G** includes a similar breakdown, but to the river pool and HNA river reach levels. The UMRCP has adopted these baseline conditions for its planning effort as well. **Table 7** provides detailed examples of the actual reach-specific (pool level) environmental objectives identified by the workshop participants. A more complete list of actual pool-wide objectives from the workshops is located in Appendix D of the workshop report (that report can be downloaded from the following site: ftp://ftp.usace.army.mil/Incoming/MVR/NavStudy/ .

4. INVENTORY AND FORECAST OF FLOODPLAIN ENVIRONMENTAL CONDITIONS.

4.1. Past, Present, and Future without Project Floodplain Environmental Conditions.

UMRCP Chapter 1, Attachment B provides the environmental team's general summary of past, present and future (without project) conditions for each of the river's significant floodplain environmental resources. The discussion of past conditions is subdivided into discussions of pre-settlement, early settlement, and modern historic

conditions. The pre-settlement era is prior to the European settlement of the 1800s, early settlement extends up to the period of major river engineering improvements (i.e. dams, levees, treatment facilities, etc.), and the modern historic period is post-major river improvements up to the present time. Much of the background information for this write-up is derived from the UMRS-EMP Long-term Resource Monitoring Program's Trends Analysis Report (1998), and the UMRS-EMP Habitat Needs Assessment (2000).

UMRCP Chapter 1, Attachment F provides a general characterization and prioritization of the 120 leveed areas within the UMRS floodplain. This assessment was conducted using acreage data from the navigation study GIS database, flood flow frequency study data, computer programming, and a scaling-weighting methodology.

5. ENVIRONMENTAL CONSIDERATIONS.

5.1. Environmental Measures Identification.

The basic categories of environmental measures used in the navigation study, were also applied to the UMRCP study (**see Table 8**). The identification of a more detailed subset of measures was determined by reviewing various informational sources, including: the FPMA Report, Galloway Report, NOAA Report, Delft Hydraulics Report, Corps H&H Reports, UMR-IWWS Navigations Study Report and the EMP and Environmental CAP project reports. By far the navigation study workshops provided the most comprehensive listing of potential UMRS management measures (or actions). **Table 8** includes a sampling of the many types of improvement measures that can be applied to the river's ecosystem. For a more in-depth description of potential environmental measures, the reader is referred to **Chapter 1, Attachment C.**

5.2. Environmental Measures Compatible with FDR Measures.

No direct evaluation was made of the pros and cons to the various environmental measures per se. The team felt that all of the identified measures could have an appropriate place on the system depending on site-specific conditions. It was felt that collectively these measures represent a "tool-box" of procedures for future systemic ecosystem restoration. However, early on in the study there was an interest in assessing the environmental utility of the then identified FDR measures for subsequent plans development. To accomplish this, the environmental team applied the **Chapter 1, Attachment D, Table 2** evaluation criteria to the **Chapter 1, Attachment D, Table 1** list of FDR measures using the matrix format of **Chapter 1, Attachment D, Table 3**.

Each measure was rated against each of the evaluation criteria using a 1 to 3 rating scale. A value of 1 indicated that a given measure provided little or no value in addressing the specified rating criterion. A value of 3 indicated a major contribution to the criterion relative to other planning measures. Next, the team totaled the points for each measure, and then based on total score; the measures were ranked into one of three priority categories (**Chapter 1, Attachment D, Table 3**). On this basis, the one-third highest priority FDR measures were determined to be: new flood control reservoirs,

small watershed ponds and detentions, vegetation management to reduce energy loss, controlled overtopping of levees/structures, alternative agriculture/flood tolerant crops, and reduced damages via acquisition/buyouts. However, subsequent hydraulics and economics screenings showed only the controlled overtopping option to have merit from an FDR standpoint. Somewhat later in the study, ring levees and highway raises were also judged to have enough economic/hydraulic/environmental merit for inclusion within the plan formulation framework.

5.3. Systemic Floodplain Ecosystem Restoration Project Opportunities

5.3.1. Number of Projects.

The UMRCP study has conceptually adopted the reach-specific ecosystem actions (measures) developed by the navigation study. However, the primary focus of the UMRCP study is on the protected floodplain, while that of the navigation study is on the river and its immediate unprotected floodplain. The following screening process was applied to determine the general magnitude of the floodplain ecosystem project opportunities applicable to the UMRCP study.

The navigation study identified approximately 2,567 site-specific environmental objectives for the UMRS via the workshops process (**Table 6**). Subsequently (**Table 9**), a list of 1,450 environmental project opportunities were identified (referred to as the virtual reference) to address those environmental objectives. Of the 1,450 project opportunities, 1,007 (**Table 10**) were selected for inclusion in the Navigation Feasibility Study's recommended Ecosystem Restoration Plan (Plan D).

Approximately 443 (1,450-1,007) environmental opportunities are not being addressed by the navigation study (**Table 11**), and of these—about 240 are UMRCP floodplain related (**Table 12**). Generally speaking, the Rock Island and St. Louis Districts regarded each D&LD as representing one environmental project opportunity.

5.3.2. Acres of Projects.

Table 13 indicates that the average number of acres per navigation study identified floodplain ER project is 1,295 acres. Accordingly, the total acres for the 239 navigation study identified floodplain project opportunities is of a magnitude of about 309,000 acres. The 309,000 acres can be viewed as representing the 100 percent floodplain ecosystem sustainability level for the UMRS. **Table 13** also displays the 100 percent sustainability level for each individual UMRCP reach. The **Table 13** acreages will subsequently serve as a point of reference for determining the relative ER performance of the various FDR study plans.

5.4. Environmental Opportunities Compatible with FDR Plans.

Since FDR is the primary study driver, it was deemed necessary to take a closer look at each alternative FDR plan to further discriminate the potential for ER project opportunities. Also considered was the type of habitat management strategy that might

be applied at a given floodplain site--this could ultimately impact the number of manageable habitat acres.

5.4.1. **FDR** ***Plans.***

Table 14 provides a tabular summary of the UMRCP systemic FDR alternative plans. The component features of these plans are described in detail in the UMRCP **Main Report, Section 2**. The FDR plans range all the way from the purely non-structural to the purely structural.

5.4.2. Habitat Management Strategies.

Four different options for floodplain ecosystem management were evaluated against each of the FDR alternative plans. The options are described in **Table 15**.

5.5. Environmental Impacts Evaluation.

The following section provides a brief summary of the environmental impacts of the alternative study plans. More detailed discussions of these impacts are described in **Environmental Appendix A** and also **CD Environmental Chapters 5** (Environmental Quantification), **6** (Nutrients), and **7** (Sediments).

5.5.1. Methods.

5.5.1.1. General Evaluation.

The general environmental impacts of the various alternative plans were assessed by the environmental team by assigning judgmental ratings for each a number of socio-economic and environmentally related factors. The scale ranged from a value of -3 at the low end to a +3 at the high end. The written rationale for assigning the ratings is provided in **Environmental Appendix A** to the main report.

5.5.1.2. Specific Evaluations.

Alternative plans were evaluated from an environmental aspect in five major categories: mitigation, secondary development, ecosystem restoration opportunities, and nutrients and sediments reduction opportunities. The evaluation approach is discussed briefly below, with a more detailed explanation presented in **CD Environmental Chapter 5.**

Resource specific impact quantifications were performed for each of the five evaluation categories. **Table 17** shows the relationship between the study plans and the impact factors evaluated. In all cases, the stated impacts assumed fully implemented alternative plans independent of economic considerations.

a. Mitigation. Early in the planning process, a decision was made to defer the development of a full-fledged Incremental Cost Analysis (ICA) until future site-specific feasibility studies have been performed. Accordingly, at this conceptual level of planning, the variability with respect to mitigation is primarily that inherent in the overall impact differences associated with the various alternative plans.

To obtain a gross indication of the magnitude of habitat mitigation required under each systemic alternative, the environmental team determined the net change in levee/floodwall footprint and affected habitat acres for each plan using engineering design data and GIS. The total impacted acreage of open water, non-forested, and forested habitat for each plan was then multiplied against a generic mitigation cost per restored floodplain acre.

b. **Secondary Development.** By far, the most significant potential impact of the flood damage reduction systemic plans relates to induced secondary development. This is especially true in areas with minimal existing flood protection. Adverse effects of increased development include: water pollution from storm runoff, increased urban flooding from increased permeable surfaces, increased damages from floods overtopping levees, and a demand for even more structural measures. In recognition of this problem, Executive Order 11988 discourages federal actions that act as an inducement to future floodplain development--unless there is no reasonable alternative. While the Corps does not require compensatory mitigation for unavoidable secondary development effects; the minimization of such effects is an important planning priority.

The approach to the assessment of secondary development was to document the amount of alternative plan lands that would be at or above a 100-year level of protection with a project plan in place (i.e. likely to be within the regulated floodplain)--and available for potential development. In addition (as supplemental information), **Environmental Chapter 5** looks at the proximity of those lands relative to two potential specific development catalysts—existing river highway bridge crossings, and existing major urban areas.

c. ER Opportunities. Similar to the mitigation discussion, the environmental team determined that the use of an ICA was inappropriate for a general assessment of habitat restoration opportunities. As an alternative approach, ecosystem opportunities were identified for each management option and alternative plan in terms of potential ER management acres, percent ER sustainability achieved, and ER related construction costs.

The identification of potential ER locations for the various alternative plans and options were based on an affirmative response to a mix of questions relating to: whether a given D&LD site (with an FDR project in place) would have less or more than a 100-year level of protection, whether or not the site requires flowage easements, whether or not the site has a significant degree of existing urbanization, and whether or not the riverside levee would be raised in elevation (**Table 16**). **Table 17** shows the relationship between the ER management options and the FDR plans.

Next, the D&LD ER location acres were totaled for each alternative plan and option. These acreages were then multiplied against an estimate of the percentage of those acres that might be manageable under each option to give a rough estimate of the total potential ER managed acres. Finally, these managed acres were then multiplied against a dollar cost per restored acre value derived from data developed in the navigation study.
It is important to note that the site locations portrayed in **Chapter 6** are for general planning purposes only. It represents an order of magnitude for a given plan's ER potential, and it is not intended to be an actual selection of specific sites for ecosystem projects. To achieve that degree of specificity would require the future development and testing of a UMRS region-wide ecosystem functions model for sites evaluation and prioritization.

The environmental team did not make an estimate of O&M costs. While such an O&M determination is required for reach-specific feasibility analyses, it was felt that insufficient information exists for a meaningful quantification at the programmatic level. In addition, it was recognized that the annual O&M costs for an ER project is typically minor when compared to the annualized construction costs. For example, the Swan Lake EMP project's estimated annual O&M costs were less than 10% of the annualized construction costs for that project.

d. Nutrients Reduction. The Wetlands Initiative estimated that 38% of the lands within the 100-year flood zone, represent existing or drained wetlands. The nutrients analysis multiplied that percentage by the number of acres of potential ER managed lands (within levees) under each alternative plan to approximate the potential number of acres of wetland nutrients reduction opportunities.

e. Sediments Reduction. The method used in this analysis was to determine the number of tributary feeders entering each of the floodplain Drainage and Levee Districts identified as ER opportunities for each alternative plan in subsection c above. These values provide an indicator for the magnitude for sediments reduction opportunities available for addressing the sedimentation problem.

5.5.2. Results.

5.5.2.1. General Evaluation.

A general assessment of the systemic environmental impacts of the alternative study plans is provided by **Table 18** and is otherwise described in Main Report Appendix A.

5.5.2.2. Specific Evaluations.

a. Plans Quantified for Environmental Impacts

As would be expected, the acreages and costs for mitigation fell out proportional to the amount of structural features implemented. Systemically, the acres and costs from highest to lowest were as noted in **Table 19**: Plan B (2,721 acres at $15.2 million), Plan

D (1,755 acres at $9.8 million), Plan E (1,345 acres at $7.5 million), Plan H (1,240 acres at $6.9 million, and Plans I and J (no mitigation acres or costs).

As would be expected, the potential for secondary development in the floodplain increases as the amount of structural flood protection increases (**Table 20**). Systemically, the plans can be ranked from lowest to highest potential for secondary development as follows: Plan J (-334,328 acres), Plan I (-8,776 acres), Plan D (1,048 acres), No Action Plan (0 acres), Plan E (4,987 acres), Plan H (+215,775 acres) and Plan B (320,037 acres). [It should be noted that the Plan D effects could be more severe than the development acreages suggest. Plan D raises levees to an elevation, close to, but just shy of the regulated 100-year floodplain. This condition could encourage development with neither insurance nor building elevations being required, even as the possibility of a catastrophic flood increases.]

Obviously, plans yielding the highest number of potentially manageable acres for ecosystem restoration would be preferred from an environmental standpoint. The plans with the highest number of management acres (**Table 21**) also tended to achieve a higher degree of sustainability (**Table 22**), and a higher ER measures implementation cost (**Table 23**). Systemically, the plans ranked from highest to lowest potential for environmental opportunities, were as follows: Plan J (807,943 potential acres at a cost of $261 million); Plans B & H (175,002 acres at $455 million), Plan E (133,889 acres at $348 million); Plan D (131,995 acres at $672 million); Plan I (9,791 acres), and No Action Plan (no acres or costs).

Since the nutrients reduction opportunities were calculated as a fixed proportion of the ER management acres—the relative ranking of the various plans is nearly the same (**Table 24**). The plans are ranked from highest to lowest potential for nutrients reduction opportunities as follows: Plan J (307,018 wetland acres); Plans B & H (66,501 acres); Plan D (50,158 acres); Plan E (50,612 acres); Plan I (3,721 acres), and the No Action Plan (0 acres).

The plans ranked from highest to lowest potential for sediments reduction opportunities are as follows: Plan J (286 tributary feeders); Plan D (206 feeders); Plan H (141 feeders); Plan E 135 feeders), and Plan B (124 feeders)(**Table 25**).

Of the plans quantified, Plan J performed the best from an environmental opportunities perspective. This plan required the least amount of mitigation, had the least potential for secondary development, had the highest potential for ER manageable acres, the highest potential for wetlands development, and the highest potential for applying sediment reduction features.

b. Plans Not Quantified for Environmental Impacts

For various reasons, Plans A, C, F, G, K and L were not directly quantified for environmental impacts. However, to an extent, the potential magnitude of impacts from these plans can be deduced (see **Table 26**):

Plan A (Confined, 500-year protection), the most structural of the flood damage reduction plans, would likely have adverse environmental effects surpassing those of Plan B (Unconfined, 500-year protection). It would thus be the least desirable plan from an environmental standpoint.

Plan C (with 200-year agricultural protection) would likely be intermediate in its environmental effects between Plans B (including 500-year agricultural protection) and Plan D (including 100-year agricultural protection), but closer to Plan D effects than Plan B effects.

Plan F with no additional agricultural protection and its urban containment approach is judged to have environmental effects very similar to the No Action Plan (with no net effects).

Plan G would have effects similar to Plan B, but slightly more adverse due to its higher allowable flood stage rise and reduced requirements for real estate acquisitions.

Plans K and L, from a systemic perspective, would entail only minor changes in the environment, with effects not vastly different from those of the No Action Plan.

6. ENVIRONMENTAL CONCLUSIONS.

The environmental team reached the following programmatic level environmental conclusions:

- **Conclusions Regarding Systemic FDR Plans.**
    - ***Environmental Desirability.*** The systemic FDR alternative plans vary in environmental desirability. In general, the more non-structural a plan is, the more environmentally desirable it is. The more non-structural a plan is--the less mitigation it requires, the less likely it is to induce development, and the less likely it is to provide substantial environmental restoration opportunities.
    - ***No Justified ER Projects.*** Significant systemic ER project opportunities do exist within the UMRS floodplain; however, at this time there are no cost-justified systemic FDR plans that would support the inclusion of ER projects.
- **Conclusions Regarding Potential Quincy Bridge Approach and FDR Reconstruction Studies.**
    - ***Information Needs.*** Protection of the Quincy bridge approach and reconstruction of existing FDR systems are potential proposals for further

study. If such studies are approved, a site-specific feasibility level investigation with integrated NEPA documentation would be required for any economically viable alternatives that emerge. This compliance would need to give full consideration to stakeholder concerns, fish and wildlife habitat needs, endangered species, clean water, prime farmland, cultural resources, and cumulative effects.

- **Conclusions Regarding Floodplain Management Considerations.**

  - ***State-of-the Art.*** Our current understanding of the mechanisms affecting the environmental health and management of the river is incomplete, and could require additional decades to fully understand. Due to the current state-of-the-science, the initial years of any future proposed floodplain ecosystem restoration program should emphasis research and monitoring over that of construction.

  - ***Integrated River Management.*** In the future, FDR concerns should be incorporated into an adaptive management process for the UMRS that brings floodplain stakeholders into broader river management planning. FDR measures and floodplain agri-systems are inseparable elements of the overall UMRS. The following are specific considerations for such a management system:

    - ***Documentation.*** The documentation vehicle for integrated river management could be the development of a permanent, Integrated Management Plan (IMP) (that includes navigation/FDR/environment/recreation considerations). The IMP would be a "living document", one that receives periodic updates, and takes advantage of state-of-the-art planning and Monitoring/Modeling/ Research (MMR) innovations.

    - ***Adaptive Management.*** The adaptive management approach to IMP preparation should include an iterative approach to decision making involving a cycle of planning, implementation, monitoring, research, and subsequent reexamination of decisions, plans and priorities, based on new information.

    - ***Decision Support System (DSS).*** A regional IMP effort could be founded on an interagency web-based DSS allowing access to basin (or sub-basin) level databases and models for system-wide assessments. A useful starting point would be the application of the Corps' System-wide Modeling, Assessment, and Restoration Techniques Program (SMART). This DSS would allow watershed mission needs to be more fully addressed, could increase the effectiveness of partnering with federal, state and local entities, and could help encourage sustainable management. SMART could

become the primary planning tool for future site-specific FDR planning activities. This regional effort would need to fully recognize the jurisdictional authorities, missions, and project implementation limitations of each of the federal and state agencies contributing to the effort.

- ***Ecosystem Functions Model.*** The application of the Ecosystem Functions Model (EFM) to the UMRS, a program embedded in SMART, could be an improvement. EFM is a computer model that analyzes ecological responses to changes in flow regime that uses topographic data, HEC-RAS, and GIS. Indicators of eco-change are linked to flow and stage changes in terms of season/frequency/duration and rate of change.

- ***Habitat Needs Assessment.*** The development of a second generation of HNA could be included as part of a UMRS level IMP/DSS process.

- ***Support to Programs and Pilot Projects.*** Actions that could contribute to our understanding of the environmental dynamics of UMRS include: (1) continuous and sufficient funding to support IMP and MMR programs, and (2) pilot projects to test innovative approaches to ecosystem restoration.

- ***Research Support.*** Funding support for the development of a UMRS regional IMP (based at MVR) and a regional database (based at UMESC) would be beneficial. Continued federal funding in support of state level DSS and IMP initiatives would also be of help, as well as the continued funding of ERDC and HEC in the R&D portion of SMART. Also beneficial would be funding for continued IWR R&D of a combined economics/environmental project evaluation/justifications model as an interface for use with SMART.

- ***Environmental Pilot Projects.*** To encourage management innovation within the UMRS, it would be instructive to select sub-basins for establishment as pilot planning projects. The environmental component (including habitat) could be planned, designed, constructed, monitored, reassessed, and modified (as appropriate) under the purview of the EMP or the Navigation Study. The performance of these projects could be reported within periodic "Reports to Congress". The program could include the states and larger NGO groups as potential project sponsors. The pilot projects could be cost-shared at the typical environmental restoration project rate of 65% Federal and 35% non-Federal. Using a strategy of adaptive management, and assuming the pilot projects prove

successful, additional increments of project could be proposed to Congress for implementation via the Report to Congress.

- ***Environmental Incentives Programs.*** The continuation of funding support to UMRS federal habitat management programs would provide positive benefits. These programs include the: Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Forestry Incentives Program (FIP), Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentives Program (WHIP), Wetlands Reserve Program (WRP), UMRS Environmental Management Program (EMP), UMR-IWW Navigation Study Ecosystem Restoration Program, Section 1135 Program, and Section 206 Programs.

- ***Insurance Programs.*** Continued funding support to federal programs that discourage floodplain development would have an environmentally positive effect. Such programs would yield net ecological benefits. Examples include, FEMA's NFIP Community Rating System (an incentives program to reduce insurance costs when communities implement mitigation measures beyond the minimum participation requirements), and FEMA's Flood Mitigation Assistance Program (a buyout program) should be encouraged. Future NFIP reforms that reduce the attractiveness of residing in high risk areas and that increase public education on floodplain management and non-structural FDR solutions.

8. GENERAL REFERENCES.

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TABLE 1. UMRCP STUDY REACHES AND CORRESPONDING HNA REACHES

UMRCP Reaches		HNA Reaches		
R1	UMR, Head of Navigation (R.M. 870) to L&D 13 (R.M. 522)*	1	Miss R. HN (St. Paul, MN) to L&D 3 (Red Wing, MN)	R.M. 870 to 797
		2	Miss R. L&D 3 (Red Wing, MN) to L&D 4 (Alma, WI)	R.M. 797 to 753
		3	Miss R. L&D 4 (Alma, WI) to L&D 9 (Harper's Ferry, IA)	R.M. 753 to 648
		4	Miss R. L&D 9 (Harper's Ferry, IA) to L&D 13 (Clinton, IA)	R.M. 648 to 522
R2	UMR, L&D 13 (R.M. 522) to 19 (R.M. 364)	5	Miss R. Pool 13 (Clinton, IA) to L&D 17 (New Boston, IL)	R.M. 522 to 437
		6	Miss R. L&D 17 (New Boston, IL) to L&D 19 (Keokuk, IA)	R.M. 437 to 364
R3	UMR, L&D 19 (R.M. 364) to Open River at Cairo (R.M. 0.0)	7	Miss R. L&D 19 (Keokuk, IA) to L&D 22 (Saverton, MO)	R.M. 364 to 301
		8	Miss R. L&D 22 (Saverton, MO) to L&D 27 (Granite City, IL)	R.M. 301 to 185
		9&10	Miss R. L&D 27 (Granite City, MO) to Cairo, IL	R.M. 185 to 0
R4	Illinois River [IR]	11	IL R HN (Chicago, IL) to Starved Rock L&D (Utica, IL)	R.M. 320 to 230
		12	IL R Starved Rock L&D (Utica, IL) to River's mouth (Grafton, IL)	R.M. 230 to 0

Note: This reach is largely without levee districts

TABLE 2. ENVIRONMENTAL REQUIREMENTS
Federal Law/Executive Order
Bald Eagle Protection Act (16 U.S.C. 668)
Clean Air Act (42 U.S.C.§§ 7401-7671g)
Clean Water Act (33 U.S.C. 1251 et seq.)
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. §§ 9601-9675)
Endangered Species Act (16 U.S.C. 1531 et seq.)
Farmland Protection Policy Act (7 U.S.C. 4201 et seq.)
Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.)
Food Security Act of 1985 (16 U.S.C. §§ 3801-3862)
National Environmental Policy Act (NEPA) (42 U.S.C. 4321-4347)
National Historic Preservation Act (16 U.S.C. 470 et seq.)
Noise Control Act (42 U.S.C. §§ 4901-4918)
Resource, Conservation and Rehabilitation Act (RCRA)(42 U.S.C. 6901 et seq.)
Floodplain Management, E.O. 11988
Protection and Enhancement of the Cultural Environment, E.O. 11593
Protection and Enhancement of the Environmental Quality, E.O. 11514
Protection of Wetlands, E.O. 11990
Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, E.O. 12898

TABLE 3. ENVIRONMENTAL OPERATING PRINCIPLES

Principle		Description
1	Strive Towards Environmental Sustainability.	Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.
2	Consider Ecosystem Impacts of Programs.	Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.
3	Seek Balance/Synergy Between Development & Ecosystem.	Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.
4	Accept Corporate Responsibility/Accountability for Environmental Actions.	Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.
5	Mitigate Cumulative Impacts and Conduct Systemic Studies.	Seek ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of our processes and work.
6	Utilize a Comprehensive Approach.	Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.
7	Utilize a Collaborative Approach.	Respect the views of individuals and groups interested in Corps activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the Nation's problems that also protect and enhance the environment.

TABLE 4. SELECTED UMRS STUDIES HIGHLIGHTING THE EVOLVING COMPREHENSIVE RIVER MANAGEMENT CONCEPT

YEAR	STUDY	PURPOSE	PLANNING APPROACH	COMPREHENSIVENESS			
				GEOGRAPHIC SCOPE	RESOURCES STUDIED	INTERAGENCY COLLABORATION	PUBLIC INVOLVEMENT
1961	Basin Plan for Upper Mississippi River Basin	Prepare a river basin development plan	An economics systemic study. Selected other related resources considered to the extent they contribute to, rather than constrain , economics growth.	Upper Mississippi River Basin	Economic Resources: power, irrigation, reclamation, navigation, and industry Related Resources: recreation, and health	None: An intra-agency effort (Rock Island, St. Paul, St. Louis Districts)	No: Public perspectives not actively sought
1972	Upper Mississippi River Comprehen sive Basin Study	Prepare a comprehensive river basin management plan	Approach was to establish a framework for future planning and implementation studies.	Upper Mississippi River Basin	Economics Resources: agriculture, navigation, flood control, power, water supply, and dredging. Related Resources: NEPA defined resources including fish and wildlife, recreation, and water quality.	Some: An Upper Mississippi River Basin Coordinating Committee (UMRBCC) lead inter-agency effort. Provided for active participation of interested Federal and State agencies via eight advisory committees formed for specific study tasks.	
1974to 1975	EIS-UMR 9-Foot Channel Project	Prepare an EIS for O&M program	Evaluated program environmental impacts for various alternatives (i.e. no action, terminate or modify existing program). Followed NEPA requirements.	Upper Mississippi & Illinois Rivers	O&M Resources: pool regulation, channel dredging, dredge material placement, and dikes/revetment maintenance. Related Resources: NEPA defined significant resources including fish and wildlife, and water quality.	Views of agencies sought and considered during EIS preparation	Yes
1976	EIS, Lock & Dam 26 (Replaceme nt)	Prepare an EIS for a replacement of L&D 26	Evaluated project environmental impacts for various alternatives (i.e. no action, rehabilitation of existing dam, and various dam replacement scenarios). Analytical methods are becoming more sophisticated (e.g. sediments analysis, channel geomorphology, electro-fishing). Followed NEPA requirements.	Both site-specific (Alton, IL vicinity) and systemic (Mississippi & Illinois Rivers)	Economic Resources: navigation Related Resources: NEPA defined resources, including floodplain and river biota and habitats, endangered species, cultural resources, water quality, noise, and social. Aspects.	Views of agencies sought and considered during EIS preparation	Yes. Project was highly controversial, and the public involvement and litigative documentation extensive. Public meetings were formal and rather confrontational.

YEAR	STUDY	PURPOSE	PLANNING APPROACH	COMPREHENSIVENESS			
				GEOGRAPHIC SCOPE	RESOURCES STUDIED	INTERAGENCY COLLABORATION	PUBLIC INVOLVEMENT
1980	Upper Mississippi River Main Stem Level B Study	Prepare a resource management plan	Provide recommendations (addressing problems of flooding, boating safety, navigation, environment, water quality, sedimentation, and land use) for the beginning of improved management of UMR main stem resources. Described resources effects using the Corp's code of accounts.	Upper Mississippi River	Economic Resources: navigation, water supply, and agriculture Related Resources: fish & wildlife, water quality, recreation, sedimentation.	Upper Mississippi River Basin Commission (UMRBC) included representation from 6 states and 8 federal agencies. Many other individuals governmental and private provided materials and advice to the study.	Yes. Public via 15 informal public meetings provided vital input to all phases of the plan formulation effort.
1981 to 1982	Great River Resource Manageme nt Study	Prepare a comprehensive master plan	Approach was to develop a multi-resource management plan to identify management problems and recommended solutions. Followed P&S and NEPA requirements.	Upper Mississippi River	Economics Resources: navigation, floodplain management Related Resources: NEPA defined significant resources, including fish & wildlife, water quality, recreation, cultural resources	Corps of Engineers had the lead. Study formulation and evaluation process was a multi-agency, inter-disciplinary cooperative effort involving Federal/State agencies and UMRBC. Twelve work groups.	Yes
1982	Comprehen sive Master Plan for the Manageme nt of the UMRS	Prepare a comprehensive master plan	Broad based study looking at issues concerning navigation carrying capacity, environmental impacts of navigation, dredging material out of floodplain, and computer inventory and analysis capabilities.	Upper Mississippi River System	Economic Resources: navigation Related Resources: NEPA defined significant resources	UMRBC had the lead. Plan developed in cooperation with 5 federal, 5 states & numerous local interests.	Yes.
1983	UMR Land Use Allocation Plan	Prepare a land use master plan	In coordination with the USFWS prepare a land use plan to balance and enhance public recreational use of fish and wildlife management while maintaining the river navigation system.	St. Paul District Portion of UMR	Economic Resources: navigation Related Resources: fish and wildlife, recreation	Corps was the lead agency in cooperation with USFWS.	Yes.
1984	Defense Use of Civil Works Navigation Projects	Prepare an IWR report	To identify defense use of the Corps' navigation projects.	Nationwide	Resources: military support	Corps led effort, with input from FEMA, Coast Guard, Bureau of Mines, and GSA.	No

YEAR	STUDY	PURPOSE	PLANNING APPROACH	COMPREHENSIVENESS			
				GEOGRAPHIC SCOPE	RESOURCES STUDIED	INTERAGENCY COLLABORATION	PUBLIC INVOLVEMENT
1994	Sharing the Challenge: Floodplain Manageme nt into the 21st Century	Prepare a Review Committee Report (often referred to as "the Galloway Report".	To take a fresh look at federal floodplain management and other policies that may have contributed to the severity of 1993 flood damages.	Midwest	Floodplain Resources: ecological, economic and social	U.S. Secretary of Agriculture established Interagency Floodplain Management Review Committee (IFMRC) led the effort. Extensive contacts made with other agencies, Congressmen and interested public.	No
1995	The Ecosystem Approach: Healthy Ecosystems and Sustainable Economies	Prepare a Task Force Report	To adopt a proactive approach to ensuring a sustainable economy and a sustainable environment through ecosystem management. Task Force sought to increase our understanding of the "ecosystem approach" by reviewing case studies.	Nationwide	Generic Resources: ecological, economic and social	Administration National Performance Review established Interagency Ecosystem Management Task Force	No.
1995	Floodplain Manageme nt Assessment	Prepare a Report to Congress	To apply Corps planning process to culminate in a recommended plan of improvements to the current flood control system. It explored 3 plans of change in flood insurance, floodplain regulation, flood hazard mitigation, disaster assistance, wetlands restoration, and agricultural support policies.	Upper Mississippi & Lower Missouri Rivers & their Tributaries	Floodplain Resources: ecological, economic and social	Effort was reflected a degree of cooperation and team work (with 5 District and 3 Division Offices, and Headquarters), NRCS, FEMA, USEPA, USFWS, and 7 flood affected states.	Yes. A series of public meetings were held.
1996	Mel Price Locks and Dam	Prepare a Program Progress Report	To reduce the potential environmental impacts of increased navigation traffic from the construction of a second lock at Mel Price L&D via the existing authority of the O&M program.	St. Louis District portion of UMR	Economic Resources: navigation Environmental Resources: fish and wildlife	St. Louis Corps District led effort through an A&M team (consisting of federal/state/private partners in natural resources and industry.	No.
1997	Evaluation of UMRS-EMP	Prepare a program Report to Congress	To provide documentation on the outputs of 3 major elements of the EMP: Habitat Rehabilitation and Enhancement Projects (HREPs), Long Term Resources Monitoring (LTRM) and the Computer Inventory and Analysis (CIA). The LTRM and CIA jointly referred to as the Long Term Resources Monitoring Program (LTRMP).	Upper Mississippi River System	Environmental Resources: fish and wildlife	Corps of Engineers	Yes. EMP has an environmental outreach component.

YEAR	STUDY	PURPOSE	PLANNING APPROACH	COMPREHENSIVENESS			
				GEOGRAPHIC SCOPE	RESOURCES STUDIED	INTERAGENCY COLLABORATION	PUBLIC INVOLVEMENT
1998	Ecological Status and Trends of the UMRS	Prepare a Background Report to UMRS-EMP report to Congress	To compare river health criteria with measured observations, and convey this comparison via gauges that reflect stable, declining, or improving conditions.	Upper Mississippi River System	Environmental Resources: fish and wildlife	LTRMP is under the funding control of the Corps of Engineers, while the day to day management of the program is conducted by the Upper Midwest Environmental Science Center.	Yes. EMP has an environmental outreach component.
1999	Rivers Project Master Plan	Prepare Updated Master Plan	To consolidate several prior St. Louis District O&M Master Plans into a single more comprehensive Rivers Project Master Plan.	St. Louis District	River Resources: fish and wildlife, recreation	St. Louis Corps District was the lead agency, with significant cooperation from the USFWS and the state conservation departments.	Yes. Public meetings were held.
2000	UMRS Habitat Needs Assessment (HNA)	Prepare an HNA Report	To provide the first HNA in support of the UMRS-EMP, with the intent of helping to guide the development of future HREPs.	Upper Mississippi River System	Environmental Resources: fish and wildlife	Corps of Engineers was the lead agency, with participation from the USFWS, USGS, the state conservation/natural resources departments, and the Upper Mississippi River Basin Association (UMRBA).	Yes. Public meetings were held.
2004	UMR-IWS Navigation Study	Prepare a feasibility study report	To identify and evaluate a planning framework for ecosystem restoration and navigation improvements on the Upper Mississippi River and Illinois Waterway System.	Upper Mississippi River and Illinois Waterway System	River Resources: Navigation improvements, Integrated management of channel maintenance activities with island building and backwater restoration, Managing water levels to restore plant habitat and consolidate sediment, Mooring facilities to protect environmentally sensitive areas, Impoved institutional arrangements, Fish passage structures	Collaborative effort with other federal and state agencies, non-governmental organizations and the public in developing the study's recommendations.	Yes, Public meetings were held.

2006	Illinois River Basin Restoration	Prepare a plan	To develop an overall plan for the restoration of the Illinois River Basin, including system needs and recommendations describing the restoration program, lon-term resource monitoring, computerized inventory and analysis system, and innovative dredging technologies and beneficial use of dredged material	Illinois River Basin	River Resources: sedimentation, backwaters and side channels, aquatic/floodplain/riparian habitats, connectivity (fish passage), hydrology and water levels, water and sediment quality	Collaborative effort between the Corps of Engineers and the Illinois Department of Natural Resources	Yes. Public meetings were held.

TABLE 5. ENVIRONMENTAL PLANNING ASSUMPTIONS		
Topic	Planning Assumption	Documentation
Federal Purpose	Per its authorizing legislation, the UMRCP is a single-purpose FDR project. It gives equal consideration (but not equal purpose) to environmental resources.	5 Jun 02 MFR
	Legislatively, the UMRCP is not an all encompassing comprehensive plan that addresses all river resources. It solely addresses floodplain problems/needs.	5 Jun 02 MFR
	End product of the UMRCP Study is an FDR Plan.	30 Jan 03 IPR MFR
Ancillary Purposes	UMRCP will include only a limited look at sediment, water quality, and bankline erosion	5 Jun 02 MFR, 30 Jan 03 IPR MFR
Planning Study Level of Detail	Just slightly more detailed than the traditional (Older) Recon Report	5 Jun 02 MFR
	Alternative plans will be displayed as a tabulation of reach features (e.g. 50,000 feet of setback levee, or 500 acres of planted forest in a particular study reach), rather than with absolute mapped specificity.	24 Apr 03 MVR/MVS/MVD Phone Discussion
NEPA Level of Detail	NEPA documentation will be prepared at a programmatic level of detail	5 Jun 02 MFR
Information Source	Primary source is existing readily available data.	Sec 459 of WRDA 99
	HNA will be the informational source for UMRS habitat problems. Most ecosystem sustainability objectives and management measures will be derived from navigation study workshops.	24 Apr 03 MVR/MVS/MVD Phone Discussion
Study Limits	Limited to the floodplain (bankline to toe of bluff). Watershed issues will be addressed in general terms as it affects the floodplain.	5 Jun 02 MFR
	FDR work would not be done in areas that are presently unleveed.	30 Jan 03 IPR MFR
NER Considerations	Consistent with the project's authorization, NER will not be studied as an independent project purpose.	12 Feb 03 MVR/MVD/HQ Phone Discussion (Kincaid summarized)
	ER opportunities and benefits will be identified by the study.	5 Jun 02 MFR
	Attempting to combine NED and ER benefits is potentially allowable, but would require an approved Planning Guidance Memorandum (PGM) from MVD	30 Jan 03 IPR MFR, 24 Apr 03 MVR/MVS/MVD Phone Discussion
	In addition to an NED (FDR) Plan, there will be an NED/ER Plan, and a non-structural plan with ER benefits.	30 Jan 03 IPR MFR
	Cost-effectiveness analysis will use acres rather than habitat units as its measure of ER output, and would use generic cost multipliers per acre of managed habitat.	30 Jan 03 IPR MFR
Environmental Sustainability Considerations	To extent consistent with Principles and Guidelines (P&G), and the study's authorizing legislation, the UMRCP environmental planning process will strive to achieve environmental sustainability as prescribed in the Corps Environmental Operating Principles.	March 2002 Corps Environmental EOP Guidance, P&G, Sec 459 of WRDA 99
Follow-on Studies	FDR Plan will be developed at the program level. All study objectives will be addressed, and follow-on implementation studies will be recommended as appropriate	5 Jun 02 MFR, 30 Jan 03 IPR MFR
Study Oversight	Federal Principles Group will be expanded to include UMRCP Study.	5 Jun 02 MFR
Report Completion Versus Economic Viability	The alternatives analysis will be completed, and the findings presented, even if the study's economics are negative.	12 Feb 03 MVR/MVD/HQ Phone Discussion (Kincaid summarized)
	The authorizing legislation says, "The Secretary shall develop a plan…"	Sec 459 of WRDA 99
	A PGM on this item will be approved prior to completing the environmental study effort.	
Comprehensive Floodplain Management	Conceptual level "integrated river management" planning within the context of the UMRCP has high-level Corps support. So too does the concept of "Adaptive Management".	30 Jan 03 IPR MFR, 24 Apr 03 MVR/MVS/MVD Phone Discussion
Project Implementation	Project implementation process would be structured similar to that used at Everglades.	30 Jan 03 IPR MFR
EIS Format	Outline for the EIS is essentially that prescribed by NEPA, and the ER 200-2-2 Procedures for Implementing NEPA.	24 Apr 03 MVR/MVS/MVD Phone Discussion, ER 200-2-2
EIS Termination	If it is officially determined that the study has no economically viable systemic plan, there would be no environmentally impactable action, and the need for an EIS, and a Record of Decision would dissipate. The intensity of the effort on the study's environmental appendices would be reevaluated.	14 May 03 Environmental Team Strategy Paper
Planning Procedure	The planning process will be conducted consistent with ER 1105-2-100 Guidance for Conducting Civil Works Planning Studies.	ER 1105-2-100
Agency Involvement	Environmental planning activities will be accomplished through interagency collaboration.	PMP
Technical Review	The environmental studies will be subjected to a "scientific peer review".	PMP
Project Justification	Developing a methodology to better integrate BCR considerations of both tangible and intangible values is a magnitude of effort beyond the scope of the current UMRCP study effort.	

TABLE 6. SUMMARY—NUMBER OF ENVIRONMENTAL OBJECTIVES BY UMRCP STUDY REACH					
Objective	Study River Reach (Number Environmental Objectives Identified)				
	1	2	3	4	UMRS Total
Water Clarity	188	40	79	51	358
Backwater Depth	203	43	81	56	383
Water Level	23	6	5	0	34
Connectivity	71	18	75	27	191
Aquatic Areas	85	40	167	43	335
Terrestrial Areas	317	27	51	54	449
Land Cover/Use	395	54	149	78	676
Plants	0	0	0	3	3
Fish	2	3	1	0	6
Birds	0	0	0	1	1
Other	21	12	69	29	131
TOTAL	1,305	243	677	342	2,567

TABLE 7. EXAMPLES OF SPECIFIC POOL-WIDE ENVIRONMENTAL OBJECTIVES IDENTIFIED BY WORKSHOP PARTICIPANTS	
General Objective	Specific Objectives
Water Clarity	• Address concerns of 303D (impaired water's list) • Water clarity in secondary channels should have a secchi disk transparency of 1.5m during all seasons by 2010 • Reduce erosion • Restore and create islands that provide protection from wind fetch
Backwater Depth	• Restore 10% of the backwater areas so that they are at least three meters deep with proximity to flow and dissolved oxygen>=5ppm • Decrease sediment-loading from tributaries • Maintain water clarity sufficient to support vegetation to a depth of 1.5m • Reduce sedimentation throughout each pool
Water Level	• Create a more natural hydrograph • Recreate the natural hydrograph • Reduce incidence of summer water level "bumps" to less than 1 year in 3
Connectivity	• Increase connectivity so that 20% of the floodplain is inundated during 10-year flood events • Increase floodplain connectivity by 40% • Increase connectivity to 25% of currently isolated backwaters
Aquatic Areas	• Sustain quality habitat through natural processes • Increase quantity of woody debris in side channels of pools
Terrestrial Areas	• Actively manage floodplain forests • Restore and maintain riparian corridors (200 ft. wide) • Restore historic meanders • Provide one 1000-acre core block habitat (wetland, grassland and forest) per pool •
Land Cover/Use	• Work to achieve habitat restoration through agricultural programs on the floodplain (e.g. Conservation Reserve Program (CRP), Wetland Reserve Program (WRP), etc.) • Support environmental pool plans
Plants	• Eliminate reed canary grass wherever possible
Fish	• Restore the presence of lake sturgeon • Provide over wintering habitat for fish every 5-7 miles
Birds	• Provide bird nesting areas every 20 miles
Other	• Protect mussels—recovering communities • Reduce the nutrient load by 15% • Protect, maintain, and enhance threatened and endangered species habitat and other natural areas

TABLE 8. ECOSYSTEM MANAGEMENT ACTIONS		
Measure Category	Category Definition	Sample Measures
SC Connectivity	Various methods used to ensure the continued habitat connection and function between the river and its secondary channels	• Secondary Channel Structures • Partial Closures • Channel Dredging
Island Protection	Various methods used to control the detrimental effects resulting from island bank erosion	• Chevron dikes • Riprap
Dike Modification	Modifications to channel regulating structures to enhance habitat diversity	• Notched dikes • Bullnose dikes (around islands) • Log piles • Gravel bars
Island Area	Any means by which new island areas can be created	• Seed islands • Chevron islands • Barrier Islands • Low Islands
Fish Passage	Any means by which fish are permitted to circumvent existing barriers to movement	• Fish ladder • Modified dam gate operation • Riffle-pool by-pass
WLM—Pool	Modifications for water level management on a large scale	• Environmental Pool Management (EPM)
WLM—BW	Modifications for water level management on a small localized scale.	• Water control structures (levees, gated CMPs, pumps, ditches)
FP Connectivity	Modifications directed at restoring the biological relationships between a river and its adjacent floodplain	• Levee removal • Gated structure at levee • Channel Dredging • Backwater Dredging
Topographic Diversity	Modification of the existing ground surface elevations to improve habitat diversity.	• Dredged Material Management Plans • Confined Dredge Material Placement & Tree Plantings • Behind Levee Dredge Material Placement
Depth	Modifications directed at improving water depth diversity	• Dredging • Potholes excavation
Shore Protection	Various methods used to control detrimental effects resulting from bank erosion	• Riprap • Offshore revetments • Biotechnical techniques
Dam Point Control	Modified water level regulation at the navigation dams to provide improved conditions for fish spawning and over-wintering habitat and for migratory waterfowl habitat above and beyond that possible utilizing EFM alone.	• Modified Water Control Plan • Dam Gates Automation • Additional Lands Acquisition
FP Immediate Projects	ER projects in an advanced stage of planning awaiting implementation and funding authority for implementation	• Spunky Bottoms Project • Emiquon Project • Hennepin Project

TABLE 9. SUMMARY—NUMBER OF ECOSYSTEM RESTORATION PROJECT OPPORTUNITIES IDENTIFIED WITHIN UMRS (= VIRTUAL REFERENCE)

Measure	Study River Reach (Number Environmental Objectives Identified)				
	1	2	3	4	UMRS Total
SC Connectivity	35	20	131	39	225
Island Protection	131	1	10	15	157
Dike Modification	10	6	55	3	74
Island Area	146	6	16	4	172
Fish Passage	14	6	8	5	33
WLM—Pool	14	6	6	0	26
WLM—BW	8	0	1	1	10
FP Connectivity	44	8	31	15	98
Topographic Diversity	16	8	8	0	32
Depth	203	43	81	56	383
Shore Protection	70	31	73	60	234
Dam Point Control	0	1	2	0	3
FP Immediate Projects	0	0	0	3	3
TOTAL	691	136	422	201	1,450

TABLE 10. SUMMARY—NUMBER OF ECOSYSTEM RESTORATION PROJECT OPPORTUNITIES ADDRESSED BY NAVIGATION STUDY

Measure	Study River Reach (Number Environmental Objectives Identified)				
	1	2	3	4	UMRS Total
SC Connectivity	31	19	63	34	147
Island Protection	131	1	10	15	157
Dike Modification	9	6	46	3	64
Island Area	65	6	16	4	91
Fish Passage	6	2	5	0	13
WLM—Pool	6	3	3	0	12
WLM—BW	5	0	1	1	7
FP Connectivity	21	6	6	4	37
Topographic Diversity	16	8	8	0	32
Depth	82	31	48	46	207
Shore Protection	70	31	73	60	234
Dam Point Control	0	1	2	0	3
FP Immediate Projects	0	0	0	3	3
TOTAL	442	114	281	170	1,007

TABLE 11. SUMMARY—NUMBER OF ECOSYSTEM RESTORATION PROJECT OPPORTUNITIES NOT ADDRESSED BY NAVIGATION STUDY

Measure	Study River Reach (Number Environmental Objectives Identified)				
	1	2	3	4	UMRS Total
SC Connectivity	4	1	68	5	78
Island Protection	0	0	0	0	0
Dike Modification	1	0	9	0	10
Island Area	81	0	0	0	81
Fish Passage	8	4	3	5	20
WLM—Pool	8	3	3	0	14
WLM—BW	3	0	0	0	3
FP Connectivity	23	2	25	11	61
Topographic Diversity	0	0	0	0	0
Depth	121	12	33	10	176
Shore Protection	0	0	0	0	0
Dam Point Control	0	0	0	0	0
FP Immediate Projects	0	0	0	0	0
TOTAL	249	22	141	31	443

TABLE 12. SUMMARY—NUMBER OF FLOODPLAIN RELATED ECOSYSTEM RESTORATION PROJECT OPPORTUNITIES NOT ADDRESSED BY NAVIGATION STUDY

Measure	Study River Reach (Number Environmental Objectives Identified)				
	1	2	3	4	UMRS Total
WLM—BW*	3	0	0	0	3
FP Connectivity*	23	2	25	11	61
Depth*	121	12	33	10	176
TOTAL	147	14	58	21	240

TABLE 13. DETERMINATION OF 100 PERCENT ENVIRONMENTAL SUSTAINABILITY LEVEL

Factor	UMRCP Study Reach				
	1	2	3	4	UMRS Total
Unaddressed Floodplain Opportunities Related to UMRCP FDR Study	147	14	58	21	240
Average Acres of Influence Per ER Project Opportunity	1,295	1,295	1,295	1,295	1,295
Total Acres of Influence—All ER Project Opportunities Combined (= 100% Floodplain Sustainability)	190,365	18,130	75,110	25,900	309,505

TABLE 14. ALTERNATIVE PLANS SUMMARY

Alternative		Confined Systemic Plan	Unconfined Systemic Plan	Urban 500-yr protection	Urban—no increase in protection	Urban—Devel. In 500-yr floodplain	Ag—500 yr protection	Ag—500 yr if contains regional CI, no raise otherwise	Ag—200 yr protection	Ag—about 100-yr protection	Ag—50 yr protection	Ag Areas—cost effective comparison for buyouts	Ag Areas--no increase in protection	Ag Areas—remove existing levees	Ag Areas—Buyout levee district	Inside Ag—protect communities (ring levee & no new Devel.)	Inside Ag—emergency bridge approaches protected	Inside Ag—buyout communities in 100-year floodplain	Unprotected towns—500-yr protection	Unprotected towns--buyout	Unprotected Ag—no protection	Bridge approaches—500-yr protection	Bridge approaches—no protection	Impact at Thebes, IL, 0.9-1.0 feet
NA	No Federal Action		x																					
A	500-yr Urban / 500-yr Ag Protection (Confined)	x		x																				
B	500-yr Urban / 500-yr Ag Protection (Unconfined)		x	x			x												x		x			
C	500-yr Urban / 200-yr Ag Protection (Unconfined)		x	x					x										x		x			
D	500-yr Urban / 100-yr Ag Protection (Unconfined)		x	x						x									x		x			
E	500-yr Urban / 50-yr Ag Protection (Unconfined)		x	x							x								x		x			
F	500-yr Urban & Hwy Approach Protection (Unconfined)		x	x									x			x	x		x		x			
G	500-yr Urban & Ag Protection w/no Impacts Reduction to LMV		x	x			x												x		x			x
H	500-yr Urban & Ag Protection w/ Selective Buyouts		x	x								x							x		x			
I	Urban Relocation Out of 100-yr Floodplain		x		x								x					x		x	x		x	
J	Floodplain Management		x			x								x	x									
K	Protection of Regional Critical Infrastructure		x	x				x					x						x		x			
L	Protection of Critical Bridge Approaches		x																					

TABLE 15. DESCRIPTION OF ECOSYSTEM RESTORATION OPTIONS		
OPTION		**DESCRIPTION**
1	*No Action.*	No additional expenditure of federal funds via the UMRCP for the management of UMRS floodplain habitat development.
2	*Conservation Easements Acquired in Conjunction with Plan Flowage Easements.*	Under this option, a payment for residual property rights on FDR flowage easement lands would be offered to landowners (on a voluntary basis) as conservation easements for future fish and wildlife management purposes. The conservation easement cost would be equivalent to the difference between fee simple acquisition costs and the costs of flowage easements. This option would encourage enhanced federal funding to support the management of existing state and federal conservation programs (e.g. the CRP, CREP, WRP, EMP programs, etc.). It is assumed that the eligible locations could be approximated by determining those leveed areas that would have less than a 100-yr level of flood protection (with a UMRCP project in place), and those sites that would require flowage easements. The acreage opportunities available would be directly proportional to the amount of landowner interest in the program. Lands under conservation easements would be enhanced using a wide variety of available habitat improvement methods. For example, fisheries management might include backwater channel dredging, the incorporation of woody debris, or the placement of rock and gravel within aquatic areas to serve as aquatic habitat structures. Wildlife management might include the placement of bird nesting structures, the protection of special habitat areas, the enhancement of habitat corridors, the planting of prairie vegetation, the planting of trees on dredged disposal material sites, the creation of a mix of successional stages, exotic species control, and water level management.
3	*Buyouts.*	Under this option, lands included as FDR buyouts would meet two key criteria: (1) the cost of levee improvements for a given D&LD would have to exceed the value of the land protected, and (2) leveed areas must be less than 10% urbanized. The same site development measures described for Option 2 would be applied here as well. Areas of high physical diversity and areas in close vicinity to existing federal refuges and state management areas would receive a high priority for future study. Federal and state conservation agencies would manage the lands similar to the Corps' current General Plan lands leased out to the agencies under a cooperative agreement. This option addresses a more literal interpretation of the WRDA '99 language that states "FDR and floodplain management by means of…habitat management…"
4	*Conservation Easements on Lands adjacent to Levees Construction*	This measure is similar to Option 2. However, since no flowage easements would be involved, obtaining conservation interests landward of the levees would be tantamount to the cost of a fee simple acquisition. Areas of high physical diversity, and areas in close vicinity to existing federal refuges and state management areas would receive a high priority for future study.

TABLE 16. QUESTIONS APPLIED TO DETERMINE ER LOCATIONAL OPPORTUNIITES	
OPTION	**QUESTION ***
1	• No applicable questions
2	• With a project in place, will the location have less than a 100-Yr level of protection? (Y/N) • Does the location require flowage easements? (Y/N)
3	• Does the cost of levee improvements at the location exceed the value of the lands protected? (Y/N) • Is the landuse at the location less than 10 percent urban ? (Y/N)
4	• With a project in place, will the location have less than a 100-Yr level of protection? (Y/N) • Would the location be without flowage easements? (Y/N) • Would there be a levee raise at the location ? (Y/N)
*	An affirmative response to all option criteria yields an ER locational opportunity for a given alternative plan

TABLE 17. PLANS QUANTIFIED FOR SPECIFIC TYPES OF IMPACT							
Plan	Mitigation Analysis	Secondary Development	ER Opportunities			Nutrients	Sediments
			Option 2	Option 3	Option 4		
No Action	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A	No	No	No	No	No	No	No
B	Yes	Yes	Yes	Yes	Yes	Yes	Yes
C	No	No	No	No	No	No	No
D	Yes	Yes	Yes	Yes	Yes	Yes	Yes
E	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F	Yes	No	No	No	No	No	No
G	No	No	No	No	No	No	No
H	Yes	Yes	No	Yes	No	Yes	Yes
I	No	Yes	No	Yes	No	Yes	No
J	No	Yes	No	Yes	No	Yes	Yes
K	No	No	No	No	No	No	No
L	No	No	No	No	No	No	No

Table 18. Magnitude of Probable Environmental Impacts Associated with Implementation of Alternative Plans

Plan/ Subplan	Social Effects										Economic Effects										Environmental Effects											
	Noise Levels	Aesthetic Values	Recreational Opportunities	Public Health and Safety	Transportation	Community Cohesion	Community Growth and Development	Business and Home Relocations	Existing/Potential Land Use	Controversy	Property Values	Tax Revenues	Public Facilities and Services	Regional Growth	Employment	Business Activity	Farmland/Food Supply	Commercial Navigation	Energy Needs and Resources	Flooding	Air Quality	Terrestrial Habitat	Wetlands	Aquatic Habitat	Habitat Diversity and Interspersion	Biological Productivity	Quality of Surface Water	Water Supply	Groundwater	Soils	Threatened or Endangered Species	Architectural/Archaeological Values
No Action	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A	0	-2	0	+1	+3	+1	+3	+2	+3	-3	+2	+2	+1	+2	+1	+2	+1	0	0	+1	0	-2	-2	0	0	-2	-1	0	-2	-3	-1	0
B	0	-1	0	+2	+3	+1	+1	+1	+2	-3	+2	+2	+1	+2	+1	+2	+1	0	0	+1	0	-1	-1	0	0	-1	-1	0	-2	-3	-1	-1
C	0	-1	0	+2	+2	+1	+1	+1	+2	-2	+2	+2	+1	+2	+1	+2	+1	0	0	+1	0	-1	-1	0	0	-1	0	0	0	-2	0	-1
D	0	-1	0	+2	+1	+1	+1	+1	+2	-1	+2	+2	+1	+2	+1	+2	+1	0	0	+1	0	-1	-1	0	0	-1	0	0	0	-1	0	-1
E	0	-1	0	+2	0	+1	+1	+1	+1	-1	+2	+2	+1	+1	+1	+1	+1	0	0	+1	0	-1	-1	0	0	-1	0	0	0	-1	0	-1
F	0	-1	0	+2	+2	+1	+1	+1	+1	0	+2	+2	+1	+1	+1	+1	+1	0	0	+1	0	-1	-1	0	0	-1	0	0	0	0	0	-1
G	0	-1	0	+2	+3	+1	+1	+1	+3	-3	+2	+2	+1	+2	+1	+2	+1	0	0	+1	0	-1	-1	0	0	-1	-1	0	-2	-3	-1	-1
H	0	0	+1	+2	+2	0	+1	-2	0	-2	+2	+2	+1	+2	+1	+2	+1	0	0	+1	0	+1	+1	+1	+1	+1	+1	0	+1	+1	+1	-1
I	0	+1	0	+2	0	-2	-3	-2	-2	-2	-3	-3	-2	-3	-3	-3	0	0	-1	+1	0	+1	+1	0	0	+1	+1	0	0	+1	0	-2
J	0	+2	+1	+3	0	0	-3	-3	-3	-3	-2	-2	-2	-3	-3	-3	-1	0	-1	+1	0	+3	+3	+2	+2	+3	+2	0	+2	+3	+2	-1
K	0	0	0	+2	+3	0	0	0	0	0	+2	+2	+1	+2	+1	+2	+1	0	0	+1	0	0	0	+1	0	0	+1	0	0	0	0	0
L	0	0	0	+1	+2	0	0	0	0	0	+1	+1	+1	+1	+1	+1	+1	0	0	+1	0	0	0	0	0	0	0	0	0	0	0	0

RATINGS CODE:

+3 Major beneficial environmental impacts likely
+2 Moderate beneficial "
+1 Minor beneficial "
0 No appreciable "
-1 Minor adverse "
-2 Moderate adverse "
-3 Major adverse "

Table 19. Mitigation					
FDR Plan	Impacted Native Habitat (Acres)				
	Reach 1	Reach 2	Reach 3	Reach 4	Entire UMRS
No Action	0	0	0	0	0
B	1	323	1,300	1,097	2,721
D	1	67	1,206	481	1,755
E	1	15	840	489	1,345
H	1	259	724	256	1,240
	First Costs ($ Millions)				
No Action	0	0	0	0	0
B	0	1.8	7.3	6.1	15.2
D	0	0.4	6.8	2.7	9.8
E	0	0.1	4.7	2.7	7.5
H	0	1.5	4.1	1.4	6,9
* The costs reported here assume that all non-developed, non-agricultural habitat types impacted would be mitigated. Only the mitigation and costs associated with permanent easements are shown, for a depiction of temporary easement associated impacts—see Appendix A and Environmental Documentation Chapter 5.					

Table 20. Secondary Development						
FDR Plan	Buyouts	Potential Net Increase in Secondary Development Lands (Acres)				
		Reach 1	Reach 2	Reach 3	Reach 4	Entire UMRS
No Action	N	0	0	0	0	0
B	N	0	61,568	189,167	69,302	320,037
B	Y	0	56,560	161,143	-1,928	215,775
D	N	0	0	896	152	1,048
D	Y	0	0	896	-7,117	-6,221
E	N	0	-113	896	152	935
E	Y	0	-113	896	4,204	4,987
H	Y	0	56,560	161,143	-1,928	215,775
I	Y	0	-1,452	-5,001	-2,343	-8,776
J	Y	0	-49,285	-221,455	-63,588	-334,328

Table 21. Ecosystem Opportunities-- Potential ER Managed Acres						
FDR Plan	Option	Acres				
		Reach 1	Reach 2	Reach 3	Reach 4	UMRS
No Action	1	0	0	0	0	0
B	2	0	0	42,687	396	43,083
B	3	0	5,008	44,441	125,553	175,002
B	4	0	0	0	0	0
D	2	0	15,392	69,057	47,546	131,995
D	3	0	0	36,139	94,503	130,642
D	4	0	0	0	0	0
E	2	0	3,672	31,117	30,776	65,565
E	3	0	0	42,023	91,866	133,889
E	4	0	2,108	0	1,067	3,175
H	3	0	5,008	44,441	125,553	175,002
I	3	0	1,452	5,999	2,340	9,791
J	3	0	113,401	511,172	183,370	807,943

Table 22. Ecosystem Opportunities-- Percent Sustainability Achieved						
FDR Plan	Option	Percent				
		Reach 1	Reach 2	Reach 3	Reach 4	UMRS
No Action	1	0	0	0	0	0
B	2	0	0	57	2	14
B	3	0	28	60	485	57
B	4	0	0	0	0	0
D	2	0	85	92	184	43
D	3	0	0	48	364	42
D	4	0	0	0	0	0
E	2	0	20	41	119	21
E	3	0	0	56	355	43
E	4	0	12	0	4	1
H	3	0	28	60	485	57
I	3	0	8	8	9	3
J	3	0	625	681	708	261

Table 23. Ecosystem Opportunities—ER Total First Costs (Millions)						
FDR Plan	Option	River Reach				
		R1	R2	R3	R4	UMRS
No Action	1	0	0	0	0	0
B	2	0	0	217	2	219
B	3	0	13	116	326	455
B	4	0	0	0	0	0
D	2	0	78	352	242	672
D	3	0	0	94	246	340
D	4	0	0	0	0	0
E	2	0	19	159	157	334
E	3	0	0	109	239	348
E	4	0	13	0	7	20
H	3	0	13	116	326	455
I	3	0	4	16	6	25
J	3	0	295	1,329	477	261

Table 24. Wetlands Nutrients Reduction Opportunities Afforded by UMRCP FDR Plans *

FDR Plan	Option	Floodplain Nutrients Farming Potential by River Reach (Acres)				
		1	2	3	4	Total
No Action		0	0	0	0	0
B	2	0	0	16,221	150	16,372
	3	0	1,903	16,888	47,710	66,501
	4	0	0	0	0	0
D	2	0	5,849	26,242	18,067	50,158
	3	0	0	11,824	35,911	49,644
	4	0	0	0	0	0
E	2	0	1,395	11,824	11,695	24,915
	3	0	0	15,969	34,909	50,612
	4	0	801	0	405	1,207
H	2	N/A	N/A	N/A	N/A	N/A
	3	0	552	16,888	47,710	66,501
	4	N/A	N/A	N/A	N/A	N/A
I	2	N/A	N/A	N/A	N/A	N/A
	3	0	552	2,280	889	3,721
	4	N/A	N/A	N/A	N/A	N/A
J	2	N/A	N/A	N/A	N/A	N/A
	3	0	43,092	194,245	69,681	307,018
	4	N/A	N/A	N/A	N/A	N/A

The Wetlands Initiative estimated that 38% of lands that it sampled from the 100-year flood zone represent existing or drained wetlands. The above analysis has applied that percentage to the acres of ER managed lands opportunities to approximate the potential acres of wetlands restoration opportunities on the UMRCP floodplain.

Table 25. Sediments Reduction Opportunities Afforded by UMRCP FDR Plans						
FDR Plan	**Option**	**Floodplain Sediments Reduction Opportunities (Number of Tributary Feeders)**				
		1	2	3	4	Total
No Action	1	0	0	0	0	0
B	2	0	0	38	0	38
	3	0	5	42	77	124
	4	0	0	0	0	0
D	2	0	8	89	109	206
	3	0	0	27	64	91
	4	0	0	0	0	0
E	2	0	1	53	81	135
	3	0	0	35	67	102
	4	0	1	0	3	4
H	3	0	5	45	91	141
J	3	0	14	161	111	286

Table 26. Specific Impact Evaluations Summary						
Evaluation	**Environmental Desirability**					
	High		**Moderate**		**Low**	
	Q	**S**	**Q**	**S**	**Q**	**S**
Mitigation	J		E, H, I, NA	F, K, L	B, D, F	A, C, G
Secondary Development	J		D, E, I, NA	C, F, K, L	B, H	A, G
ER Opportunities	J		B, D, E, H	C, G	I, NA	A, F, K, L
Nutrients Reduction Opp's	J		B, D, E, H	C, G	I, NA	A, F, K, L
Sediment Reduction Opp's	J		B, D, E, H	C	NA	A, F, K, L

Q = Classification based on quantified information
S = Classification based on speculated position relative to other quantified plans