MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

MAIN REPORT

For

MAUMEE RIVER BASIN COMMISSION
ROOM 640 CITY-COUNTY BUILDING
FORT WAYNE, INDIANA 46802

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CBBEL PROJECT NO. 93-64

ABOUT THE MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN REPORTS

This document is one part of a series of reports generated in connection with the Maumee River Basin Flood Control Master Plan. The report series consists of six (6) separate, but closely related, report volumes documenting different aspects of the study performed.

The first report volume, entitled **"Resources and Trends of the Maumee River Basin, Indiana"**, was finalized in September 1993 by the Maumee River Basin Commission (MRBC). The report provides a very thorough review and compilation of the available information on a variety of topics relevant to flood control efforts, including history, resources and economy, trends, river description and flooding, and problems and needs. It serves as a precursor to the Basin's Master Plan.

The second report volume is entitled **"Maumee River Basin Flood Control Master Plan – Damage Inventory Report"**. This report volume, finalized in July 1994 by Christopher B. Burke Engineering, Ltd. (CBBEL) for the MRBC, provides a detailed account of the nature and severity of the flood damages in the Basin divided into study reaches.

The third report volume is entitled **"Maumee River Basin Flood Control Master Plan Damage Inventory Report (Appendices)"**. This report volume, also finalized in July 1994 by CBBEL for the MRBC, consists of appendices containing, for each damage area, the input data to the U.S. Army Corps of Engineers (Corps) computer program, SID. This input data provides pertinent information for each structure considered in the study.

The fourth report volume is entitled **"Maumee River Basin Flood Control Master Plan Main Report"**. This report volume, finalized in May 1995 by CBBEL for the MRBC, summarizes the major findings of the master plan study. It documents the identification, development, screening, and selection of the alternative solutions and provides an implementation plan for the recommended Master Plan components.

The fifth report volume is entitled **"Maumee River Basin Flood Control Master Plan Appendices 1 through 8 to Main Report"**. This report volume, also finalized in May 1995 by CBBEL for the MRBC, consists of appendices referred to in the "Main Report".

The sixth report volume is entitled **"Maumee River Basin Flood Control Master Plan Comment Response Document"**. This report volume, finalized in May 1995 by CBBEL for the MRBC, consists of detailed responses to comments received during the public review period of the draft copy of the "Main Report".

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INTRODUCTION

This report summarizes the results of a flood control master plan study by Christopher B. Burke Engineering, Ltd. (CBBEL) for the Maumee River Basin (Basin) . The study area covers five counties (Steuben, Noble, DeKalb, Allen, and Adams) with City of Fort Wayne, City of Auburn, and City of Decatur being the three major urbanized areas in the Basin. Exhibit 1 shows the Basin's location and its features.

A very thorough review and compilation of the available information on a variety of topics relevant to flood control efforts, including history, resources and economy, trends, river description and flooding, and problems and needs has been given in a report entitled: "**Resources and Trends of the Maumee River Basin, Indiana**". The report, prepared in September, 1993 by the Maumee River Basin Commission (MRBC), serves as a precursor to the Basin's Master Plan.

A detailed account of the nature and severity of the flood damages in the Basin was prepared earlier by CBBEL as part of the Master Plan studies and is presented as a separate report entitled: "**Maumee River Basin Flood Control Master Plan - Damage Inventory Report**" , dated July 1994. For the purpose of Master Plan studies, the 40 million dollar U.S. Army Corps of Engineers' (Corps') Fort Wayne diking project, which is currently scheduled to start construction in 1995, was assumed to be in place. The Damage Inventory Report concluded that although the diking project will significantly lower the potential flood damages in Fort Wayne, the Basin will continue to suffer significant agricultural and urban flood damages in the future.

The objectives of this phase of the study are to identify and compile a list of possible solutions to the Basin's remaining flooding problems, perform an initial screening of the identified solutions, develop a short list of promising alternative solutions, and, after more detailed analyses of the short listed alternatives, select and recommend the Master Plan components. This study focuses on the selection of the most promising set of plan components among several possible alternative solutions, with recommendation of the order in which the solutions may be implemented. In the master planning stage, these suggested plan components are developed only conceptually. Before a suggested measure is actually implemented, it may be necessary to perform detailed feasibility studies, develop refined cost estimates, acquire all necessary funds and permits, and prepare the design plans and specifications.

PLAN FORMULATION

The goals and objectives of the Maumee River Flood Control Master Plan were drafted and approved by the Maumee River Basin Commission (MRBC) in mid 1993 (see Appendix 1). The main objective of the plan, simply stated, is to **prevent and/or mitigate the destructive effects of a 100-year flood** in the Basin's flood hazard areas through a combination of structural and non-structural solutions. An additional objective, to **prevent and/or mitigate the 5-year flood damages in agricultural areas**, was added by the MRBC during the public comment and review process of the Draft Master Plan reports in September, 1994. The following is a summary of technical, environmental, institutional, and economic criteria and other study specific constraints by which the suggested alternative solutions were screened.

Technical Criteria

- The recommended improvement plan should not result in increased flood levels in other portions of the river basin or other affected basins;
- The baseline condition (100-year flood elevations, number of structures in the 100-year floodplain subject to flood damage, first floor elevations, structure values, etc.) for Decatur and Auburn is the existing condition as described in the most recent damage analyses by the Corps of Engineers in their Section 22 studies;
- The baseline condition for Fort Wayne and vicinity is the "With-diking project" condition as modeled in the most recent damage analysis by the Corps of Engineers in their General Design Memorandum report dated May 1993;
- The baseline conditions for the Holiday Lakes area in DeKalb County and the urban damage area in Noble County are the existing conditions of the Little Cedar Creek as modeled by SEG Consultants in 1993, as revised.

Environmental Criteria

- The recommended improvement plan will not have any significant and/or permanent negative impacts on the environment, recreational opportunities, and/or fish and wildlife resources;
- The recommended improvement plan must preserve existing wetlands to maintain their natural flood control and environmental benefits and incorporate water quality and habitat protection measures.

Institutional Criteria

- The recommended improvement plan should be compatible with and complement the U.S. Army Corps of Engineers' "Fort Wayne Diking Project" which is tentatively due to start construction in 1995;

- The recommended improvement plan must be permittable under existing Federal, state, and local permit programs;

- The recommended improvement plan should be compatible with the existing property acquisition and park plans in the Basin;

- The recommended improvement plan should discourage any future development or structural improvements in the Basin's flood risk areas to curb any potential increase in the already large flood-induced damages in the Basin;

- The recommended improvement plan should attempt to prevent any further loss of the existing flood storage provided in the floodplain areas and, when possible, recommend an increase to such flood storage throughout the Basin;

- The recommended improvement plan must take into considerations, the restrictions placed upon powers of the MRBC by Section 36-7-6.1-23 of the MRBC's enabling legislation. This section of the Act restricts, with few exceptions, the MRBC's powers upon scenic or recreational rivers and nature preserves, including Cedar Creek in Allen County as well as one mile into DeKalb County and the three dedicated nature preserves adjoining the stream (See Indiana Code 36-7-6.1 for a complete text of the Act).

Economic Criteria

- The recommended improvement plan should be fundable and should also significantly reduce the economic damages resulting from either the 100-year flood event (for urban flood damages) or the 5-year flood event (for agricultural damages);

- The recommended improvement plan must be the least cost solution among the alternatives that provide effective flood hazard protection /mitigation of known damages in each reach. However, in some cases, a recommendation of "No Action", at this time, may be made, when warranted due to insignificant present property damage in the reach, when the cost of flood protection/mitigation measures is considered to be excessive, or

where the reach is subject to other flood protection plans whose implementation is imminent. Examples of the latter category are the COE's diking project and the City of Fort Wayne's planned flood control work at Vesey Dike Area and Pauline Avenue neighborhoods

INITIAL SCREENING OF POSSIBLE ALTERNATIVE SOLUTIONS

The flooding problems of the Maumee River Basin, particularly in Fort Wayne and vicinity, have been the subject of numerous studies and workshops. These studies and workshops have culminated in an array of suggestions and possible solutions ranging from total evacuation of all the floodplain areas to the total protection of these areas by flood control levees and floodwalls. Tables 1 through 9 provide, by the damage area, a summary listing of possible alternative solutions identified through a review of previous Basin flood studies, information gathered at public meetings held in the early project stages, review of similar studies in other basins by the consultant, and information gathered during the Draft Master Plan reports review process.

The suggested solutions were of two general types. Some solutions were designed to **prevent any further increase** in the already significant Basin flood damage potential while other solutions included measures to **mitigate the present level of potential damages through an array of structural and non-structural solutions**. The alternatives were evaluated against the study criteria and constraints set forth in the previous section. The results of this preliminary screening are also summarized in the tables under the "Remarks" column.

Based on this screening process, a short list of promising solutions for further consideration and possible inclusion in the Master Plan was compiled. The short list of solutions designed to prevent any further increase in the potential damages is provided in Table 10 while Table 11 shows the short list of solutions designed to mitigate the present level of potential damages. An in-depth discussion of the short-listed alternatives will be provided in the next section of the report.

TABLE 1
SCREENING OF KNOWN SUGGESTED ALTERNATIVES
NOT LIMITED TO A SPECIFIC DAMAGE AREA
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

ALT#	SUGGESTION	SOURCE	REMARKS
1	Flowage easement along the streams and rivers	Izaak Walton League (IWL), Sep 1993 memo to MRBC	Elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
2	Protect existing wetlands and restore previous wetlands	IWL, Sep 1993 memo to MRBC & Our Rivers Symp. , Jan 1988	This alternative will be carried to the short list of possible Master Plan components for further analysis
3	Adopt as a plan component, the acquisition and removal of all possible structures subject to flood damage or structures which occupy temporary flood storage	IWL, Sep 1993 memo to MRBC	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
4	Stormwater control should be a required element of all large real estate developments.	Our Rivers Symposium, Jan 1988	This alternative will be carried to the short list of possible Master Plan components for further analysis
5	Dry dams and diversions of St. Marys floodwaters to the Wabash R. via Junk D. and to Maumee R. via Trier Ditch	Our Rivers Symposium, Jan 1988	These alternatives will be carried to the short list of possible Master Plan components for further analysis
6	Short term responses including flood warning, education, and debris removal (tires, garbage,...) should be considered	Our Rivers Symposium, Jan 1988	Elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
7	Ongoing maintenance programs to control tree growth and deadfalls in rivers should be discussed along with possible solutions in the Master plan	George Machlan of Allen County, Sep 14, 1993 public hearing held by MRBC	Elements of this alternative will be carried to the short list of possible Master Plan components for further analysis

8	Bypass channel from St Marys R. near the Ohio State line to Maumee R.	Robert Vanderau, Sep 14, 1993 public hearing by MRBC	This alternative does not meet the institutional criteria and probably is also economically and environmentally infeasible. This alternative was not given any further consideration.
9	River restoration on 129 miles of streams in the Basin	MRBC staff (Tim Ehlerding) through numerous requests to DNR	Although it may have beneficial effects on lower flood frequencies, drainage, and outdoor recreation, this alternative, by itself, will have negligible impact on the 100-year flood elevations and does not meet the economic criteria. A more limited and case by case measure calling for "ongoing maintenance and debris removal" will be carried to the short list of possible master plan components
10	Floodplain development restriction: prohibit development within the floodplains of all five counties through ordinances. Only Allen County currently has such an ordinance	MRBC staff (Tim Ehlerding) Oct 1993 notes	This alternative will be carried to the short list of possible Master Plan components for further analysis
11	Stormwater management consistent throughout the watershed: watershed basis retention/detention requirements	MRBC staff (Tim Ehlerding) Oct 1993 notes	This alternative will be carried to the short list of possible Master Plan components for further analysis
12	Wetlands: creation, restoration, enhancement where possible with willing landowners and cooperation of local drainage boards	MRBC staff (Tim Ehlerding) Oct 1993 notes	This alternative will be carried to the short list of possible Master Plan components for further analysis
13	Improved flood warning system for outlying communities such as Auburn, Decatur, etc.	MRBC staff (Tim Ehlerding) Oct 1993 notes	This alternative will be carried to the short list of possible Master Plan components for further analysis
14	Reach by reach evaluation and selection of either a "No Action" recommendation, non-structural measure (buyout and floodproofing), or a limited promising structural solution (if any) for each damage reach throughout the Basin identified in the Damage Report	Christopher B. Burke Engineering, Ltd. (CBBEL)	This alternative will be carried to the short list of possible Master Plan components for further analysis

TABLE 2
SCREENING OF KNOWN SUGGESTED ALTERNATIVES
FOR THE CITY OF DECATUR
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

ALT#	SUGGESTION	SOURCE	REMARKS
1	Removal of an unpermitted dike downstream of Decatur	MRBC staff (Tim Ehlerding) Oct 1993 notes	This alternative will be carried to the short list of possible Master Plan components for further analysis
2	Raising of US 224 near Bellmont by INDOT or Adams County, installation of a flap gate where St Marys backs up towards Ogg Street	MRBC staff (Tim Ehlerding) notes in 1993	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
3	Levee protection for different study reaches	Corps 1992 Decatur Section 22 study	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
4	Reach by reach evaluation and selection of either a "No Action" recommendation, non-structural measure (buyout and floodproofing), or a limited promising structural solution (if any) for each damage reach throughout the Basin identified in the Damage Report	Christopher B. Burke Engineering, Ltd. (CBBEL)	This alternative will be carried to the short list of possible Master Plan components for further analysis

TABLE 3
SCREENING OF KNOWN SUGGESTED ALTERNATIVES
FOR FORT WAYNE AND VICINITY
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

ALT#	SUGGESTION	SOURCE	REMARKS
1	Junk Ditch overflow restoration: increasing the existing overflow capacity by 1700 cfs to restore to 1913 conditions (from 3300 cfs to 5000 cfs)	MRBC staff (Tim Ehlerding), Oct 1993 notes	This alternative will be carried to the short list of possible Master Plan components for further analysis
2	Trier Ditch overflow restoration: increasing the existing overflow capacity by 1500 cfs to restore to 1913 conditions (from 1500 cfs to 3000 cfs)	MRBC staff (Tim Ehlerding), Oct 1993 notes	This alternative will be carried to the short list of possible Master Plan components for further analysis
3	St. Joseph River retention/detention basin	MRBC staff (Tim Ehlerding), Oct 1993 notes	This alternative would most probably not meet the economic criteria. The limited amount of benefit to be derived from the project is not likely to justify the cost of the measure and its possible environmental effects.
4	St. Marys River retention/detention Basin southeast of Decatur in Adams Co.	MRBC staff (Tim Ehlerding), Oct 1993 notes	This alternative will be carried to the short list of possible Master Plan components for further analysis
5	Purchase and demolish approx. 101 structures in the Riverhaven area and floodproof about 82 others	MRBC staff (Tim Ehlerding), Oct 1993 notes	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
6	Purchase and demolish approx. 26 structures in the Ferndale neighborhood and floodproof about 15 others	MRBC staff (Tim Ehlerding), Oct 1993 notes	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
7	Purchase and demolish approx. 6 structures in the New Haven city limits and floodproof about 19 others	MRBC staff (Tim Ehlerding), Oct 1993 notes	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis

8	Floodproofing program worth $150,000 from MRBC funds	Fort Wayne 24-month workplan dated May 1991	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
9	Installation of portable pump at Hale and Pauline to be funded by $41,000 MRBC funds	Fort Wayne 24-month workplan dated May 1991	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
10	Acquisition and relocation of repetitive loss properties at Headwater's "Thumb" area from $1,000,000 FEMA, State of Indiana and local funds (Headwater's Park Project); purchase of three (3) props at Ross/Michael area from $140,000 CDBG funds, one (1) prop at Pauline from $35,000 CDBG funds, five (5) props at Nebraska area from $100,000 local sources funds, and three (3) props at Eastbrook /Westbrook area from $100,000 local sources funds	Fort Wayne 24-month workplan dated May 1991	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
11	Increase the height of the existing Vesey Dike from $150,000 MRBC funds	Fort Wayne 24-month workplan dated May 1991	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
12	Confluence area channel improvement from $300,000 State of Indiana funds	Fort Wayne 24-month workplan dated May 1991	This alternative is unlikely to be permittable due to environmental concerns and also has a very limited damage reduction benefit by itself. The alternative is unlikely to satisfy the institutional, environmental, and economic criteria and will not be studied further
13	Fairfield Ditch cleaning and debrushing from $200,000 Allen County funds	Fort Wayne 24-month workplan dated May 1991	This alternative by itself is unlikely to affect the 100-year flood stages. However, a measure consisting of ongoing limited ditch maintenance and debris removal which includes the elements of this alternative will be carried to the short list of possible master plan components
14	State St. Island silt deposit removal from $120,000 Allen County funds	Fort Wayne 24-month workplan dated May 1991	This alternative by itself is unlikely to affect the 100-year flood stages. However, a measure consisting of ongoing limited ditch maintenance and debris removal which includes the elements of this alternative will be carried to the short list of possible master plan components

15	New construction of Eastbrook/ Westbrook floodwall from $350,000 MRBC funds	Fort Wayne 24-month workplan dated May 1991	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
16	New construction of St. Marys dike from Taylor to Hale (1000 feet in length, 100-yr protection with no freeboard) from $155,000 MRBC funds	Fort Wayne 24-month workplan dated May 1991	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
17	1982 Fort Wayne-Allen County Plan: Including 40% Trier Ditch cutoff, modification of the Maumee River downstream from Trier Ditch, dredging the St. Joseph River from mouth to Catherine Ave.(2.1 miles), improvements of existing levees (Same as The Corps Diking Project), and evacuation/relocation of four areas (Thumb area, Michael/Ross area, Fairmont Place area, and Riverhaven area)	Fort Wayne and Allen County plan in 1982	The cut-off channel construction portion of this alternative will be carried to the short list of possible Master Plan components for further analysis. The St. Joseph River Dredging will most likely be environmentally and institutionally unacceptable. Other elements of the plan are included in other considered alternatives.
18	Several variations of Trier Ditch cutoff schemes	Corps 1987 Feasibility Report rev. 1988	The most acceptable version of this alternative, 40% cutoff, has been addressed in another alternative (above)
19	Rehab of existing levees and floodwalls (the Corps Diking Project)	Corps 1993 GDM	This project which is scheduled to start construction in 1995 is assumed to have been completed for the current master plan preparation purposes.
20	Total Levee and floodwall protection	Corps 1987 Feasibility Report rev. 1988	This alternative is unlikely to satisfy the economic criteria due to large amount of funds which will be required.
21	Selective floodplain evacuation in eight selected areas (Thumb area, Michael Ross area, Riverhaven, Vesey Ave., Pauline St., Eastbrook/Westbrook, Tillman Road, and Winchester Road) not protected by the Diking Project	Corps 1987 Feasibility Report rev. 1988	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
22	Misc. non-structural measures such as conservation tillage and wetland preservation	Corps 1987 Feasibility Report rev. 1988	Elements of this alternative in a different format will be carried to the short list of possible Master Plan components for further analysis

23	Total permanent evacuation of all flooded areas	Corps 1987 Feasibility Report rev. 1988	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
24	Widen the three rivers to provide adequate cross sections	Corps 1987 Feasibility Report rev. 1988	The plan was determined to be detrimental to the natural environment to a greater extent than would be warranted by any benefits achieved and will not be studied further
25	St. Joseph/Trier Ditch cut-offs: includes the construction of two new major waterways, each to divert 10,000 cfs to separate confluence points along the Maumee River	Corps 1987 Feasibility Report rev. 1988	No detailed investigations were performed; The plan was determined by The Corps to be detrimental to the natural environment to a greater extent than would be warranted by any benefits achieved
26	Upstream impoundments by means of constructing dams in Indiana or Ohio	Corps 1987 Feasibility Report rev. 1988	Elements of this alternative in a different format will be carried to the short list of possible Master Plan components for further analysis
27	Riverhaven diversion: alternative proposes elimination of the constriction caused by a 90 degree bend in the Maumee River at Riverhaven	Corps 1987 Feasibility Report rev. 1988	No detailed investigations were performed; It was determined by the Corps that this alternative would not provide sufficient flood damage reduction and also the solution involves crossing a landfill containing various potential contaminants
28	Reach by reach evaluation and selection of either a "No Action" recommendation, non-structural measure (buyout and floodproofing), or a limited promising structural solution (if any) for each damage reach throughout the Basin identified in the Damage Report	Christopher B. Burke Engineering, Ltd. (CBBEL)	This alternative will be carried to the short list of possible Master Plan components for further analysis

TABLE 4
SCREENING OF KNOWN SUGGESTED ALTERNATIVES
FOR THE CITY OF AUBURN
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

ALT#	SUGGESTION	SOURCE	REMARKS
1	Cedar Creek reservoir	MRBC staff (Tim Ehlerding)	This alternative will be carried to the short list of possible Master Plan components for further analysis
2	Floodproof approx. 50 structures	MRBC staff (Tim Ehlerding) Oct 1993 notes	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
3	Purchase and demolish approx. 6 structures around 11th street and Wilson (study reach 7) for a potential park expansion	MRBC staff (Tim Ehlerding) Oct 1993 notes	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
4	Construction of 1000 feet of floodwall and 10,000 feet of levee	Corps 1974 Maumee Basin Report	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
5	Reach by reach evaluation and selection of either a "No Action" recommendation, non-structural measure (buyout and floodproofing), or a limited promising structural solution (if any) for each damage reach throughout the Basin identified in the Damage Report	Christopher B. Burke Engineering, Ltd. (CBBEL)	This alternative will be carried to the short list of possible Master Plan components for further analysis

TABLE 5
SCREENING OF KNOWN SUGGESTED ALTERNATIVES
FOR THE TOWN OF WATERLOO
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

ALT#	SUGGESTION	SOURCE	REMARKS
1	Relocate the mobile home park to a different area	MRBC staff (Tim Ehlerding) Oct 1993 notes	This alternative solution is unlikely to satisfy the economic criteria. The magnitude of existing damages in this reach will most likely not justify the cost involved.
2	Cedar Creek reservoir	MRBC staff (Tim Ehlerding)	This alternative will be carried to the short list of possible Master Plan components for further analysis

TABLE 6
SCREENING OF KNOWN SUGGESTED ALTERNATIVES
FOR THE HOLIDAY LAKES AREA IN DEKALB COUNTY
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

ALT#	SUGGESTION	SOURCE	REMARKS
1	Floodproofing of individual houses	MRBC staff (Tim Ehlerding) Oct 1993 notes	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
2	Clearing of logjams or other obstructions downstream of the area	MRBC staff (Tim Ehlerding) Oct 1993 notes	This alternative by itself is unlikely to affect the 100-year flood stages. However, a measure consisting of ongoing limited ditch maintenance and debris removal which includes the elements of this alternative will be carried to the short list of possible master plan components
3	Reach by reach evaluation and selection of either a "No Action" recommendation, non-structural measure (buyout and floodproofing), or a limited promising structural solution (if any) for each damage reach throughout the Basin identified in the Damage Report	Christopher B. Burke Engineering, Ltd. (CBBEL)	This alternative will be carried to the short list of possible Master Plan components for further analysis

TABLE 7
SCREENING OF KNOWN SUGGESTED ALTERNATIVES
FOR THE SPENCERVILLE AREA IN DEKALB COUNTY
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

ALT#	SUGGESTION	SOURCE	REMARKS
1	Purchase and demolish approx. 6 structures	MRBC staff (Tim Ehlerding) Oct 1993 notes	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
2	Reach by reach evaluation and selection of either a "No Action" recommendation, non-structural measure (buyout and floodproofing), or a limited promising structural solution (if any) for each damage reach throughout the Basin identified in the Damage Report	Christopher B. Burke Engineering, Ltd. (CBBEL)	This alternative will be carried to the short list of possible Master Plan components for further analysis

TABLE 8
SCREENING OF KNOWN SUGGESTED ALTERNATIVES
FOR THE DAMAGE AREA IN NOBLE COUNTY
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

ALT#	SUGGESTION	SOURCE	REMARKS
1	Purchase and demolition of approx. 5 structures	MRBC staff (Tim Ehlerding) Oct 1993 notes	A more comprehensive measure (reach by reach plan evaluation and selection) which includes the elements of this alternative will be carried to the short list of possible Master Plan components for further analysis
2	Reach by reach evaluation and selection of either a "No Action" recommendation, non-structural measure (buyout and floodproofing), or a limited promising structural solution (if any) for each damage reach throughout the Basin identified in the Damage Report	Christopher B. Burke Engineering, Ltd. (CBBEL)	This alternative will be carried to the short list of possible Master Plan components for further analysis

TABLE 9
SCREENING OF KNOWN SUGGESTED ALTERNATIVES
FOR THE AGRICULTURAL DAMAGE AREAS THROUGHOUT THE BASIN
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

ALT#	SUGGESTION	SOURCE	REMARKS
1	Alternative crops within the floodplain	MRBC staff (Tim Ehlerding) Oct 1993 notes	This alternative is incorporated in another more comprehensive measure which will be carried to the short list of possible Master Plan components for further analysis
2	Support, promote, and help fund flowage easement, land set aside programs, and alternative flood-tolerant crops in the flood prone agricultural properties for erosion control and flood damage mitigation purposes	Christopher B. Burke Engineering, Ltd. (CBBEL)	This alternative will be carried to the short list of possible Master Plan components for further analysis
3	River restoration of selected streams in the Basin to alleviate the agricultural damages resulting from a 5-year flood.	Adams County farmers, Sep 1994	This alternative will be carried to the short list of possible Master Plan components for further analysis
4	Modification of the S.R. 469 bridge over St.Marys River in Allen County to reduce the negative impacts of the bridge on the 5-year agricultural flood damages in Adams County.	Adams County farmers, Sep 1994	Based on our review of the INDOT files, it appears that even under the most unfavorable stream maintenance conditions, the effect of the S.R. 469 bridge on the 100-year flood stages upstream,is diminished and negligible before reaching the Allen - Adams County Line. CBBEL's independent analysis, based on the most recent hydraulic model prepared for the MRBC by the SEG Consultants, indicates that the S.R. 469 bridge has no negative impact on the 5-year flood stages in the St. Marys River either in Allen County or in Adams County.

TABLE 10

SHORT LIST OF PROMISING SOLUTIONS DESIGNED TO PREVENT FURTHER INCREASE IN THE POTENTIAL DAMAGES
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

PLAN I.D.	CANDIDATE PLAN COMPONENT	AFFECTED DAMAGE AREAS
a	Adoption of uniform floodplain, stormwater, and erosion control ordinances by all the communities and counties in the Basin.	Basin-wide
b	Preservation, restoration, and enhancement of wetlands in the Basin when effective towards the overall master plan flood control objectives; where possible with willing landowners and cooperation of local drainage boards.	Basin-wide
c	Implementation of an ongoing stream maintenance and debris removal (e.g., logjams, felled trees, trash, etc.) program for the affected streams in the Basin.	Basin-wide
d	Implementation of an ongoing public education/awareness program as well as consideration of improved flood warning systems for outlying communities such as Auburn and Decatur, etc. .	Basin-wide

TABLE 11
SHORT LIST OF PROMISING SOLUTIONS DESIGNED TO MITIGATE THE PRESENT LEVEL OF THE POTENTIAL DAMAGES
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

PLAN I.D.	CANDIDATE PLAN COMPONENT	AFFECTED DAMAGE AREAS
e	Reach by reach evaluation and selection of a combination of non-structural (buyouts & floodproofing) and limited promising structural solutions (if any) in the damage reaches identified in the "Maumee River Basin Damage Inventory Report".	Basin-wide
f	Support, promotion, and funding of land acquisition, flowage easements, land set-aside programs, and alternative flood-tolerant crops in the flood prone agricultural properties for erosion control and flood damage mitigation purposes.	Basin-wide
g	Removal of the unapproved Yost Levee or construction of a bypass channel through the area downstream of Decatur on the St. Mary's River (for reducing flood stages at Decatur).	Decatur
h	Construction of a Trier Ditch cut-off that would carry 40 percent of the 100-year flood peak discharge of the St. Marys River with no further channel modifications (for reducing flood stages in Fort Wayne and vicinity).	Ft. Wayne and Vicinity
i	Construction of a major retention/detention basin on Cedar Creek in DeKalb County (for the reduction of flood stages in Auburn and Waterloo and to reduce downstream agricultural damages).	Auburn, Waterloo, &some d/s ag. lands
j	Construction of a major retention/detention basin on the St. Marys River upstream of Decatur (for reduction of flood stages in Decatur and Fort Wayne as well as for reduction of downstream agricultural damages).	Decatur, Ft. Wayne, &some d/s ag. lands
k	Restoration of the Junk Ditch bypass capacity by constructing a cut-off that would carry 30% of the 100-year flood peak discharge of the St. Mary's River to the Wabash River Basin .	Ft. Wayne and Vicinity
l	Restoration of the Trier Ditch bypass capacity by constructing a cut-off that would carry 20 percent of the 100-year flood peak discharge of the St. Marys River to Maumee River.	Ft. Wayne and Vicinity
m	River restoration of selected streams in the Basin to alleviate the agricultural damages resulting from a 5-year flood.	Basin-wide (Ag. areas)

DESCRIPTION OF CANDIDATE PLANS

The short list of promising solution s compiled as described in the previous section was subjected to a more detailed evaluation for hydraulic effectiveness, economic advantage, social and institutional impacts, and environmental feasibility. The results of these analyses are summarized in this section. For each short-listed solution (Candidate Plan Component), detailed discussion is provided under each sub-heading.

a. UNIFORM ORDINANCES

Candidate Plan Component "a" calls for the adoption of a uniform model flood hazard areas ordinance and a storm drainage/erosion control ordinance by all the communities and counties in the Basin.

Currently, there are a variety of ordinances in use within the Basin for flood hazards, storm drainage and erosion control. Many of the ordinances were initially adopted anywhere from 5 to 35 years ago and have been periodically updated through Federal or IDNR required ordinance amendments for flood hazard areas. At this time, it is unclear whether all the flood hazard ordinances for the 14 communities within the Basin contain all current provisions required by both FEMA and IDNR.

Since 1974, the IDNR has required all communities to adopt, as a minimum, the Indiana Model Ordinance for Flood Hazard Areas. This model ordinance contains the minimum Federal and State regulations pertaining to development and use of the 100-year floodplain and regulatory floodway. Currently, there are guidelines and recommendations for storm drainage and erosion control, but no State model ordinance.

Some communities have adopted the IDNR model ordinance by reference and therefore have an independent ordinance regarding flood hazard areas. Other communities have combined the model ordinance with other community ordinance. Either manner is allowed by FEMA and the IDNR. However, it was not the intention of the community-by-community approach of ordinance adoption to address the current basin-wide problems.

While adequate to meet individual community needs, the ordinance may lack the clarity and cohesiveness of the current IDNR model ordinance for flood hazard areas. The frequency and extent of flooding within the Basin requires a unified, consistent approach which considers the basin-wide impacts of local development. Therefore, the adoption of uniform ordinances by each of the 14 communities is necessary to implement basin-wide planning through consistent and equitable regulations.

The use of model ordinance provides the following benefits for the Basin and therefore, the individual communities:

1. Assuring that new development does not increase the flood or drainage hazards to others, or create unstable conditions susceptible to erosion;

2. Protecting new buildings and major improvements to buildings from flood damages.

3. Managing and mitigating the effects of urbanization on stormwater drainage throughout the Basin;

4. Reducing the existing potential for stormwater damage to public health , safety, life, and property;

5. Controlling sediment and erosion in and from stormwater facilities, developments, and construction sites;

6. Preventing the further degradation of the quality of ground and surface waters due to sedimentation and erosion;

7. Requiring appropriate and adequate provision for site runoff control, especially when the land is developed for human activity;

8. Encouraging the use of stormwater storage in preference to stormwater conveyance;

9. Lessening the taxpayer's burden for flood-related disasters, repairs to flood-damaged public facilities and utilities, and flood rescue and relief operations;

10. Making federally subsidized flood insurance available to individual communities and for property throughout the county by fulfilling the requirements of the National Flood Insurance Program;

11. Complying with the rules and regulations of the National Flood Insurance Program codified in Title 44 of the Code of Fedearl Regulations and the appropriate State statues;

12. Encouraging cooperation between communities nd other governmental entities with respect to floodplain and stormwater management; and

13. Requiring cooperation and consistency in stormwater management activities within and between the units of government having stormwater management jurisdiction.

14. Preserving and enhancing existing wetlands and aquatic and riparian environments, and encouraging restoration of degraded areas;

The model ordinances proposed here exceed the minimum Federal and State requirements for flood hazard areas, storm drainage and erosion control. The most significant enhancements are the requirements for compensatory storage in the floodway fringe areas (flood hazard areas ordinance) and detention storage for new development number 1, 2, 3, 7 and 8 from the above list. The objective is to prevent future development from being damaged or creating additional damages to existing structures. The uniform ordinance approach will provide the regulatory consistency required for the successful implementation of the master plan.

Model Ordinance For Flood Hazard Areas

Introduction

Floodplains and their associated stream, wetland, and shoreline areas are among the State's greatest assets, because of multiple benefits related to environmental quality, natural resource management, and recreational opportunity. Floodplains are generally best able to provide these benefits if kept in a natural condition. Alterations of floodplains have resulted in increased flood and stormwater hazards, reduced water quality, loss of habitat and recreational opportunities and poor aesthetics within communities. Wherever possible, the natural characteristics of floodplains and their associated water bodies should be preserved.

Development practices and lack of planning have resulted in flooding for which mitigation has been sought through stream modification such as channelization and reservoir construction. Such modifications may be costly to build and maintain and certainly do not provide for a full range of floodplain benefits, such as aquatic habitat, even though many millions of dollars have been spent to improve the water quality in the channels or watercourses within the floodplains. Often the preservation of natural floodplains may have been more cost effective. In some situations, flood protection and other stream benefits can be achieved by remedial activities which restore natural characteristics of previously altered floodplain corridors.

In some instances, flood and stormwater problems simply cannot be addressed by natural floodplains and more extensive measures must be undertaken; similarly, intense demands for water-dependent recreational or commercial activities necessitate localized modifications within floodplains. Decisions to alter floodplains and especially floodways and streams within floodplains should be the result of a careful planning and design process, which evaluates resource conditions and human needs. A well though out and officially adopted plan is the best basis for land use regulations which affect the use and development of land.

Use Of The Model Ordinance for Flood Hazard Areas

The Model Ordinance for Flood Hazard Areas contained in Appendix 2 is drafted to incorporate the minimum requirements of the Federal Emergency Management Agency (FEMA) for eligibility of units of government in the National Flood Insurance Program (NFIP), as well as the requirements of the Indiana Department of Natural Resources (IDNR) concerning development within and adjacent to designated floodplains and floodways. However, any community may include more restrictive language and performance requirements in their final, adopted ordinance.

The basis for the draft model ordinance presented here is the "Indiana Model Ordinance for Flood Hazard Areas", prepared by the IDNR – Division of Water. This model ordinance is used state-wide and by itself meets both the current minimum Federal requirements of the NFIP and the State statutes regarding floodplain management. Responsibilities and duties of local ordinance administrators are also defined within the model ordinance.

The IDNR model ordinance was enhanced to provide additional definitions related to regulatory and technical terminology and to clarify ordinance provisions regarding performance and administrative requirements. The model ordinance was modified to include a Maumee River Basin specific requirement of compensatory storage, on a one-to-one basis, for the replacement of floodplain storage lost due to fill or other development within the floodway fringe.

Communities adopting the Model Ordinance for Flood Hazard Areas will become part of a uniform basin-wide approach to minimize the impacts and damages associated with future development within floodplain areas.

Model Ordinance for Storm Drainage and Erosion Control

Introduction

The Model Ordinance for Storm Drainage and Erosion Control contained in Appendix 3 has been prepared for consideration by local governments in the Maumee River Basin. It was developed in recognition of the continuing damages which have resulted from inadequate local drainage systems which were not designed to address comprehensive watershed-level water resource management objectives.

As watersheds urbanize, the volume, frequency, and duration of runoff events of a given rainfall magnitude increase. If these changes are not mitigated through drainage system planning and detention design, streams often will attempt to adjust to increases in bankfull flows resulting in bank erosion and scouring and the destruction of habitat. Damages cause by bank erosion can be difficult and expensive to repair.

The purpose of this model ordinance is to recommend drainage and detention criteria and requirements which address each of the above issues by meeting the following objectives:

- Prevent increases in Downstream flooding due to new urbanization;

- Prevent increases in the magnitude and frequency of small flood events (e.g., the 2-year event) which contribute to increased bank erosion;

- Prevent increases in drainage-related damages due to inadequate design of local drainage systems;

- Prevent the loss of beneficial stream uses due to degraded stormwater quality; and

- Prevent the loss of beneficial stream uses due to adverse hydrologic and hydraulic impacts of urbanization.

This model ordinance presents a regulatory approach to stormwater management that emphasizes conservative approaches to stormwater drainage and detention which should be effective throughout the basin. It should not be considered a substitute, however, for a planning approach to stormwater management. It has long been considered that the best way to manage stormwater quantity and quality is to study existing and future watershed[s needs. In the absence of such detailed local planning studies, the recommendations in this ordinance will achieve the above objectives abased on current practices in stormwater management.

Use of the Model Ordinance for Storm Drainage and Erosion Control

This model ordinance has been designed to be an independent, self-sufficient ordinance. However, it is recognized that the majority of local governments do not have independent ordinances but rather add ordinance provisions to their subdivision ordinance, building code or zoning ordinance. This ordinance can be used to accommodated any of these options simply by excluding language which is redundant with existing local government codes.

This document provides language which should ease the burden of any community wishing to revise its ordinance requirements for storm drainage and erosion control. It is hoped that these concepts and approaches will be attractive to local governments requiring a more comprehensive and effective approach to stormwater management. Further, it is recommended to that ordinance be considered as just one component of a comprehensive regulatory approach to watershed management which also addresses needs for floodplain management and protection for wetlands, lakes, and streams.

Implementation of the Ordinances

Once the two draft model ordinances are finalized and the individual flood hazard areas ordinance is approved by the IDNR, it is recommended that the communities within the Maumee River Basin adopt their ordinances by a mutually agreeable date. This will ensure the uniformity of the ordinance implementation.

The IDNR will review and approve the flood hazard areas ordinance on behalf of FEMA. Approval will be subject to adoption by the communities. Adoption of the new flood hazard areas ordinance will supersede the current FEMA floodplain ordinances in each community. Failure to adequately administer a local floodplain management program, as required by the ordinance, will violate NFIP regulations and IDNR requirements and could ultimately result in suspension from the NFI and other Federal sanctions.

Keys to Successful Administration of the Programs

In order to successfully implement flood hazard and drainage/erosion control management programs, all participating communities must provide a full commitment of qualified personnel and adequate administrative procedures to provide a strong base for the programs. The keys at the community level (city, town, or county) include:

1. **Update of current policies and procedures for issuing floodplain and drainage permits.** Interaction among various community departments is necessary to ensure the proper issuance of permits.

2. **Designation of a single department or official for issuing permits and approval of drainage and site plans.**

3. **Qualified staff to assist in administration of the ordinances**. In addition to the permit official recommended above, additional staff members with a thorough understanding of the ordinance requirements will promote proper issuance of permits and provide program continuity in the event of personnel changes.

4. **Understanding of NFIP regulations and the FEMA/IDNR policies and procedures**.

5. **Education of community officials and the public**. Public notices, press releases and training sessions for community staff and outside interests such as engineers, land surveyors, architects, developers or other potential permit applicants will enhance the public understanding of the requirements of the new ordinance.

6. **Preparation of a user-friendly technical guide for ordinance administrators and permit applicants.** Use of a technical guide to explain the policy and data requirements, along with standardized checklists of required permit data will strengthen the quality of the permit applications and thereby streamline the permit review process.

7. **Strict enforcement of the variance criteria.** By following the intent and requirements of the variance criteria, communities will maintain both their standing within the NFIP and the consistency of the application of their ordinances.

The adoption and enforcement of the above ordinances are of prime importance in preventing further increases in the potential future flood damages in the Basin. It is therefore recommended that adoption and enforcement of the model ordinances, provided in Appendices 2 and 3 of this report, be accepted as a component of the Master Plan.

b. WETLAND RESTORATION

Candidate Plan Component "b" calls for the preservation, restoration, and enhancement of wetlands in the Basin when effective towards the overall Master Plan flood control objectives; where possible with willing landowners and cooperation of local drainage boards.

Wetlands provide an essential role in maintaining the ecosystem. The role and benefits of wetlands in improving water quality, providing habitat for fish and wildlife, storing and delaying floodwaters, acting as buffer areas, and providing areas for outdoor recreation are well documented. However, in the context of th Maumee River Basin Flood Control Master Plan, the creation, restoration, and enhancement of wetlands may be utilized to achieve two main functions: as a flood control measure, and as an alternative land use.

The first function, under the Master Plan, is to provide additional flood storage in order to reduce the peak discharges. Although this could be an effective measure for small drainage areas, the effect of providing a reasonably-sized wetland on the 100-year flood stages in the studied streams is practically negligible.

CBBEL conducted a study for a proposed detention basin on the St. Marys River, in order to lower the 100-year flood stage at Fort Wayne by two (2.0) feet. Based on this study, approximately 36,000 acre-feet of flood storage should be provided. According to the U.S. Fish and Wildlife Services recommendations, to minimize damage to nesting wildlife during storm events, the flood storage above the normal wetland water level should be limited to maximum of two (2.0) feet. Therefore, it is estimated that approximately 18,000 acres (about 28 square miles) of additional wetlands in both the St. Joseph River and St. Marys River basins would be necessary, if the wetlands were expected to be the sole source of controlling the flooding in the Basin.

The above estimates assume that the wetland sites would provide two feet of storage over and above the normal water elevation, the sites would be outside the area presently inundated by the 100-year flood, and they would be located upstream of the communities subject to flooding.

Since the existing and additional storage have a positive effect on lowering the flood stages in the Basin, the preservation, restoration, and enhancement of wetlands should be encouraged. The wetlands also prevent the potential increase in flood stages by discouraging development of the affected land at some point in the future. Therefore, to prevent future increases in potential flood damages in the Basin, it is important to ensure that the temporary flood storage in existing wetlands be protected from fill placement. In addition, where feasible, efforts should be made to increase such temporary storage through wetland restoration measures. However, it should be realized that this alternative by itself, can not compete in terms of effectiveness in reducing existing flood damages, with some of other structural or non-structural measures discussed in this report.

The second function is for wetlands to act as an alternative to agricultural land in the floodplain. Since no net flood storage is added to the system as a result of conversion to wetland, the peak flood stages are unaffected. However, unlike the agricultural or urban land uses, there would be no additional flood damages to contend with.

The use or wetlands as an alternative land use fits well with the overall flood hazard mitigation plan being proposed for the Basin in this report. While most of the urban structures subject to flooding in the studied communities in the Basin are being recommended for voluntary buyouts or floodproofing (Candidate Plan Component “e”), the agricultural lands in the floodplain are recommended to be converted to a different land use, including wetlands (Candidate Plan Component “f”). This change of land use would eliminate agricultural flood damages for the area converted and would create additional benefits such as recreational opportunities, increased water quality and increases in the quality of the wildlife habitat.

It is recommended that preservation, restoration, and enhancement of wetlands as an alternative land use to the flood prone agricultural areas in the 100-year floodplain be adopted as a Master Plan component. This subject will also be addressed in the discussion of Candidate Plan Component “f”, later in this report.

c. ONGOING STREAM MAINTENANCE

Candidate Plan Component "c" calls for the implementation of an ongoing stream maintenance and debris removal (e.g., logjams, felled trees, trash, etc.) program for the affected streams in the Basin.

Ongoing maintenance of the streams in the area by the respective county drainage boards, or by the landowners themselves, on an annual basis is an effective way of preventing logjams and other obstructions to flood flows. Such obstructions often cause higher flood stages (especially during smaller floods), result in increased sedimentation, and also promote additional stream bank erosion. By removing the logjams, felled trees, and general garbage (tires or other debris) from the streams annually, the need for extensive river restoration work can be significantly reduced.

The extent of work being proposed as part of this plan component is intended to be limited and localized in nature. The annual maintenance will be limited to removal of logjams, felled trees, and general garbage from the stream on a case-by-case basis as opposed to an extensive stream-long clearing and snagging project. In many instances, the fallen trees and logs removed from the stream may be secured to stream banks to help reduce the bank erosion while providing some habitat. General garbage and debris as well as those logs which are not appropriate for use as bank erosion control materials, should be disposed of or deposited outside the floodplain area to eliminate the possibility of these materials being washed back into the stream during major flood events.

In those man-made ditches that are classified as a "legal drain", the county drainage boards already have access easements and right to perform the suggested maintenance activities. However, presently no acceptable program or procedure is in place to obtain funds and/or required easements to perform ongoing maintenance in natural streams.

It is the recommendation of this Master Plan that during the project development phase of this plan component, programs and guidelines be developed to fund such annual maintenance activities throughout the Basin. The funds may be disbursed to the county drainage boards so that they, upon securing access easements and applicable permits, can perform the required maintenance activities on the problem spots in natural streams.

Alternatively, cost-sharing programs may be developed to assist the individual landowners keep their property free of debris without having to depend on drainage boards for every small logjam or felled tree. With proper guidance on safe and environmentally sound removal of obstructions, landowners and volunteers may be able to perform most debris removal themselves. Through a proper early coordination and notification process, the Basin landowners may find that many of maintenance activities of this magnitude may not even require certain permits, if done with appropriate and acceptable tools and methods.

The annual stream clean-up and maintenance activities reduce the potential impacts from existing and future logjams. Logjams can aggravate bank erosion and also induce higher future flooding stages than the unobstructed waterway. According to results of a recent hydraulic analysis performed by CBBEL for a pilot stream reach in Adams County, removal of larger logjams from the channel can often be just as effective as a large-scale river restoration project in reducing future increases in potential flood damages (see the discussion of Plan Component "m" for more details). Such maintenance activities cost much less than a large-scale river restoration project, are more friendly to the environment, and usually do not involve a long and drawn out permit process. The annual maintenance of affected streams in the Basin (including the removal of existing logjams) is therefore recommended as a Master Plan component.

d. ONGOING PUBLIC EDUCATION AND IMPROVED FLOOD WARNING SYSTEMS

Candidate Plan component "d" calls for the implementation of an ongoing public education/awareness program as well as consideration of improved flood warning systems for outlying communities such as Auburn and Decatur.

A strong public awareness program should educate community officials about Master Plan components and model ordinance requirements. This will facilitate the implementation of the Master Plan and acceptance of the proposed ordinances. A well- planned program will aid in dispelling concerns or misunderstanding of the Master Plan objectives. Residents and community officials must understand that the implementation of the Master Plan will benefit residents, businesses, and commercial activities in the Basin through reduced damages, less traffic delays, and better use of tax dollars.

Although the proposed model ordinance will affect future development, it is important to note that the additional restrictions will be for the protection of new and existing development. With the exception of the compensatory and detention storage requirements, the other flood hazard area ordinance components represent existing Federal and state floodplain development requirements. The proposed ordinances should not be considered as "anti-development" but rather as "anti-flood damage" through the application of appropriate floodplain management activities to reduce or eliminate flood risks for new construction.

The goals of the public awareness program should, as a minimum, attempt to:

1. Increase awareness of the Master Plan objectives by residents an developers;

2. Provide education to community officials about the requirements associated with the Master Plan and model ordinances;

3. Identify the administrative requirements for applicants and communities;

4. State the reasons for and benefits associated with the proposed model ordinances; and

5. Explain the Federal and state requirements involved in the Master Plan and Proposed model ordinances.

It is recommended that development and implementation of an ongoing public education/awareness program be adopted as a Master Plan Component.

According to the MRBC staff, the City of Fort Wayne, in cooperation with the Fort Wayne office of the National Weather Service, currently has a flood warning system which includes river gages in the following locations:

St. Marys River:

- U.S. 27 bridge in Decatur, IN
- Anthony Boulevard bridge south of Fort Wayne

St. Joeseph River:

- Newville, IN
- Roots Ski House, north of Fort Wayne

Spy Run Creek:

- Near State Street bridge

Cedar Creek:

- Near Auburn Wastewater Treatment Plant

Maumee River:

- Anthony Street bridge in Fort Wayne
- Landin Road bridge near New Haven

The following rain gages are also utilized for the warning system:

- Auburn, IN
- Newville, IN
- Irene Byron Health Complex, north of Fort Wayne on Lima Road
- Roots Ski House, north of Fort Wayne
- Spy Run in Fort Wayne
- Anthony Blvd. bridge south of Fort Wayne
- Poe, IN
- Decatur, IN
- Salem, IN
- Rockford, OH

The Fort Wayne off of the National Weather Service, located at the Fort Wayne International Airport, in a cooperative effort with the City of Fort Wayne, monitors various gages and develops forecasts for the elevation and timing of the expected flood crests. These two entities also cooperate in providing information on potential floods to the outlying communities.

During a flood, the counties of Adams, DeKalb, Noble, and Steuben rely on the Civil Defense of Emergency Management departments in their respective counties to coordinate the needed flood relief efforts. For the City of Fort Wayne, an Emergency Operation Center is set up through a coordinated effort between the various city departments once the Anthony Street gage

on the Maumee River hits 19.0 feet. Once this elevation is reached, personnel from the City are assigned to various regions and are required to monitor levee conditions, flood elevations, and potential damage areas. These personnel are also responsible to coordinate the relief efforts in their respective regions.

Because of the importance of effective early flood warning systems in reducing potential flood damages in the Basin, it is also recommended that continued upgrading of the early warning system in Fort Wayne and the outlying communities be studied further as a Master Plan Component.

e. REACH BY REACH PROJECT SELECTION

Candidate Plan Component "e" calls for the reach by reach evaluation and selection of a combination of non-structural (voluntary buyouts & floodproofing assistance) and limited promising structural solutions (if any) in the damage reaches identified in the "Maumee River Basin Damage Inventory Report". A total of 82 damage reaches were identified throughout the Basin's six major urban flood damage areas. These damage areas include the City of Fort Wayne and its vicinity, City of Decatur, City of Auburn, Holiday Lakes area, Spencerville, and an isolated area in Noble County.

Based on the most recent U.S. Army Corps of Engineers' (Corps') studies and the Basin's Damage Inventory Report, prepared as part of this Master Plan by CBBEL, there are currently about 4,900 structures subject to damage in the 100-year floodplain of the studied streams in the Basin's damage areas. The majority of these structures, about 3,190, will be protected by the COE's Fort Wayne diking project which covers ten (10) of the damage reaches identified in the Basin. The objective of this candidate plan component was to protect the remaining 1,710 structures throughout the Basin by the most appropriate measure in each damage reach.

This candidate plan component is the most promising and comprehensive alternative solution for mitigating the existing non-agricultural damages in the Basin. The plan consists of a reach by reach evaluation of each economic damage reach identified in the "Damage Inventory Report" and selection of the most appropriate measure for the reach as a master plan component.

Alternative Analysis Strategy

For each damage reach, three alternative solutions were examined:

No Action: This is the alternative with no recommended projects. If this alternative is recommended for any reaches, it should be noted that future circumstances may impact the No Action recommendation, and at that time those reaches may be reevaluated using the alternatives described below.

Alternative 1: This is a non-structural alternative which could eventually lead to creation of open space corridors along the studied stream in the affected reach. This alternative consists of floodproofing and buyouts (for those residential structures meeting the buyout criteria). A discussion of the buyout criteria considered for this alternative is provided later in this report.

According to this alternative, all structures meeting the buyout criteria would be eligible for purchase from willing sellers and removed from the lot. The structures meeting the buyout criteria but not sold will not be eligible for other funding programs such as floodproofing assistance. All building structures, including businesses, not meeting the selected buyout criteria were recommended to be floodproofed.

The purpose of this alterative is to eliminate structures from experiencing overbank flooding by non-structural measures only. If this alternative is chosen for a reach, further information such as property parcel data needs to be developed and/or evaluated prior to implementation. Such information can help identify additional properties which may also need to be bought out so that a contiguous riparian corridor (open space/greenway area) that maintains the existing floodplain and preserves natural features may be established. This will not only eliminate all existing structural flooding damage, but will also prevent potential future damages due to structural improvements.

Alternative 2: This is a combination of structural and non-structural improvements. The goal of this alternative was to use structural flood control measures to reduce the number of buildings that currently experience overbank flooding damages. However, complete elimination of flooding damages with structural means was not always cost-effective or feasible. Therefore, those structures that were still subject to overbank flooding after the proposed structural flood control measures were considered to be in place were recommended for buyout if they met the buyout criteria, otherwise they were recommended to be floodproofed. It should be noted that this type of structural solution was not necessarily considered for all the damage reaches. These limited structural solutions were considered only when they were suggested by earlier studies or when, due to the concentration of a large amount of property damage in a relatively small area, cost effectiveness of such a solution appeared to be highly promising.

Buyouts – Concepts and Assumptions

For each of the considered damage reaches, residential structures are considered as eligible for buyout if they meet one or more of the following conditions:

- The structure is subject to three (3.0) feet or more of flooding,
- The structure is identified to be in the regulatory floodway, or
- The structure has been recommended for acquisition based on the available park plans, property acquisition plans, or if it has been designated as a repetitive loss property by FEMA.

All residences not meeting the criteria and all business structures were not considered for buyout in this study. A detailed discussion on the selection of the buyout criteria is provided separately.

For residential structures, buyout cost was determined based on structure values used in the Damage Inventory Report which, except for few areas, were taken from the 1993 COE's GDM Report or Section 22 studies. Based on recent comparisons made by CBBEL between the structure values in the COE's studies and the asking price for a sample of similar structures located in different damage reaches as well as based on the information on the previous buyout experience in the area, it appears that for those structures which meet the buyout criteria , on the average, the structure values determined in COE's studies will be adequate to cover the associated relocation, closing costs, building demolition, and site restoration costs.

The primary advantages of buyouts are the removal of flood prone structures from the floodplain while increasing the temporary flood storage in form of open space. Open space created in this manner can be used for recreational purposes and natural area restoration. The expenses involved in converting the contiguous buyout properties to parks or other uses are not included in this Master Plan study. **By removing structures from the floodplain, the potential for these structures to be damaged by an event larger than those studied is eliminated.** A disadvantage with buyouts is that they do not reduce flood elevations in the studied streams. As a result, traffic damages are not reduced. Also, buyouts take the affected properties off the tax rolls and may also create discontinuity in the neighborhoods' landscapes. In some cases, infiltration of stormwater into sanitary sewers results in overloading of treatment plants and backup of sanitary sewers into individual homes. These problems would not be lessened by buyouts. The feasibility of buyouts for the Basin may also be limited by its ability to be implemented. Some home owners whose residences are recommended for buyout may not be willing to sell their properties.

In general, the buyout plans being recommended in this report are to be implemented over time and on a voluntary basis. As noted elsewhere in this report, the buyout is considered where floodproofing is inappropriate due to various reasons such as excessive flooding depth or the location of the property in relation to the floodway. Therefore, if a property is recommended for buyout, it would be ineligible for any future floodproofing assistance. The properties subject to buyout would be appraised and purchased according to methods acceptable to the Federal, state, and local governments.

It is recommended that after the structure is removed, the site is cleaned of debris and graded to match adjacent yards and seeded or planted with trees. The foundation below this elevation will be left in place. Depending on the restrictions associated with the local, state, or Federal agency providing the buyout funding, the property could be deeded to either the community, a local parks department, local neighborhood association, or other appropriate agency or group which will be responsible for future upkeep and maintenance of the property. In some instances, the property may be deeded over to the adjacent property owner(s) to be added to their lot and be maintained by them. The property will have a deed restriction limiting its use in the future.

Floodproofing –Concepts and Assumptions

Floodproofing is any measure that a property owner might take to minimize flood damage to any structure within their property. In the past, floodproofing of residential structures has not typically been undertaken by local government funds because the primary benefit is to the individual property owner and not to the community at large. However, research of communities in the nation that have recently considered or implemented floodproofing programs revealed numerous funding arrangements with the local governments as one of the main funding entities. These arrangements ranged from the full funding of projects on public and/or private property to cost sharing with state or federal funds as well as with the property owner. Alternatively, some communities only provided low interest loans and some only technical help.

In 1991, the Indiana State Legislature appropriated $120,000 from the "Build Indiana Funds" to the Maumee River Basin Commission (MRBC) for assisting homeowners to floodproof their homes. Accordingly, the MRBC prepared a draft program outlining the criteria, design considerations, application, review, and funding method involved (Appendix 4). Because of budgetary problems with the Build Indiana Funds, the funds were never received; but the program is a good starting point in establishing an appropriate program for any future floodproofing efforts by the Commission.

There are several floodproofing options available, varying from simple to complex, and in general, the more complex the option, the more expensive it will be to implement. Floodproofing may be designed either to reduce the number of times the building is flooded or to limit the potential damage to the building and its contents when it is flooded. General approaches to floodproofing, ranging in cost from virtually nothing (when the homeowner moves the valuables out of the floodable area) to as high as $20,000 (when some elevation and floodwall construction techniques are used), include:

1. Implementing measures that prevent basement flooding and sewer backups;

2. Wet floodproofing: Modifying the building and relocating the contents to allow the structure to flood inside with a little or no damage;

3. Dry floodproofing: Preventing water to enter the structure by making the building floor and walls watertight;

4. Floodwalls: Preventing the floodwaters to come near the building by constructing barriers around the building or at the low sides of the property; and

5. Elevation: Preventing the floodwaters to enter the building by raising the building in place.

Another method that is sometimes included in the list of floodproofing measures, is "relocation". If structurally feasible, relocating a building is the most dependable floodproofing method. However, it generally involves a considerable amount of expenditure due to the need for elevating and moving the building to another location away from the floodplain. In addition to expenses involved in moving the building, other expenses associated with purchasing a new lot (if there are no suitable flood-free locations on the present lot), building a new foundation, relocating utilities, landscaping, and professional services and fees need to be considered. For the purpose of the Master Plan, those structures determined to be eligible for voluntary buyout will also be eligible for relocation, at the owner's request, so long as an appropriate site is available, the relocation is structurally feasible, and the total cost of relocation is less than that involved in the buyout of the property.

Detailed guidelines on determining the most appropriate measure for a particular building may be found in a recent COE's publication entitled: "Flood Proofing – How to Evaluate Your Options", prepared in July 1993 by the National Floodproofing Committee.

Floodproofing costs are extremely difficult to estimate without a detailed evaluation of each individual structure. Therefore, reliable cost estimates cannot be determined without developing detailed plans for each structure. However, based on the review of available literature, personal communications with several state agencies, and the cost estimates provided by the applicants to the MRBC in the early stages of its Floodproofing Cost-Share Assistance Program, the following average unit floodproofing costs are assumed for the purpose of the Master Plan comparisons:

- Single Family Residential structures: $10,000 /bldg.
- Mobile Home units $3,000 /unit
- Apartment housings $15,000 /bldg.
- Non-residential structures $20,000 /str.

Limited Structural Solutions – Concepts and Assumptions

As indicated earlier, these limited structural solutions were considered only when they were suggested by earlier studies or when, due to the concentration of a large amount of property damage in a relatively small area, cost effectiveness of such a solution appeared to be highly promising.

The structural solutions considered for this plan (usually ring levees) were limited in that they were only designed to protect a single damage reach. Unlike the much more extensive Fort Wayne diking project, they normally did not include extensive closure structures or associated modifications to other infrastructures. In addition, these structures are expected to cost less due to a lower level of freeboard.

FEMA requires a minimum of three (3) feet of freeboard to be provided before it considers qualifying a levee/floodwall as a flood protection measure eligible to remove the protected structures from mandatory Federal requirement to buy flood insurance. However, as a matter of policy, the level of protection for the limited structural solutions considered in this Master Plan was limited to the 100-year flood with only one to two feet of freeboard to account for any potential embankment settlement or inherent inaccuracies involved in the 100-year flood stage predictions in an urbanizing watershed. By not meeting FEMA's minimum freeboard criteria, the protected structures will be disqualified from any potential waiver of the Federal requirement to purchase flood insurance. This policy is advocated to significantly reduce the 100-year flood damages while avoiding the appearance of providing a false degree of security to the protected structures. The flood insurance requirement is a constant reminder that floods greater than the designed level of protection do and will happen.

Except for the freeboard requirements, the flood control work suggested in this study will be designed and constructed according to the IDNR and FEMA specifications for the flood control works.

The overall average unit cost of protection for the Fort Wayne diking project is estimated at about $750 per lineal foot of protection. This average figure includes all the expenses associated with the protection project such as engineering and design, land acquisition, easements, closures, internal drainage, labor, material, etc. Preliminary cost estimates for the conceptually designed protection plans considered in our study under this plan, produced an average unit cost in the range of $150 to $750 per lineal foot. The lower values were expected as most of the levees and floodwalls considered here are lower in height, requiring less material and underlying land, and also do not normally span major transportation routes as the diking project does. For the purpose of Master Plan comparisons, except for one of the areas, the limited structural measure cost estimates were developed using an average cost of $500 per lineal foot of protection.

Selection of the Buyout Criteria

Floodproofing a building is almost always cheaper than its buyout. However, most floodproofing techniques are not appropriate in areas subject to deep flooding, high velocity, flash flooding, or erosion. Based on review of several floodproofing guides, it seems appropriate to limit floodproofing projects only to areas which are not in the floodway (therefore, normally experience low velocities), and also to areas not subject to three (3.0) feet or more of floodwaters. Floodproofing is also not appropriate when the building has been designated by local agencies for acquisition due to established plans, such as park plans or repetitive loss structures acquisition plans.

For the purpose of Master Plan comparisons, based on the above considerations, a criteria was adopted that calls for a residential property to be bought out if one or more of the following conditions apply.

- The structure is subject to three (3.0) feet or more of flooding,
- The structure is identified to be in the regulatory floodway, or
- The structure has been recommended for acquisition based on the available park plans, property acquisition plans, or if it has been designated as a repetitive loss property by FEMA.

The magnitude of the cost associated with buyouts and floodproofing in different damage reaches in the Basin is greatly affected by the choice of the buyout criteria. In order to investigate the effect of the buyout criteria on the number of structures to be bought out and the resulting overall costs, a sensitivity analysis was performed in which the effects of several variations of the buyout criteria were examined. The City of Fort Wayne was selected for this sensitivity analysis as the majority of the structures subject to flood damage were in this community.

Six different buyout criteria were considered. The first three criteria considered the buyout eligibility of structures based only on the depth of flooding: respectively, one (1.0) foot, two (2.0) feet, or three (3.0) feet. The next three criteria considered the buyout eligibility based not only on the depth of flooding, but also on the structure's designation as being in the floodway or subject to different acquisition plans. These latter criteria will be referred to, respectively, as "1.0 ft. Input", "2.0 ft. Input", and "3.0 ft. Input". The "input" designations stem the fact that the number of structures for these criteria had to be **input** to the worksheets that were developed for each damage reach.

Using the "Flood Stage Versus Number of Structures Damaged" relationship developed s part of the Basin's Flood Damage Inventory Study for each reach, the numbers of structures subject to buyouts and floodproofing were separately determined for each structure type and for each damage reach. For the purpose of this analysis, the recommended plan for all the reaches was assumed to be the Alternative 1, buyouts and floodproofing. Table 12 summarizes the overall results for the damage area.

TABLE 12

SENSITIVITY ANALYSIS OF THE BUYOUT CRITERIA (FOR FORT WAYNE DAMAGE AREA[1])

Buyout Criteria	# of Strs. to be bought out	# of Strs. to floodproof	Total # of Strs.	Buyout Costs	Floodproof. Costs	Total Capital Costs
1.0 ft.	827	626	1,453	$54,861,900	$7,264,000	$62,125,900
2.0 ft.	379	1,074	1,453	$23,592,200	$11,782,000	$35,374,200
3.0 ft.	162	1,291	1,453	$9,253,200	$13,979,000	$23,232,200
1.0 ft. Input	845	608	1,453	$56,067,074	$7,044,655	$63,111,728
2.0 ft. Input	451	1,002	1,453	$26,653,961	$11,099,189	$37,753,149
3.0 ft. Input	315	1,138	1,453	$16,510,700	$12,573,000	$29,083,700

1 - Assuming Alternative 1 (buyout and floodproofing) is recommended for every reach.

As can be seen from the table, the adopted criteria (3.0ft. Input) produces the second lowest number of structures to be bough tout as well as second lowest cost among the six criteria considered while being more comprehensive, because of inclusion of floodway designation and acquisition plans, than the depth-only types of criteria. The number of structures subject to buyout as well as the overall costs increases dramatically when the 1.0 ft. or 2.0 ft. criteria are used instead of the 3.0 ft. criteria.

Non-residential structures were not considered for buyout in this study (except for the thumb area in Fort Wayne where few non-residential structures are subject to acquisition due to the Headwaters Park plans). This criteria is subject to modification by the Maumee River Basin Commission prior to or during the actual implementation.

Recommended Capital Improvement Plan by Damage Reach

For each of the six major urban flood damage areas identified in the Damage Inventory Report, detailed reach by reach evaluations of the three alternatives ?("No Action", "Alternative 1", and "Alternative 2") were performed.

The "No Action" plan is recommended in cases where the reach is subject to another MRBC accepted plan such as the Corp's diking project or the City of Fort Wayne's protection plans for Hale Street and the Vesey Dike area. The "No Action" plan is also recommended where no significant 100-year flood-induced property damages were indicated in the Damage Inventory Report.

Alternative 1, “Voluntary Buyouts and Floodproofing”, was considered for every study reach with a significant level of property damage identified in the “Damage Inventory Report”. This plan is recommended if no structural measures are considered for the reach or, if considered, the estimated cost of such measures would be higher than the non-structural measures.

Alternative 2, “Limited Structural Measure” was considered only when it was suggested by earlier studies or when, due to the concentration of a large amount of property damage in a relatively small area, cost effectiveness of such a solution appeared to be highly promising. This alternative is recommended only when its associated cost is less than the non-structural solution for that study reach or where the non-structural solutions are not expected to be effective in reducing the flood damages in the reach.

The criteria for choosing among the three (3) alternatives, in each damage reach, resulted from the implications of the Master Plan objective and in particular the economic criteria stated earlier; i.e., selection of the least-cost alternative capable of eliminating/mitigating the 100-year flood induced property damages in each damage study reach. Since, according to this criteria, an effective plan must be recommended for every study reach that has property damage, not all the recommended plans would have benefit-cost ratios exceeding one. The costs associated with the least-cost alternative solutions (that would also eliminate the property damages identified in the study reach), in some instances, exceeded the expected tangible benefits resulting from the implementation of the recommended plans. However, it is important to note that, although not readily quantifyable, benefits other than the property damage reduction benefits provided in the report do exist making the recommended plans economically more desirable.

Most of the effort was directed toward the evaluation of the cost involved with the Alternative 1, buyouts and Floodproofing. This task was accomplished by developing individual worksheets for every damage reach being studied. Tables 13 and 14 are two examples of the worksheets developed for two of the damage reaches (Reach E7SM and reach E1FD in Fort Wayne). Worksheets for other study reaches are provided in Appendices 5 through 8.

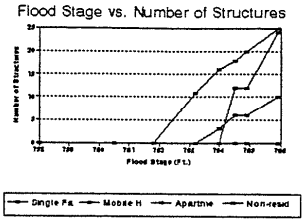
TABLE 13

Buyout and Floodproofing Costs by Reach
MAUMEE RIVER BASIN MASTER PLAN

Study Area : Fort Wayne & Vicinity **Stream Name :** St. Marys River **R#:** 7 (E7SM)
Plan Number : 1 (no Maj. Proj.) **Alt. Number :** 1 (Non-structural) **[See NOTES]**

Flood Stage (Feet)	# of SFR Str.	# of Mobile Str.	# of Apt. Str.	# of Non-Res. Str.	Fld. R.I. Yr.
758.0	0	0	0	0	2
760.5	0	0	0	0	5
761.8	0	0	0	0	10
763.2	0	0	11	0	25
764.0	0	0	16	3	50
764.5	12	0	18	6	75
764.9	12	0	20	6	100
765.9	24	0	25	10	200

Flood Stage vs. Number of Structures



Structure Type	Plan/Criteria Variables			Buyouts			Floodproofing			TOTAL	
	100-Yr Elev. (Feet)	Buyout Criteria (Feet)	Buyout Stage (Feet)	Unit Structure Value	# of Str.	Total Prop. Buyout Cost	Unit Floodpr. Cost	# of Str.	Total Floodproof. Cost	# of Str.	Total Capital Cost
Single Family Residences (SFR)	764.9	1.0	763.9	$80,600	0	$0	$10,000	12	$120,000	12	$120,000
	764.9	2.0	762.9	$80,600	0	$0	$10,000	12	$120,000	12	$120,000
	764.9	3.0	761.9	$80,600	0	$0	$10,000	12	$120,000	12	$120,000
	764.9	Input		$80,600	3	$241,800	$10,000	9	$90,000	12	$331,800
Mobile Home Residences	764.9	1.0	763.9	$0	0	$0	$3,000	0	$0	0	$0
	764.9	2.0	762.9	$0	0	$0	$3,000	0	$0	0	$0
	764.9	3.0	761.9	$0	0	$0	$3,000	0	$0	0	$0
	764.9	Input		$0	0	$0	$3,000	0	$0	0	$0
Apartment Housings	764.9	1.0	763.9	$292,000	15	$4,380,000	$15,000	5	$75,000	20	$4,455,000
	764.9	2.0	762.9	$292,000	9	$2,628,000	$15,000	11	$165,000	20	$2,793,000
	764.9	3.0	761.9	$292,000	1	$292,000	$15,000	19	$285,000	20	$577,000
	764.9	Input		$292,000	1	$292,000	$15,000	19	$285,000	20	$577,000
Sub-Total Residential		1.0			15	$4,380,000		17	$195,000	32	$4,575,000
		2.0			9	$2,628,000		23	$285,000	32	$2,913,000
		3.0			1	$292,000		31	$405,000	32	$697,000
		Input			4	$533,800		28	$375,000	32	$908,800
Non-Resid.	764.9	Input		$0	0	$0	$20,000	6	$120,000	6	$120,000
TOTAL		1.0			15	$4,380,000		23	$315,000	38	$4,695,000
		2.0			9	$2,628,000		29	$405,000	38	$3,033,000
		3.0			1	$292,000		37	$525,000	38	$817,000
		Input			4	$533,800		34	$495,000	38	$1,028,800

File: FWR07.wq1
Dated: 4/12/94

NOTES:

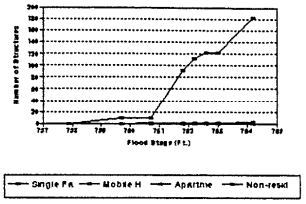
1. Flood stage vs. # of structures data were based on the Corps' Fort Wayne GDM computer runs dated April 1993.
2. Unit structure values were based on Corps' Fort Wayne 1993 GDM studies.
3. Total property buyout costs were calculated as Structure value * # of Structures. Structure values, taken from Corps' study, were judged sufficient to include relocation, land acquisition, demolition, and cleanup costs.
4. Average Unit Floodproofing costs were estimated based on available references complemented by site visits.
5. Buyout was not considered to be a viable option for the non-residential structures except according to park plans,etc.
6. The Input Buyout Criteria refers to structures that are either damaged by three (3) feet of flooding and/or are located within floodway limits and/or have been considered for acquisition according to City's Flood-Prone Property Acquisition program and/or are subject to a park plan,etc. Number of structures meeting this criteria is entered as input to this table.
7. Three (3) rep. loss structures in this reach (on Fairfield and Tillman Avenues) have been identified by the City.

TABLE 14
Buyout and Floodproofing Costs by Reach
MAUMEE RIVER BASIN MASTER PLAN

Study Area : Fort Wayne & Vicinity **Stream Name :** Fairfield Ditch **R#:** 53 (E1FD)
Plan Number : 1 (no Maj. Proj.) **Alt. Number :** 1 (Non-structural) **[See NOTES]**

Flood Stage (Feet)	# of SFR Str.	# of Mobile Str.	# of Apt. Str.	# of Non-Res. Str.	Fld. R.I. Yr.
757.9	0	0	0	0	2
759.7	10	0	0	0	5
760.7	10	0	0	2	10
761.8	92	2	0	2	25
762.2	112	2	0	2	50
762.6	122	2	0	2	75
763.0	122	2	0	2	100
764.2	183	2	0	3	200

Flood Stage vs. Number of Structures



Structure Type	Plan/Criteria Variables			Buyouts			Floodproofing			TOTAL	
	100-Yr Elev. (Feet)	Buyout Criteria (Feet)	Buyout Stage (Feet)	Unit Structure Value	# of Str.	Total Prop. Buyout Cost	Unit Floodpr. Cost	# of Str.	Total Floodproof. Cost	# of Str.	Total Capital Cost
Single Family Residences (SFR)	763.0	1.0	762	$51,400	102	$5,242,800	$10,000	20	$200,000	122	$5,442,800
	763.0	2.0	761	$51,400	32	$1,644,800	$10,000	90	$900,000	122	$2,544,800
	763.0	3.0	760	$51,400	10	$514,000	$10,000	112	$1,120,000	122	$1,634,000
	763.0	Input		$51,400	50	$2,570,000	$10,000	72	$720,000	122	$3,290,000
Mobile Home Residences	763.0	1.0	762	$12,000	2	$24,000	$3,000	0	$0	2	$24,000
	763.0	2.0	761	$12,000	1	$12,000	$3,000	1	$3,000	2	$15,000
	763.0	3.0	760	$12,000	0	$0	$3,000	2	$6,000	2	$6,000
	763.0	Input		$12,000	2	$24,000	$3,000	0	$0	2	$24,000
Apartment Housings	763.0	1.0	762	$0	0	$0	$15,000	0	$0	0	$0
	763.0	2.0	761	$0	0	$0	$15,000	0	$0	0	$0
	763.0	3.0	760	$0	0	$0	$15,000	0	$0	0	$0
	763.0	Input		$0	0	$0	$15,000	0	$0	0	$0
Sub-Total Residential		1.0			104	$5,266,800		20	$200,000	124	$5,466,800
		2.0			33	$1,656,800		91	$903,000	124	$2,559,800
		3.0			10	$514,000		114	$1,126,000	124	$1,640,000
		Input			52	$2,594,000		72	$720,000	124	$3,314,000
Non-Resid.	763.0	Input		$0	0	$0	$20,000	2	$40,000	2	$40,000
TOTAL		1.0			104	$5,266,800		22	$240,000	126	$5,506,800
		2.0			33	$1,656,800		93	$943,000	126	$2,599,800
		3.0			10	$514,000		116	$1,166,000	126	$1,680,000
		Input			52	$2,594,000		74	$760,000	126	$3,354,000

File: FWR53.wq1
Dated: 4/14/94

NOTES:

1. Flood stage vs. # of structures data were based on the Corps' Fort Wayne GDM computer runs dated April 1993.
2. Unit structure values were based on Corps' Fort Wayne 1993 GDM studies.
3. Total property buyout costs were calculated as Structure value * # of Structures. Structure values, taken from Corps' study, were judged sufficient to include relocation, land acquisition, demolition, and cleanup costs.
4. Average Unit Floodproofing costs were estimated based on available references complemented by site visits.
5. Buyout was not considered to be a viable option for the non-residential structures except according to park plans,etc.
6. The Input Buyout Criteria refers to structures that are either damaged by three (3) feet of flooding and/or are located within floodway limits and/or have been considered for acquisition according to City's Flood-Prone Property Acquisition program and/or are subject to a park plan,etc. Number of structures meeting this criteria is entered as input to this table.
7. There are approximately 52 residential structures in the floodway in this reach according to the City.

The Flood Stage versus Number of Structures relationships for different categories were developed or used in the Damage Inventory Report. Using these relationships, the number of structures subject to buyout in each category was calculated using different buyout criteria. The buyout criteria adopted for the Master Plan study is that designated as “Input” in the Table

The determination of the number of structures meeting the adopted criteria for each reach was a lengthy process that involved comparing several sources of information to find out which structures were included in the list of structures in the floodway, which ones were included in the property acquisition lists or park plans, and how many may have already been accounted for in the 3.0 feet flooding depth determinations.

Once the numbers of structures to be bought out of floodproofed were determined for each structure category, the costs involved were calculated using the unit structure values and unit floodproofing costs determined for each reach as descried in earlier sections. The results were then totaled for each considered criteria. The information corresponding to the adopted buyout criteria summarizes the overall number of structures to be bought out and floodproofed and the associated costs involved for Alternative 1 for this damage reach.

The detailed reach by reach evaluations performed in each of the six major damage areas are summarized in the following sections. An overall summary of the costs involved with this candidate plan is provided at the end.

City of Decatur Damage Area:

Exhibit 2 shows the damage reaches identified in the City of Decatur. The damage area is divided into five (5) damage reaches containing a total of 150 structures that could be damaged by a 100-year flood. A detailed account of the nature of flooding and the damages involved can be found in the Damage Inventory Report.

Table 15 summarizes the Decatur plan components for each alternative by reach, along with the associated costs and benefits. The baseline condition is considered to be the “No Action” Alternative. The alternative recommended for each reach is marked with an “X” and the “Recommended Plan Totals” at the bottom of the table are respective totals for the “X” alternatives.

The first two categories (columns 3 through 7) are the non-structural improvements (buyouts and floodproofing). The number of structures to be bought out or floodproofed as well as their associated costs were calculated by utilizing the worksheet described earlier for each reach. These worksheets are provided in Appendix 5. The third category is the cost of limited structural improvements considered for the reach (if any) followed by the total plan cost for that reach and that alternative. The next column is the average annual costs for the reach and the indicated alternative and includes amortized capital cost (50 year project life at an assumed interest rate of 8.25%), interest during construction (if applicable), and annual operation and maintenance costs (if applicable).

The next column shows the average annual benefits that can be achieved by implementing the specified alternative in the reach. For the non-structural alternatives, this value is equivalent to the total property damage reduction benefit as described in the Damage Inventory Report. For the structural alternative, in addition to the property damage benefits, other benefits that can be achieved through reduction of other physical damages and emergency costs for a 100-year flood are also included because these types of solutions also usually prevent street flooding, etc.

The next column in the table ives the average annual residual damage remaining even after the alternative is implemented. For the "No Action" alternative, this value represents the total damage for the reach (within the 100-year floodplain) and includes the expected average annual property damage (given in the Damage Inventory Report) increased by 20% to account for other physical damages and related emergency costs.

In their 1992 Section 22 Study for the City of Decatur, the U.S. Army Corps of Engineers considered several levee alignments to protect different study reaches. According to the report, the levees will have a negative impact on the upstream flood stages. For the purpose of the Master Plan, these suggested levee alignments were used to estimate approximate costs of structural solutions for each reach. The amount given under the "Structural Flood Control Measure Costs" column, reflects the estimated cost associated with a 100-year flood protection for each of the five study reaches according to the structural measures, as explained earlier in this report. Protection of study reaches 3 and 4 requires raising the elevation of Monroe Street. The cost for this highway work was not included in the structural measure estimates above.

As Table 15 shows, the estimated costs associated with these limited structural measures were excessive. Given other technical and environmental problems associated with these solutions, they were not recommended as part of this plan.

As indicated in the table, the overall recommended plan for the Decatur area consists of the voluntary buyout of approximately 12 structures and providing floodproofing assistance to approximately 138 others. The recommended measure for each study reach is shown in Exhibit 2. The total capital cost required for this plan is estimated at about $2,000,000.

TABLE 15

ALTERNATIVE ANALYSIS SUMMARY FOR THE CITY OF DECATUR MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
REACH 1	No Action		0	$0	0	$0	$0	$0	$0	$0	$32,616	
	1	X	4	$204,800	94	$975,000	$0	$1,179,800	$99,221	$27,180	$5,436	
	2		0	$0	0	$0	$2,500,000	$2,500,000	$210,250	$32,616	$0	
REACH 2	No Action		0	$0	0	$0	$0	$0	$0	$0	$2,100	
	1	X	0	$0	6	$80,000	$0	$80,000	$6,728	$1,750	$350	
	2		0	$0	0	$0	$675,000	$675,000	$56,767	$2,100	$0	
REACH 3	No Action		0	$0	0	$0	$0	$0	$0	$0	$29,568	
	1	X	2	$72,600	13	$170,000	$0	$242,600	$20,403	$24,640	$4,928	
	2		0	$0	0	$0	$725,000	$725,000	$60,972	$29,568	$0	
REACH 4	No Action		0	$0	0	$0	$0	$0	$0	$0	$70,296	
	1	X	6	$217,800	15	$190,000	$0	$407,800	$34,296	$58,580	$11,716	
	2		0	$0	0	$0	$950,000	$950,000	$79,895	$70,296	$0	
REACH 5	No Action		0	$0	0	$0	$0	$0	$0	$0	$2,856	
	1	X	0	$0	10	$130,000	$0	$130,000	$10,933	$2,380	$476	
	2		0	$0	0	$0	$500,000	$500,000	$42,050	$2,856	$0	
No Action Plan Total		=	0	$0	0	$0	$0	$0	$0	$0	$137,436	
Recommended Plan Total		=	12	$495,200	138	$1,545,000	$0	$2,040,200	$171,581	$114,530	$22,906	

File: DECPLT.WQ1
Dated: 5-8-94

NOTES

1. Alternative "No Action" is the existing condition.
2. Alternative 1 is a non-structural alternative and includes buyouts and floodproofing according to the selected buyout criteria.
3. Alternative 2 is the most appropriate structural solution (if any) for each individual reach. This solution will provide 100-year flood protection w/o freeboard.
4. Average annual costs include amortized capital cost, interest during construction (if applicable), and annual operation and maintenance costs (if applicable).
5. Average annual benefits include property damage reduction benefits and, in the case of structural solutions, reduction of other damages and emergency costs for a 100-yr flood.
6. Average annual residual damages for the "No Action" alternative represents the total damage for the reach (within the 100-yr. floodplain) and includes the expected average annual property damage (given in the Damage Inventory Report) increased by 20% to account for other physical damages and related emergency costs.

Fort Wayne and Vicinity Damage Area:

Exhibit 3 shows an index map of the damage reaches identified in the City of Fort Wayne and its vicinity. The damage area is divided into sixty four (64) damage reaches of which nine (9) are to be completely, and one (1) partially, protected by the COE's diking project. These damage reaches are also designated in the exhibit. The remaining 54 reaches contain a total of 1,453 structures subject to 100-year flood damage. A detailed account of the nature of flooding and the damages involved can be found in the Damage Inventory Report.

Table 16 summarizes the Fort Wayne plan components for each alternative by reach, along with the associated costs and benefits. The baseline condition is considered to be the "No Action" Alternative. The alternative recommended for each reach is marked with an "X" and the "Recommended Plan Totals" at the bottom of the table are respective totals for the "X" alternatives.

The first two categories (columns 3 through 7) are the non-structural improvements (buyouts and floodproofing). The number of structures to be bought out or floodproofed as well as their associated costs were calculated by utilizing the worksheet described earlier for each reach. These worksheets are provided, for study reaches containing structural damages, in Appendix 6. The third category is the cost of limited structural improvements considered for the reach (if any) followed by the total plan cost for that reach and that alternative. The next column is the average annual costs for the reach and the indicated alternative and includes amortized capital cost (50 year project life at an assumed interest rate of 8.25%), interest during construction (if applicable), and annual operation and maintenance costs (if applicable).

The next column shows the average annual benefits that can be achieved by implementing the specified alternative in the reach. For the non-structural alternatives, this value is equivalent to the total property damage reduction benefit as described in the Damage Inventory Report. For the structural alternative, in addition to the property damage benefits, other benefits that can be achieved through reduction of other physical damages and emergency costs for a 100-year flood are also included because these types of solutions also usually prevent street flooding, etc.

The next column in the table gives the average annual residual damage remaining even after the alternative is implemented. For the "No Action" alternative, this value represents the total damage for the reach (within the 100-year floodplain) and includes the expected average annual property damage (given in the Damage Inventory Report) increased by 20% to account for other physical damages and related emergency costs.

As indicated in the table, the overall recommended plan for the Fort Wayne area consists of the voluntary buyout of approximately 250 structures, providing floodproofing assistance to approximately 871 others, and the implementation of two structural measures (in the St Marys River – Junk Ditch area) to protect about 179 residential and commercial structures. The recommended measure for the Fort Wayne study reaches are shown in Exhibits 4 through 14. The total capital cost required for this plan is estimated at about $26,000,000. **Overall, the average annual benefits to be gained from the implementation of the recommended plan exceeds the average annual costs.**

TABLE 16

ALTERNATIVE ANALYSIS SUMMARY FOR FORT WAYNE AND VICINITY MAUMEE RIVER BASIN MASTER PLAN

Phase #

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
E1SM (R01)	No Action		0	$0	0	$0	$0	$0	$0	$0	$119,604	
	1	X	14	$1,357,600	53	$830,000	$0	$2,187,600	$183,977	$99,670	$19,934	Includes the Thumb Area
	2		0	$0	0	$0	$0	$0	$0	$0	$119,604	
E2SM (R02)	No Action		0	$0	0	$0	$0	$0	$0	$0	$33,912	
	1	X	6	$469,200	21	$230,000	$0	$699,200	$58,803	$28,260	$5,652	
	2		0	$0	0	$0	$0	$0	$0	$0	$33,912	
E3SM (R03)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$105,240	City of Fort Wayne plan
	1		34	$1,557,200	72	$760,000	$0	$2,317,200	$194,877	$87,700	$17,540	(see the explanation on
	2		0	$0	0	$0	$850,000	$850,000	$71,485	$105,240	$0	page 56)
E4SM (R04)	No Action		0	$0	0	$0	$0	$0	$0	$0	$15,936	
	1	X	0	$0	18	$180,000	$0	$180,000	$15,138	$13,280	$2,656	
	2		0	$0	0	$0	$0	$0	$0	$0	$15,936	
E5SM (R05)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
E6SM (R06)	No Action		0	$0	0	$0	$0	$0	$0	$0	$21,204	
	1	X	0	$0	38	$390,000	$0	$390,000	$32,799	$17,670	$3,534	
	2		0	$0	0	$0	$0	$0	$0	$0	$21,204	
E7SM (R07)	No Action		0	$0	0	$0	$0	$0	$0	$0	$38,592	
	1	X	4	$533,800	34	$495,000	$0	$1,028,800	$86,522	$32,160	$6,432	
	2		0	$0	0	$0	$0	$0	$0	$0	$38,592	
E8SM (R08)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage

TABLE 16 (Continued)

ALTERNATIVE ANALYSIS SUMMARY FOR FORT WAYNE AND VICINITY MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
W1SM (R09)	No Action	X	This reach will be completly protected by the Corps Fort Wayne Diking Project									
	1											
	2											
W2SM (R10)	No Action	X	This reach will be completly protected by the Corps Fort Wayne Diking Project									
	1											
	2											
W3SM (R11)	No Action	X	This reach will be completly protected by the Corps Fort Wayne Diking Project									
	1											
	2											
W4SM (R12)	No Action	X	This reach will be completly protected by the Corps Fort Wayne Diking Project									
	1											
	2											
W5SM (R13)	No Action	X	This reach will be completly protected by the Corps Fort Wayne Diking Project									
	1											
	2											
W6SM (R14)	No Action		0	$0	0	$0	$0	$0	$0	$0	$258,444	Assuming hydraulic is OK
	1		27	$1,476,900	142	$1,570,000	$0	$3,046,900	$256,244	$215,370	$43,074	(see the explanation on
	2	X	0	$0	0	$0	$2,400,000	$2,400,000	$201,840	$258,444	$0	page 56)
W7SM (R15)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$17,412	City of Fort Wayne plan
	1		4	$188,800	43	$430,000	$0	$618,800	$52,041	$14,510	$2,902	(see the explanation on
	2		0	$0	0	$0	$1,000,000	$1,000,000	$84,100	$17,412	$0	page 57)
W8SM (R16)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage

TABLE 16 (Continued)

ALTERNATIVE ANALYSIS SUMMARY FOR FORT WAYNE AND VICINITY MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
W9SM (R17)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
W10SM (R18)	No Action		0	$0	0	$0	$0	$0	$0	$0	$60,252	
	1	X	8	$699,200	26	$270,000	$0	$969,200	$81,510	$50,210	$10,042	
	2		0	$0	0	$0	$0	$0	$0	$0	$60,252	
W11SM (R19)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
W12SM (R20)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
N1M (R21)	No Action	X	This reach will be completly protected by the Corps Fort Wayne Diking Project									
	1											
	2											
N2M (R22)	No Action	X	This reach will be completly protected by the Corps Fort Wayne Diking Project									
	1											
	2											
N3M (R23)	No Action		0	$0	0	$0	$0	$0	$0	$0	$23,688	
	1	X	11	$978,200	48	$168,000	$0	$1,146,200	$96,395	$19,740	$3,948	
	2		0	$0	0	$0	$0	$0	$0	$0	$23,688	
N4M (R24)	No Action		0	$0	0	$0	$0	$0	$0	$0	$27,168	
	1	X	0	$0	18	$180,000	$0	$180,000	$15,138	$22,640	$4,528	
	2		0	$0	0	$0	$0	$0	$0	$0	$27,168	

TABLE 16 (Continued)

ALTERNATIVE ANALYSIS SUMMARY FOR FORT WAYNE AND VICINITY MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
S1M (R25)	No Action		0	$0	0	$0	$0	$0	$0	$0	$24,972	
	1	X	0	$0	3	$40,000	$0	$40,000	$3,364	$20,810	$4,162	
	2		0	$0	0	$0	$0	$0	$0	$0	$24,972	
S2M (R26)	No Action		0	$0	0	$0	$0	$0	$0	$0	$22,944	
	1	X	0	$0	5	$100,000	$0	$100,000	$8,410	$19,120	$3,824	
	2		0	$0	0	$0	$0	$0	$0	$0	$22,944	
S3M (R27)	No Action		0	$0	0	$0	$0	$0	$0	$0	$16,728	
	1	X	58	$964,000	3	$60,000	$0	$1,024,000	$86,118	$13,940	$2,788	
	2		0	$0	0	$0	$0	$0	$0	$0	$16,728	
S4M (R28)	No Action		0	$0	0	$0	$0	$0	$0	$0	$480	
	1	X	0	$0	9	$120,000	$0	$120,000	$10,092	$400	$80	
	2		0	$0	0	$0	$0	$0	$0	$0	$480	
E1SJ (R29)	No Action	X	This reach will be completly protected by the Corps Fort Wayne Diking Project									
	1											
	2											
E2SJ (R30)	No Action	X	This reach will be completly protected by the Corps Fort Wayne Diking Project									
	1											
	2											
E3SJ (R31)	No Action		0	$0	0	$0	$0	$0	$0	$0	$70,200	
	1	X	0	$0	19	$285,000	$0	$285,000	$23,969	$58,500	$11,700	
	2		0	$0	0	$0	$0	$0	$0	$0	$70,200	
E4SJ (R32)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage

TABLE 16 (Continued)

ALTERNATIVE ANALYSIS SUMMARY FOR FORT WAYNE AND VICINITY MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
E5SJ (R33)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
W1SJ (R34)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
W2SJ (R35)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
W3SJ (R36)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
W4SJ (R37)	No Action		0	$0	0	$0	$0	$0	$0	$0	$14,196	
	1	X	8	$1,416,800	1	$10,000	$0	$1,426,800	$119,994	$11,830	$2,366	
	2		0	$0	0	$0	$0	$0	$0	$0	$14,196	
W5SJ (R38)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
E1SR (R39)	No Action		0	$0	0	$0	$0	$0	$0	$0	$86,160	Lower portion of this
	1	X	3	$156,900	32	$320,000	$0	$476,900	$40,107	$71,800	$14,360	reach will be protected by
	2		0	$0	0	$0	$0	$0	$0	$0	$86,160	the Corps Diking Project
E2SR (R40)	No Action		0	$0	0	$0	$0	$0	$0	$0	$3,984	
	1	X	0	$0	3	$40,000	$0	$40,000	$3,364	$3,320	$664	
	2		0	$0	0	$0	$0	$0	$0	$0	$3,984	

TABLE 16 (Continued)

ALTERNATIVE ANALYSIS SUMMARY FOR FORT WAYNE AND VICINITY MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
E3SR	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
(R41)	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
E4SR	No Action		0	$0	0	$0	$0	$0	$0	$0	$6,312	
(R42)	1	X	0	$0	1	$20,000	$0	$20,000	$1,682	$5,260	$1,052	
	2		0	$0	0	$0	$0	$0	$0	$0	$6,312	
W1SR	No Action		0	$0	0	$0	$0	$0	$0	$0	$182,472	
(R43)	1	X	20	$934,000	28	$285,000	$0	$1,219,000	$102,518	$152,060	$30,412	
	2		0	$0	0	$0	$0	$0	$0	$0	$182,472	
W2SR	No Action		0	$0	0	$0	$0	$0	$0	$0	$40,992	
(R44)	1	X	0	$0	11	$130,000	$0	$130,000	$10,933	$34,160	$6,832	
	2		0	$0	0	$0	$0	$0	$0	$0	$40,992	
W3SR	No Action		0	$0	0	$0	$0	$0	$0	$0	$127,032	
(R45)	1	X	4	$213,600	16	$160,000	$0	$373,600	$31,420	$105,860	$21,172	
	2		0	$0	0	$0	$0	$0	$0	$0	$127,032	
W4SR	No Action		0	$0	0	$0	$0	$0	$0	$0	$278,004	
(R46)	1	X	0	$0	2	$40,000	$0	$40,000	$3,364	$231,670	$46,334	
	2		0	$0	0	$0	$0	$0	$0	$0	$278,004	
E1JD	No Action		0	$0	0	$0	$0	$0	$0	$0	$572,676	Assuming hydraulic is OK
(R47)	1		0	$0	10	$200,000	$0	$200,000	$16,820	$477,230	$95,446	(see the explanation on
	2	X	0	$0	0	$0	$1,050,000	$1,050,000	$88,305	$572,676	$0	page 58)
E2JD	No Action		0	$0	0	$0	$0	$0	$0	$0	$46,428	
(R48)	1	X	0	$0	11	$130,000	$0	$130,000	$10,933	$38,690	$7,738	
	2		0	$0	0	$0	$0	$0	$0	$0	$46,428	

TABLE 16 (Continued)

ALTERNATIVE ANALYSIS SUMMARY FOR FORT WAYNE AND VICINITY MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
E3JD (R49)	No Action		0	$0	0	$0	$0	$0	$0	$0	$42,168	
	1	X	0	$0	5	$100,000	$0	$100,000	$8,410	$35,140	$7,028	
	2		0	$0	0	$0	$0	$0	$0	$0	$42,168	
W1JD (R50)	No Action		0	$0	0	$0	$0	$0	$0	$0	$57,516	
	1	X	12	$482,400	35	$510,000	$0	$992,400	$83,461	$47,930	$9,586	
	2		0	$0	0	$0	$0	$0	$0	$0	$57,516	
W2JD (R51)	No Action		0	$0	0	$0	$0	$0	$0	$0	$100,236	
	1	X	1	$32,300	16	$250,000	$0	$282,300	$23,741	$83,530	$16,706	
	2		0	$0	0	$0	$0	$0	$0	$0	$100,236	
W3JD (R52)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
* E1FD (R53)	No Action		0	$0	0	$0	$0	$0	$0	$0	$182,808	See the explanation on
	1	X	52	$2,594,000	74	$760,000	$0	$3,354,000	$282,071	$152,340	$30,468	page 59
	2		0	$0	0	$0	$5,625,000	$5,625,000	$473,062	$182,808	$0	
E2FD (R54)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
* W1FD (R55)	No Action		0	$0	0	$0	$0	$0	$0	$0	$492,420	See the explanation on
	1	X	48	$2,419,200	315	$3,150,000	$0	$5,569,200	$468,370	$410,350	$82,070	page 59
	2		0	$0	0	$0	$5,625,000	$5,625,000	$473,062	$492,420	$0	
W2FD (R56)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage

TABLE 16 (Continued)

ALTERNATIVE ANALYSIS SUMMARY FOR FORT WAYNE AND VICINITY MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
E1TD (R57)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
E2TD (R58)	No Action		0	$0	0	$0	$0	$0	$0	$0	$32,400	
	1	X	0	$0	5	$50,000	$0	$50,000	$4,205	$27,000	$5,400	
	2		0	$0	0	$0	$0	$0	$0	$0	$32,400	
W1TD (R61)	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
W2TD (R62)	No Action		0	$0	0	$0	$0	$0	$0	$0	$14,400	
	1	X	0	$0	6	$70,000	$0	$70,000	$5,887	$12,000	$2,400	
	2		0	$0	0	$0	$0	$0	$0	$0	$14,400	
NH1-4 (New Haven study)	No Action		0	$0	0	$0	$0	$0	$0	$0	$4,920	
	1	X	1	$36,600	15	$240,000	$0	$276,600	$23,262	$4,100	$820	
	2		0	$0	0	$0	$0	$0	$0	$0	$4,920	
No Action Plan Total		=	0	$0	0	$0	$0	$0	$0	$0	$3,141,900	
Recommended Plan Total		=	250	$13,287,800	871	$9,613,000	$3,450,000	$26,350,800	$2,216,102	$2,654,560	$487,340	

File: FWPLT.WQ1
Dated: 5-23-94

NOTES

1. Alternative "No Action" is the existing condition with the COE Diking Project in place.
2. Alternative 1 is a non-structural alternative and includes buyouts and floodproofing according to the selected buyout criteria.
3. Alternative 2 is the most appropriate structural solution (if any) for each individual reach. This solution will provide 100-year flood protection w/o freeboard.
4. Average annual costs include amortized capital cost, interest during construction (if applicable), and annual operation and maintenance costs (if applicable).
5. Average annual benefits include property damage reduction benefits and, in the case of structural solutions, reduction of other damages and emergency costs for a 100-yr flood.
6. Average annual residual damages for the "No Action" alternative represents the total damage for the reach (within the 100-yr. floodplain) and includes the expected average annual property damage (given in the Damage Inventory Report) increased by 20% to account for other physical damages and related emergency costs.

The following is a summary of special considerations for some of the damage reaches studied in the Fort Wayne area:

Reach 1 (E1SM): This reach includes the "Thumb Area" which is subject to the Fort Wayne Headwaters Park plans. According to the City's 24-month plan published in 1991, six (6) non-residential structures will be bought out for approximately $1,000,000. According to some reports, the park plan will encompass a much larger area and will probably involve a larger amount of property acquisition. However, for the purpose of this report, only the $1,000,000 for the buyout of six (6) non-residential properties was assumed. This value may be updated later.

Reach 3 (E3SM) The City of Fort Wayne has constructed an earthen dike in the northern portion of this reach, according to its 24-month work program, to help their efforts during flood emergencies. The purpose of the dike is to replace the need for sand bagging for flood events up to a 100-year flood. During a flood situation, the City intends to tie this dike to high ground by building a temporary barrier dike in the middle of a parking lot in the southern portion of the reach. Although, for the Master Plan, the alternative "No Action" has been recommended for this reach (Table 16), this recommendation may have to be charged in the future if the City's planned approach proves to be not as effective or acceptable as presently envisioned.

The amount given under the "Structural Flood Control Measure Costs" column, reflects the estimated cost associated with a 100-year protection of the entire reach. These figures are based on design and construction standards as well as concepts utilized in this Master Plan for structural measures, as explained earlier in this report. The City's constructed measure, different from this study's typical structural measures in its purpose and extent, was considerable less expensive.

Reach 14 (W6SM) According to the Damage Inventory Report, this reach has one of the highest residual property damages in the St. Marys River reaches. Preliminary studies seem to indicate that the reach 100-year flood damages can be eliminated by constructing approximately 3,200 ft of protection (consisting of floodwalls, levees, Taylor Street closure structures, and internal drainage measures) along the St. Marys River. Allowance has also been given for an additional 3,200 feet of 2-feet berm alongside the Norfolk & Western Railroad embankment forming the western boundary of the reach, to ensure that flow from the Junk Ditch does not flood the reach from the west side. This railroad embankment is shown to be out of the 100-year floodplain in FEMA maps. However, this must be confirmed with more accurate hydraulic modeling. Exhibit 15 shows the general location of the suggested line of protection.

The reach includes locations where, during major floods, the St. Marys River floodwaters are naturally diverted to Junk Ditch through several overland flow paths. The effect of blocking these overland flow paths on flood stages of other study reaches is not known. Accurate hydraulic modeling of this system (including the St. Marys River and Junk Ditch) is needed before such a determination can be made.

This structural measure appears to be considerably less expensive than Alternative 1 for this reach and is, therefore, recommended. This recommendation is predicated on the assumption that the suggested protection measure has no negative impact on the other study reaches, as required by the Master Plan's "Technical Criteria".

Reach 15 (W7SM): The City of Fort Wayne is scheduled to increase, according to its 24-month work program, the height of an existing intermittent spoil bank (known as "Vesey Dike") along the St. Marys River in this reach. The City expects to complete this project by end of this summer. Therefore, for the Master Planning purposes, the project is assumed to be in place. Although, for the Master Plan, the alternative "No Action" has been recommended for this reach (Table 16), this recommendation may have to be changed in the future if the City's planned approach proves to be not as effective or acceptable as presently envisioned.

The amount given under the "Structural Flood Control Measure Costs" column, reflects the estimated cost associated with a 100-year flood protection of the entire reach. These figures are based on design and construction standards as well as concepts utilized in this Master Plan for structural measures, as explained earlier in this report. The City's suggested plan, different from this study's typical structural measures in its purpose and extent, is considerably less expensive.

Reach 27 (s3m): This reach includes the Riverhaven area which has been identified as a potential buyout area in several previous studies and plans. There are a total of 58 residential structures in this reach which are all recommended for buyout. The area could then be converted to a park or other open space which would also result in increased temporary flood storage for the Maumee River.

Reach 39 (E1SR) The upper portion of this reach known as the "Eastbrook Area" is not included in the COE's diking project protection line which protects the lower portion of this reach. Instead of floodproofing of individual houses, the City of Fort Wayne has suggested the construction of a common flood barrier in front of the houses along Eastbrook Avenue with openings provided for each driveway entrance.

The suggested scheme relies, to a very large extent, on the quality and coordination of the needed human intervention. The effectiveness of the entire system is undermined if any of the homeowners involved delays on covering the flood barrier gap provided for each driveway entrance. Because of the magnitude of the risk involved, unless a fail-safe design can be provided, the common barrier system is **not** recommended.

Reach 43 (W1SR): This reach includes the area known as "Westbrook". Similar to the Eastbrook area., the City of Fort Wayne has suggested the construction of a common flood barrier in front of the houses along Westbrook Avenue with openings provided for each driveway entrance.

As indicated earlier, unless a fail-safe design can be provided, the common barrier system is **not** recommended.

Reach 47 (E1JD): The reach includes several businesses on both sides of Jefferson Boulevard, a major artery in the City of Fort Wayne. Jefferson Boulevard has to be closed during major floods due to Junk Ditch high water created by the St. Marys River backup. Because of the type of businesses involved, it is unlikely that any type of floodproofing will prevent these businesses from being closed due to floods. The best solution for this reach appeas to be the construction of an approximately 2,000-foot long levee/floodwall between two Conrail railroad embankments with provisions for internal drainage. Exhibit 16 shows the general location of the suggested line of protection.

Accurate hydraulic modeling for the Junk Ditch – St. Marys River system, currently not available, is needed to determine the hydraulic soundness of this alternative solution.

Reach 53 (E1FD) &
Reach 54 (W1FD): These two reaches are comprised of the Fernwood, Belle Vista, and Allendale neighborhoods. According to the latest FEMA maps, approximately 100 of the houses in these neighborhoods are in the floodway of Fairfield Ditch. This makes Alternative 1very costly, as according to the adopted buyout criteria, these 100 structures should be bought out. As the detailed buyouts and floodproofing worksheets for these reaches indicate (Appendix 6), only about 23 of these houses would have been subject to buyout if they were not in the floodway. According to the IDNR, the accuracy of the hydraulic model in this area is questionable and requires further work and possible revisions.

Detailed studies were performed in 1960 by the State of Indiana to investigate the feasibility of a local flood protection work on this ditch. The recommended plan of improvement for that study included, in addition to channel improvements, construction of about 15,000 feet of

levees and floodwalls along both sides of the ditch as well as excavation of a 240,000-cubic yard detention basin to attenuate the head-water flood peaks.

The extent of the suggested work is similar to the COE's diking project. It was, therefore, decided to use the $750 per lineal foot figure (the overall average unit cost of protection for the COE's diking project) as the average unit cost of protection. Based on this assumption, it is estimated that such a scheme could cost an excess of $11,250,000 in 1993 dollars. For the purpose of completing Table 16, this estimated cost was arbitrarily divided between the two reaches. Detailed hydrologic and hydraulic modeling must be performed in order to determine the hydraulic effectiveness and environmental soundness of this alternative solution.

Because of the magnitude of work and first cost involved in the structural solution, it appears that the non-structural solution is more appropriate for these reaches. Future improved hydraulic information may eliminate the need for a large scale buyout in the area, making the non-structural solution more affordable and also, perhaps, institutionally more acceptable.

City of Auburn Damage Area:

Exhibit 17 shows the damage reaches identified in the City of Auburn. The damage area is divided into ten (10) damage reaches containing a total of 84 structures that could be damaged by a 100-year flood. A detailed account of the nature of flooding and the damages involved can be found in the Damage Inventory Report.

Table 17 summarizes the Auburn plan components for each alternative by reach, along with the associated costs and benefits. The baseline condition is considered to be the "No Action" Alternative. The alternative recommended for each reach is marked with an "X" and the "Recommended Plan Totals" at the bottom of the table are respective totals for the "X" alternatives

The first two categories (columns 3 through 7) are the non-structural improvements (buyouts and floodproofing). The number of structures to be bought out or floodproofed as well as their associated costs were calculated by utilizing the worksheet described earlier for each reach. These worksheets are provided, for study reaches containing structural damages, in Appendix 7. The third category is the cost of limited structural improvements considered for the reach (if any) followed by the totatl plan cost for that reach and that alternative. The next column is the average annual costs for the reach and the indicated alternative and includes amortized capital cost (50 year project life at an assumed interest rate of 8.25%), interest during construction (if applicable), and annual operation and maintenance costs (if applicable).

The next column shows the average annual benefits that can be achieved by implementing the specified alternative in the reach. For the non-structural alternatives, this value is equivalent to the total property damage reduction benefit as described in the Damage Inventory Report. For the structural alternative, in addition to the property damage benefits, other benefits that can be achieved through reduction of other physical damages and emergency costs for a 100-year flood are also included because these types of solutions also usually prevent street flooding, etc.

The next column in the table gives the average annual residual damage remaining even after the alternative is implemented. For the "No Action" alternative, this value represents the total damage for the reach (within the 100-year floodplain) and includes the expected average annual property damage (given in the Damage Inventory Report) increased by 20% to account for other physical damages and related emergency costs.

As indicated in the table, the overall recommended plan for the Auburn area consists of the voluntary buyout of approximately 6 structures and providing floodproofing assistance to approximately 78 others. The recommended measure for each study reach is shown in Exhibit 17. The total capital cost required for this plan is estimated at about $1,000,000.

TABLE 17

ALTERNATIVE ANALYSIS SUMMARY FOR THE CITY OF AUBURN
MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
REACH 1	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
REACH 2	No Action		0	$0	0	$0	$0	$0	$0	$0	$1,080	
	1	X	0	$0	6	$120,000	$0	$120,000	$10,092	$900	$180	
	2		0	$0	0	$0	$0	$0	$0	$0	$1,080	
REACH 3	No Action		0	$0	0	$0	$0	$0	$0	$0	$960	
	1	X	0	$0	4	$70,000	$0	$70,000	$5,887	$800	$160	
	2		0	$0	0	$0	$0	$0	$0	$0	$960	
REACH 4	No Action		0	$0	0	$0	$0	$0	$0	$0	$2,676	
	1	X	0	$0	22	$245,000	$0	$245,000	$20,605	$2,230	$446	
	2		0	$0	0	$0	$0	$0	$0	$0	$2,676	
REACH 5	No Action		0	$0	0	$0	$0	$0	$0	$0	$3,264	
	1	X	0	$0	13	$130,000	$0	$130,000	$10,933	$2,720	$544	
	2		0	$0	0	$0	$0	$0	$0	$0	$3,264	
REACH 6	No Action		0	$0	0	$0	$0	$0	$0	$0	$1,044	
	1	X	0	$0	5	$50,000	$0	$50,000	$4,205	$870	$174	
	2		0	$0	0	$0	$0	$0	$0	$0	$1,044	
REACH 7	No Action		0	$0	0	$0	$0	$0	$0	$0	$1,968	
	1	X	6	$123,600	13	$123,000	$0	$246,600	$20,739	$1,640	$328	
	2		0	$0	0	$0	$0	$0	$0	$0	$1,968	
REACH 8	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage

TABLE 17 (Continued)

ALTERNATIVE ANALYSIS SUMMARY FOR THE CITY OF AUBURN
MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
REACH 9	No Action	X	0	$0	0	$0	$0	$0	$0	$0	$0	Based on the inventory,
	1		0	$0	0	$0	$0	$0	$0	$0	$0	this reach has no signific.
	2		0	$0	0	$0	$0	$0	$0	$0	$0	property damage
REACH 10	No Action		0	$0	0	$0	$0	$0	$0	$0	$5,400	
	1	X	0	$0	15	$150,000	$0	$150,000	$12,615	$4,500	$900	
	2		0	$0	0	$0	$0	$0	$0	$0	$5,400	
No Action Plan Total		=	0	$0	0	$0	$0	$0	$0	$0	$16,392	
Recommended Plan Total		=	6	$123,600	78	$888,000	$0	$1,011,600	$85,076	$13,660	$2,732	

File: AUBPLT.WQ1
Dated: 5-8-94

NOTES

1. Alternative "No Action" is the existing condition.
2. Alternative 1 is a non-structural alternative and includes buyouts and floodproofing according to the selected buyout criteria.
3. Alternative 2 is the most appropriate structural solution (if any) for each individual reach. This solution will provide 100-year flood protection w/o freeboard.
4. Average annual costs include amortized capital cost, interest during construction (if applicable), and annual operation and maintenance costs (if applicable).
5. Average annual benefits include property damage reduction benefits and, in the case of structural solutions, reduction of other damages and emergency costs for a 100-yr flood.
6. Average annual residual damages for the "No Action" alternative represents the total damage for the reach (within the 100-yr. floodplain) and includes the expected average annual property damage (given in the Damage Inventory Report) increased by 20% to account for other physical damages and related emergency costs.

Holiday Lakes Damage Area:

Exhibit 18 shows the Holiday Lakes damage area. The damage area contains a total of 16 structures that could be damaged by a 100-year flood. Recent hydraulic analysis performed by the SEG Consultants for the MRBC, indicates that ten (10) of these structures are in the Floodway of the Little Cedar Creek. A detailed account of the nature of flooding and the damages involved can be found in the Damage Inventory Report.

Table 18 summarizes the Holiday Lakes plan components for each alternative, along with the associated costs and benefits. The baseline condition is considered to be the "No Action" Alternative. The recommended alternative is marked with an "X" and the "Recommended Plan Totals" at the bottom of the table are respective totals for the "X" alternatives. After the Damage inventory Report was finalized in July 1994, it was discovered that based on a new revision of the Little Cedar Creek hydraulic model by SEG Consultants, the 100-year elevations at the site are about two (2) feet higher than previously reported. The noted change increases the estimated average annual damages from the previously reported $23,800 to approximately $50,000. Table 18 reflects this change.

Because the majority of the structures involved are in the floodway, the voluntary buyouts and floodproofing appears to be the most logical approach. The number of structures to be bought out or floodproofed as well as their associated costs were calculated by utilizing the worksheet described earlier for the damage reach. The buyouts and floodproofing worksheet for this damage area is provided in Appendix 8.

As indicated in the table, the overall recommended plan for the Holiday Lakes area consists of the voluntary buyout of approximately ten (10) structures and providing floodproofing assistance to approximately six (6) others. The recommended measure is also shown in Exhibit 18. The total capital cost required for this plan is estimated at about $1,260,000.

TABLE 18

ALTERNATIVE ANALYSIS SUMMARY FOR HOLIDAY LAKES MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
REACH 1	No Action		0	$0	0	$0	$0	$0	$0	$0	$60,000	
	1	X	10	$1,200,000	6	$60,000	$0	$1,260,000	$105,966	$50,000	$10,000	
	2		0	$0	0	$0	$0	$0	$0	$0	$60,000	
No Action Plan Total		=	0	$0	0	$0	$0	$0	$0	$0	$60,000	
Recommended Plan Total		=	10	$1,200,000	6	$60,000	$0	$1,260,000	$105,966	$50,000	$10,000	

File: HOLPLT.WQ1

Dated: 3-8-95 (REVISED)

NOTES

1. Alternative "No Action" is the existing condition.
2. Alternative 1 is a non-structural alternative and includes buyouts and floodproofing according to the selected buyout criteria.
3. Alternative 2 is the most appropriate structural solution (if any) for each individual reach. This solution will provide 100-year flood protection w/o freeboard.
4. Average annual costs include amortized capital cost, interest during construction (if applicable), and annual operation and maintenance costs (if applicable).
5. Average annual benefits include property damage reduction benefits and, in the case of structural solutions, reduction of other damages and emergency costs for a 100-yr flood.
6. Average annual residual damages for the "No Action" alternative represents the total damage for the reach (within the 100-yr. floodplain) and includes the expected average annual property damage (given in the Damage Inventory Report) increased by 20% to account for other physical damages and related emergency costs.

Spencerville Damage Area:

Exhibit 19 shows the Spencerville damage area. According to a survey of the area and data provided during the Draft Master Plan review process, there are four (4) structures that could be damaged by a 100-year flood. These structures are recommended to be individually floodproofed (Table 19). Based on the average unit floodproofing costs used in other study reaches, the total capital cost required for this plan is estimated at about $40,000.

TABLE 19

ALTERNATIVE ANALYSIS SUMMARY FOR SPENCERVILLE DAMAGE AREA MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recom-mended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
REACH 1	No Action		0	$0	0	$0	$0	$0	$0	$0	$0	
	1	X	0	$0	4	$40,000	$0	$40,000	$3,364	Not Determined	Not Determined	
	2		0	$0	0	$0	$0	$0	$0	$0	$0	
No Action Plan Total =			0	$0	0	$0	$0	$0	$0	$0	$0	
Recommended Plan Total =			0	$0	4	$40,000	$0	$40,000	$3,364	Not Determined	Not Determined	

File: SPENPLT.WQ1

Dated: 3-08-95 (revised)

NOTES

1. Alternative "No Action" is the existing condition.
2. Alternative 1 is a non-structural alternative and includes buyouts and floodproofing according to the selected buyout criteria.
3. Alternative 2 is the most appropriate structural solution (if any) for each individual reach. This solution will provide 100-year flood protection w/o freeboard.
4. Average annual costs include amortized capital cost, interest during construction (if applicable), and annual operation and maintenance costs (if applicable).
5. Average annual benefits include property damage reduction benefits and, in the case of structural solutions, reduction of other damages and emergency costs for a 100-yr flood.
6. Average annual residual damages for the "No Action" alternative represents the total damage for the reach (within the 100-yr. floodplain) and includes the expected average annual property damage (given in the Damage Inventory Report) increased by 20% to account for other physical damages and related emergency costs.

Noble County Damage Area:

Exhibit 20 shows the Noble County damage area. As indicated in the Damage Inventory Report, there are four (4) structures that could be damaged by a 100-year flood. These structures are recommended to be individually floodproofed (Table 20). Based on the average unit floodproofing costs used in other study reaches, the total capital cost required for this plan is estimated at about $40,000.

TABLE 20

ALTERNATIVE ANALYSIS SUMMARY FOR NOBLE CO. DAMAGE AREA MAUMEE RIVER BASIN MASTER PLAN

Location	Alternative	Recommended Plan	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr	Floodproofing Costs	Structural Flood Control Measure Costs	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages	Remarks
REACH 1	No Action		0	$0	0	$0	$0	$0	$0	$0	$0	
	1	X	0	$0	4	$40,000	$0	$40,000	$3,364	Not Determined	Not Determined	
	2		0	$0	0	$0	$0	$0	$0	$0	$0	
No Action Plan Total =			0	$0	0	$0	$0	$0	$0	$0	$0	
Recommended Plan Total =			0	$0	4	$40,000	$0	$40,000	$3,364	Not Determined	Not Determined	

File: NOBLEPL1.WQ1

Dated: 5-25-94

NOTES

1. Alternative "No Action" is the existing condition.
2. Alternative 1 is a non-structural alternative and includes buyouts and floodproofing according to the selected buyout criteria.
3. Alternative 2 is the most appropriate structural solution (if any) for each individual reach. This solution will provide 100-year flood protection w/o freeboard.
4. Average annual costs include amortized capital cost, interest during construction (if applicable), and annual operation and maintenance costs (if applicable).
5. Average annual benefits include property damage reduction benefits and, in the case of structural solutions, reduction of other damages and emergency costs for a 100-yr flood.
6. Average annual residual damages for the "No Action" alternative represents the total damage for the reach (within the 100-yr. floodplain) and includes the expected average annual property damage (given in the Damage Inventory Report) increased by 20% to account for other physical damages and related emergency costs.

Summary Results for the Entire Basin:

Table 21 provides a summary, by the damage area, of the total estimated costs and benefits involved with the recommended plan for each reach as well as the number of structures involved in each protection category.

As shown in the table, the total capital cost required to address the structural property damages in the entire Basin is about 30.7 million dollars, of which about 26.5 million dollars is for the mitigation of residual damages in the Fort Wayne area and its vicinity. Of the total 1,711 structures remaining subject to 100-year flood damages in the Basin (after the Fort Wayne diking project is built), 278 are recommended to be bought out. Approximately 1,101 structures are recommended to be floodproofed and 179 others are recommended to be protected by construction of levees and floodwalls along small portions of the St. Marys River and Junk Ditch in Fort Wayne. 153 other structures, located in two (2) Fort Wayne damage reaches, are being independently addressed by the City of Fort Wayne.

This plan component represents the most promising solution to the Basin's urban flooding damages and is, therefore, recommended to be adopted as a major component of the Maumee River Basin Flood Control Master Plan.

TABLE 21

SUMMARY RESULTS OF THE "REACH BY REACH" RECOMMENDED PLAN FOR THE ENTIRE BASIN MAUMEE RIVER BASIN MASTER PLAN

Location	# of Strs. Subj. to No Action	# of Strs. to Buyout	Buyout Costs	# of Strs. to Floodpr.	Floodproofing Costs	# of Strs. Subj. to Str. Meas.	Structural Flood Control Measure Costs	Total # of Strs.	Total Capital Costs	Average Annual Costs	Average Annual Benefits	Avg. Ann. Residual Damages
Decatur	0	12	$495,200	138	$1,545,000	0	$0	150	$2,040,200	$171,581	$114,530	$22,906
Ft. Wayne	153	250	$13,287,800	871	$9,613,000	179	$3,450,000	1,453	$26,350,800	$2,216,102	$2,654,560	$487,340
Auburn	0	6	$123,600	78	$888,000	0	$0	84	$1,011,600	$85,076	$13,660	$2,732
Hol. Lakes	0	10	$1,200,000	6	$60,000	0	$0	16	$1,260,000	$105,966	$50,000	$10,000
Spencerville	0	0	$0	4	$40,000	0	$0	4	$40,000	$3,364	Not Determined	Not Determined
Noble Co.	0	0	$0	4	$40,000	0	$0	4	$40,000	$3,364	Not Determined	Not Determined
Total	153	278	$15,106,600	1101	$12,186,000	179	$3,450,000	**1,711**	**$30,742,600**	$2,585,453	$2,832,750	$522,978

File: BASINPL1.WQ1

Dated: 3-08-95 (revised)

NOTES

1. Average annual costs include amortized capital cost, interest during construction (if applicable), and annual operation and maintenance costs (if applicable).
2. Average annual benefits include property damage reduction benefits and, in the case of structural solutions, reduction of other damages and emergency costs (estimated to be about 20% of the property damage values) for a 100-year flood.
3. Number of structures subject to the No Action alternative (153) reflects the structures located in the Pauline Ave. and the Vesey neighborhoods in Fort Wayne which are in the process of being partially protected by the City of Fort Wayne (pending approval of permits). 38 of these structures were eligible for buyout.
4. Number of structures subject to protection by Limited Structural Measures (179) reflect structures in two (2) Fort Wayne damage reaches which are recommended to be protected by ring levees. 27 of these structures were eligible for buyout.

f. LAND ACQUISITION AND FLOWAGE EASEMENTS

Candidate Plan Component "f" calls for the support, promotion, and funding of land acquisition, flowage easements, land set-aside programs, alternative flood-tolerant crops, and conversion to an alternative land use (woodland, wetland, or a park corridor) in the flood prone agricultural properties for erosion control and flood damage mitigation purposes.

This alternative attempts to reduce the agricultural flood damage potential in the Basin by converting the land use of the flooded areas from traditional cropland or other agricultural use to river corridors. The landowner/farmer will be compensated for the affected area through participating in programs such as the United States Department of Agriculture's "USDA's) Conservation Reserve and Conservation Easement Programs (CRP and CEP), USDA's Wetland Reserve Program, or other compatible programs funded and/or supported by the MRBC.

This alternative can be thought of as the non-urban counterpart of the recommended Master Plan component described earlier under alternative "e", the reach by reach buyouts and floodproofing plan. **Similar to alternative "e" for the urban areas, this alternative seeks to control the magnitude and extent of damages caused by the floodwater (accommodate the floodwater in preference to controlling the floodwater itself.** In the case of property damage in urban areas, the properties were recommended to be bought out and turned into open spaces or be floodproofed. In the case of flooded agricultural lands, it is suggested that the existing land use be changed to one which would not receive damages to the property or the dwellings and accessory buildings.

The change in the agricultural land use may be achieved in several ways including regulation or zoning changes, acquisition of the land either through donation or by the fee simple purchase of the property and its conversion to a woodland, wetland, or a park corridor, purchase of the flowage easement in the floodplain area, land set-aside, and conversion to alternative flood-tolerant crops. Factors such as soil conditions, property location in relation to existing or planned parks, open space or woodland corridors, erosion potential, drainage considerations, and the owner's willingness have to be taken into account before deciding on the most appropriate solution for each specific area. Further studies need to be conducted during the project development phase of this recommended plan component to recommend the most appropriate method for compensating the farmer or the agricultural landowner for recurrent flood damages.

In many instances, the farms that lay along the river may contain either open or closed drainage ways which provide for proper drainage of farms which may not be subject to flooding. During the project development phase of this recommended Plan Component, provisions need to be established which will insure that the drainage of the farms outside the floodplain or maintenance of such drainage tiles or ditches are not negatively impacted as a result of programs suggested under this recommended Plan Component.

Estimates of the total acreage subject to 100- year flood and 5-year flood were given in the "Damage Inventory Report" for the agricultural areas in the Basin. According to that report, approximately 32,000 acres of cropland will be flooded by the 100-year flood in the entire Basin. For a 5-year flood, approximately 14,000 acres of cropland are expected to sustain damage.

More detailed information such as information on land use, property lines, floodplain boundaries, etc., is needed during the project development phase to confirm the total acreage subject to 5-year and 100-year floods. This detailed information will also aid in deciding which properties are more appropriate for title acquisition from willing owners (either donation or fee simple purchase), for flowage easements, for recommendation to be in reserve programs, and so on.

Outright purchase of agricultural lands for the purpose of creating river corridors or other appropriate uses could be costly as typical floodplain acquisition costs within northeast Indiana currently range from $500 to $1,500 per acre. However, it may be possible to reduce the direct expenses to the community by coordination with other agencies programs (such as several USDA, SCS, and IDNR programs). It is recommended that the implementation of the plan component "f" be phased to initially address the farmlands being flooded by a 5-year flood, thereby reducing the more frequent flooding damages with limited funds.

As a proactive measure, existing prime wooded areas within the floodplain (that are likely to be rezoned and developed) may be purchased and combined with the converted land as a Woodland Corridor. However, further studies need to be made to develop potential funding sources for such measures.

It is recommended that this alternative be adopted s a Master Plan component and be studied and developed further.

g. REMOVAL OF YOST LEVEE

Candidate Plan Component "g" calls for the removal of the unapproved Yost Levee or construction of a bypass channel through the area downstream of Decatur on the St. Mary's River.

Based on information received from the MRBC staff, the "Yost Levee" is a large earthen flood control structure installed by the owners of the Yost Gravel Pit. The levee location is highlighted in Exhibit 21.

The levee extends from a point east of the Winchester Road in an easterly direction along the southern property line of the Yost Gravel Pit to the west bank of the St. Marys River and then forms the west bank of the river as the river meanders, continuing westerly along the southern bank and Winchester Road until its termination point at the intersection of the Winchester Road and the Northern property line of the Yost Gravel Pit. The makeup of the levee is mostly the overburden removed to expose the gravel strata below.

Although it is not entirely clear when the levee was built, it is believed that it was originally installed in the 1930's or 1940's. The height and the width of the levee have been continuously increased as a result of the gravel operation up to the past few years. The levee has never been granted any approval from either the IDNR or its predecessor. The levee provides flood protection for the two gravel pits and one residential structure. Currently, the gravel removal operation has stopped, apparently due to economic reasons.

A hydraulic model (HEC-2) of the St. Marys River recently developed by SEG, Inc. for the MRBC was used to evaluate the effect of removal of the levee or construction of a bypass channel on the flood stages at Decatur. This model has not yet received approval from the IDNR. However, it is considered to be adequate for the with- and without-project conditions comparison purposes.

Four cross sections at stream miles 26.89, 27.00, 28.11, and28.14 were added by CBBEL to adequately represent the levee. Several scenarios were investigated. These included the complete removal of the existing dike along with construction of a new ring levee to protect an affected residential structure, construction of a bypass channel to carry 50% of the St. Marys River 100-year flood through the bend, and a larger bypass channel to carry 80% of the 100-year flood flows. The general alignment of the relocated levee and the bypass channels are also shown in the Exhibit 21. The 100-year flood stages with- and without- project were compared, for each scenario, at the River Mile 30.86 which represents the Monroe Street bridge in Decatur. A summary or the results are provided in Table 22.

TABLE 22

SUMMARY OF RESULTS FOR THE YOST LEVEE REMOVAL ALTERNATIVE

SCENARIO	STAGE REDUCTION AT DECATUR
Complete Removal of the Levee	0.35 ft.
50% Bypass Channel	0.28 ft.
80% Bypass Channel	0.36 ft.

The above results were compared with the data provided in tables 1 and 2 in the Damage Inventory Report s well as with the worksheets provided in Appendix 5 of this current report. The effect of such relatively minor stage decreases on the magnitude of the potential property damage in Decatur is insignificant and does not warrant the expenses involved with implementation of any of the considered scenarios.

A review of the IDNR's permit and violation files did not produce any records regarding the legal status of either the original levee construction or any subsequent increases in its height or its width. It is not clear whether the levee construction predated the Flood Control Act or is it in violation of it. Unless the cost of the levee removal or a bypass channel is borne by the existing gravel pit owners, further study and consideration of this plan is not recommended.

h. 40 PERCENT TRIER DITCH CUT-OFF

Candidate Plan Component "h" calls for the construction of a Trier Ditch cut-off that would carry 40 percent of the 100-year flood peak discharge of the St. Marys River with no further channel modifications (for reducing flood stages in Fort Wayne and vicinity).

This plan, which is the favorable and acceptable plan from an array of Trier Ditch cut-off alternatives considered in the COE's 1987 Fort Wayne Feasibility Study (rev. April 1988), is discussed in detail in the COE's report. The following is an excerpt of the plan description taken from the COE's report.

The plan, as currently considered, has two main components. The first component is identical to the Corp's Fort Wayne Diking project which is due to begin construction in 1995. The second component which will complement the diking project consists of construction of a Trier cut-off channel to divert 40 percent of the St. Marys River 100-year flood flow, approximately 6,600 cfs, to the Maumee River just downstream of New Haven. The cut-off channel would approximately follow the existing Trier and Paul Trier Ditches, except at the present mouths of each ditch. The Channel would be trapezoidal with 2.5 horizontal on 1 vertical side slopes. The approximate alignment of the channel is shown in Exhibit 22.

Originally, a third component consisting of modification of the St. Joseph River channel from the mouth to Catherine Avenue, a distance of about 2 miles, was envisioned by Allen County and the City of Fort Wayne. However, this latter component is considered environmentally and institutionally unacceptable and is no longer considered as part of the Trier Ditch Cut-off alternatives.

As stated previously, the new drainage course would be constructed along the path of the Trier-Paul Trier Ditches, except at the entrance and exit locations. The channel would be approximately 8.5 miles in length. The upstream 5.5 miles, from the St. Marys River to Moeller Road, would have a bottom width of 85 feet and a bottom slope of 0.000483 feet/foot. The remaining three miles would have a bottom width of 60 feet and a bottom slope of 0.00084 feet/foot.

An entrance structure would be placed in the St. Marys River approximately 500 feet downstream of the existing mouth of Paul Trier Ditch. This structure would consist of a weir, an interceptor wall, levees and the necessary training walls and paving to prevent scour.

The weir would be constructed across the entrance to the diversion channel so this floodway would be operative only during periods of high flow on the St. Marys River. The weir crest elevation would be 761.0 feet, with a length of 85 feet. This elevation would keep the diversion channel inoperative until the flow on the St. Marys River exceeded 3,500 cubic feet per second (cfs). To prevent scour below the weir, an apron with a width of 85 feet would be provided.

An interceptor wall would be constructed from the downstream end of the spillway out into the St. Marys River, and then upstream of the weir. This wall would be located so as to aid in splitting the St. Marys River design flow into the proper proportion for the diversion channel and the lower St. Marys River. The upstream extremity of the wall would be located a sufficient distance above the weir so that the drawdown immediately upstream of the weir's spillway would not adversely affect flow conditions to the left of this wall. An opening would be constructed near the downstream end of this wall to prevent debris from accumulating behind the wall during periods when St. Marys River flow is less than 3,500 cfs. Adequate paving and a training wall would be placed downstream from the contracted opening to prevent scour. Tieback levees would be required on the St. Marys River to prevent flanking of the structure during large floods.

From the entrance structure, the channel would proceed northeast for approximately 3,500 feet, intercepting the existing channel north of Houk Ditch. The channel would then follow the existing ditch as closely as practicable from this point to Main Street in New Haven. At Main Street, the cutoff channel would proceed east of the Norfolk and Western Railroad tracks for 5,000 feet to the Maumee River. Riprap would be placed at the channel exit to prevent scour.

The existing channel from Houk Ditch to the St. Marys River and from Main Street to the Maumee River would be left in its natural state.

There are currently 18 bridges crossing the Trier and Paul Trier Ditches, not including farm crossings. Three of these, U.S. 27 over Paul Trier Ditch, one of the Norfolk and Western Bridges, and Parrot Road over Trier Ditch would be left in their present state. Of the remaining 15 bridges, it has been determined that one of the Norfolk and Western Railroad bridges and four road crossings could be eliminated. The railroad crossing is no longer used. The four roads are Maples Road, Wayne Trace, Adams Center Road, and Hartzell Road. These roads would be relocated to utilize bridges for nearby roads.

The remaining ten bridges would be reconstructed to provide sufficient span to cross the proposed channel. In addition, new bridges would be required over the new channel where it crosses U.S. 27 and the intersection of Parrot and Landin Roads. Old Landin road would be cut off by the new channel, so a connector to Landin Road would be constructed.

The mouths of Paul Trier Ditch at the St. Marys River and of Trier Ditch at the Maumee River are typified by wooded corridors of mature trees and undeveloped riparian habitats. These areas are considered to be valuable wildlife habitat. The proposed alignment of Trier Ditch cut-off is a result of coordination between the COE, U.S. Fish and Wildlife Service, City of New Haven, and the local sponsors in February 1986. As described in detail in the COE's report, the suggested alignment was proposed to avoid the environmentally valuable areas along each of the Trier Ditches near their confluences with the St. Marys and Maumee Rivers. The cutoff channel would be designed to allow normal flow to utilize the existing outlets. Riparian impacts resulting from widening and deepening of the remaining channel portions would be mitigated through tree and shrub plantings adjacent to the new channel corridor.

Widening and deepening of Trier Ditch would eliminate pools and shaded areas which provide good fishery habitat that exists when sufficient flows are available. To mitigate for instream fishery impacts, the Fish and Wildlife Service recommends constructing fish pools utilizing anchored log structures, and providing a minimum flow channel which would continue to run throughout the low flow summer months.

Detailed hydraulic evaluations performed as a part of the referenced feasibility study indicates that the 40% Trier cut-off channel will reduce the stages by as much as three (3) feet along most of the St. Marys River downstream from the cut-off point. The flood stages at the three-rivers confluence point was estimated to be lowered as much as two (2) feet due to the cut-off. This potential stage reduction will significantly reduce or eliminate most of the major residual flood damages remaining after the Fort Wayne diking project is built.

According to the latest detailed cost estimates provided by the COE in their May 1993 Fort Wayne diking project GDM study report, the current (1993) cost estimate of the diversion portion of the plan is $75 million. This is almost three times the estimated expenses involved in the Alternative “e”, the Reach by Reach Plan, discussed earlier.

The 40 percent cut-off plan does not entirely eliminate all of the remaining damages in Fort Wayne and vicinity (such as the damages occurring in the upper reaches of the Fairfield Ditch, Junk Ditch, Spy Run, and St. Joseph River). Considering the funding constraints related to the required high initial and total costs of the plan as well as the institutional problems involved with the implementation of the plan, further study and consideration of this plan is not recommended.

i. CEDAR CREEK IMPOUNDMENT

Candidate Plan Component "i" calls for the construction of a major retention/detention basin on Cedar Creek in DeKalb County.

The purpose of this plan was to reduce the flood stages in Waterloo and Auburn by attenuating floods through a multi-purpose retention/recreational lake upstream of Waterloo. The proposed reservoir is located on Cedar Creek upstream of Cedar Lake in DeKalb County, as shown in Exhibit 23. The reservoir would control approximately 23 square miles (8%) of the Cedar Creek watershed area and would have 900 acres of surface area at its normal level (recreational pool).

Based on the hydrologic analysis performed by SEG for the MRBC, the entire 100-year runoff volume at the site is about 4,000 acre-feet. Further analyses were performed by CBBEL to evaluate the impact of storing this entire runoff volume in the proposed reservoir on the flood stages at Waterloo and Auburn. The results indicate that the entire volume of the 100-year runoff at the site may be stored at the lake with a resultant 3.6 feet of water level increase above the normal pool level. SEG's hydrologic and hydraulic models (HEC-1 and HEC-2) were modified to reflect the full retention of the 100-year flood volume for the 23.4 square mile watershed above the retention basin. The comparison between the with- and without-project results indicate that the 100-year flood stages will be reduced by approximately 0.7 foo and 0.3 foot, respectively, at Waterloo and Auburn.

Based on the data provided in the "Damage Inventory Report", the 0.7 foot flood stage reduction at Waterloo will probably eliminate the nuisance flooding at the Waterloo Trailer Park. A detailed review of Table 17 and the Buyouts and Floodproofing worksheets provided in Appendix 7 for the City of Auburn indicates that although the reduction of 0.3 foot in the 100-year flood stage at Auburn does no eliminate the potential property damages, it does significantly reduce the need for floodproofing of a large number of structures. However, even if elimination of all potential flood damages in Auburn (an average of approximately $16,000 annually) is credited to the proposed retention basin, the expenses involved in the construction of the proposed basin (expected to be in the order of tens of millions of dollars) will not be justifiable. It is, therefore, recommended that no further study or consideration be given to this alternative.

j. ST. MARYS RIVER IMPOUNDMENT

Candidate Plan Component "j" calls for the construction of a major retention/detention basin on the St. Marys River upstream of Decatur.

The purpose of this plan was to reduce the 100-year flood stages in the St. Marys River in Decatur, Fort Wayne, and other locations adjacent to the St. Marys River downstream of the site. The Proposed dry reservoir on the St. Marys River would be located upstream of Decatur in Adams County as shown in Exhibit 24. Based on the information provided by the MRBC, the proposed dry reservoir could be created by constructing an earthen embankment with a concrete control structure and would control approximately 547 square miles (62%) of the total St. Marys River watershed area.

Preliminary hydrologic and hydraulic modeling (HEC-1 & HEC-2), prepared by SEG for the MRBC in May and July of 1993, were utilized to evaluate the effects of the proposed reservoir on the downstream flood stages. Two alternative reservoir scenarios were evaluated. The difference between the scenarios is the expected 100-year flood elevation at the location of the control structure. A brief description of each scenario follows:

1. This scenario would allow a 100-year flood elevation of 795.0 feet at the control structure which is five (5) feet higher than the existing conditions 100-year flood elevation. This scenario, which reflects the maximum capability of the site, would result in inundation of a considerable land area and also increased flood elevations within the State of Ohio.
2. This scenario would allow a 100-year flood elevation of 793.4 at the control structure which matches the existing conditions 100-year flood elevation at the Indiana-Ohio state line. Although this scenario does not increase the 100-year flood elevations in the State of Ohio, it inundates properties located in that state.

The following assumptions were made for the proposed reservoir scenarios simulated with the HEC-1 model.

1. The elevation-storage relationship was developed from the five foot contours shown on the U.S.G.S. quadrangles.

2. The control structure would consist of a concrete weir with a crest elevation at the invert of the stream. (Invert of stream is 766.0)

3. The weir openings were determined by allowing the 100-year peak discharge to be conveyed at the design elevation.

4. The existing condition HEC-1 model reach routing (in basin 3 of the SEG model) records were deleted from the with-reservoir model in the vicinity of the reservoir.

The resultant HEC-1 model peak discharges released from the reservoir were placed in the SEG's preliminary St. Marys River HEC-2 model to determine the downstream 100-year flood profile. The 100-year elevations for the existing and the with-reservoir conditions were compared at selected locations downstream. Two of these locations are U.S.G.S. stream gages on the St. Marys River. The "St. Marys River at Decatur, IN" station is located just north of Decatur (Decatur gage) and has a drainage area of about 621 square miles. The "St. Marys River Near Fort Wayne, IN" station is located approximately five (5) miles south of Fort Wayne just downstream from Anthony Boulevard Extension (Anthony Boulevard gage) and has a drainage area of about 762 square miles.

The proposed reservoir in scenario 1 which has a total storage of approximately 35,180 acre-feet at elevation 795.0 will reduce the downstream 100-year peak discharge by 6,854 cfs and 6,454 cfs at the Decatur and Anthony Boulevard gages, respectively. The concrete weir control structure would have a crest width of 20 feet. This will result in a lowering of the 100-year water surface elevation by 3.8 feet and 2.1 feet, respectively, in the vicinity of the Decatur and Anthony Boulevard gages. It should be noted that this scenario raises the 100-year backwater elevation in Ohio by 1.6 feet. In addition, a considerable portion of the 5,300 –acre area being inundated by the reservoir at the 100-year flood elevation of 795.0 is located in the State of Ohio.

The proposed reservoir in scenario 2 matches the existing 100-year water surface elevation at Indiana-Ohio state line. The proposed reservoir has a total storage of about 28,670 acre-feet at elevation 793.4 and will reduce the downstream 100-year peak discharge by 5,752 cfs and 5,473 cfs at the Decatur and Anthony Boulevard gages, respectively. The concrete weir control structure would have a crest width of 23 feet. This will result in a lowering of the 100-year water surface elevation by 3.1 feet and 1.7 feet, respectively, in the vicinity of the Decatur and Anthony Boulevard gages. Although the 100-year backwater as a result of the impoundment will be contained in the State of Indiana, a portion of the 4,500 –acre area being inundated by the reservoir at the 100-year flood elevation of 793.4 is located in the State of Ohio.

Table 23 provides a summary of the results at different locations along the River for the two scenarios considered. As indicated in the table, the Scenario 2 provides comparable downstream 100-year flood elevation decreases as Scenario 1 without extreme adverse hydraulic impacts on the properties within the State of Ohio. The scenario 2 is therefore superior to the scenario 1.

TABLE 23

SUMMARY OF RESULTS FOR THE ST. MARYS RESERVOIR ALTERNATIVE

LOCATION	DRAINAGE AREA (SQ. MI.)	100-YEAR FLOOD STAGE REDUCTION (FEET)	
		SCENARIO 1	SCENARIO 2
Indiana/Ohio State Line	393	+1.6*	+0.0*
Reservoir	547	+5.0*	+3.4*
Decatur Gage	575	-3.8	-3.1
Allen/Adams County Line	646	-2.9	-2.4
Anthony Boulevard Gage	762	-2.1	-1.7

* The effect of backwater from the proposed reservoir.

Based on the data provided in the "Damage Inventory Report", the 3.1 feet flood stage reduction at Decatur will eliminate most of the potential 100-year flood damages within the City of Decatur. The lower flood peaks will also reduce much of the agricultural 100-year flood damages occurring downstream of the reservoir site.

At its mouth, the St. Marys River joins the St. Joseph River to produce the Maumee River. The St. Marys River's potential reduced flood peaks as a result of the reservoir attenuation are associated with a longer-duration, flatter, delayed hydrograph peaks. Because of its larger watershed size, the St. Joseph River peak discharges typically occur several hours after the St. Marys River peaks. Therefore, unless the peak discharges are considerably lowered, a delayed St. Marys River peak my actually worsen the flooding effects at the confluence.

Because of the previously explained time dependency and also the lack of reliable hydrologic and hydraulic modeling for the St. Marys River downstream of the Anthony Boulevard gage, it is difficult to accurately carry the results indicated for the Anthony Boulevard gage to the three-river confluence area (downtown Fort Wayne). However, based on the calculated change in the 100-year water surface elevation at the Anthony Boulevard gage as a result of the proposed dry dam, it may be concluded that the potential stage reduction would significantly reduce or eliminate (in some reaches) most of the major residual flood damages remaining after the Fort Wayne diking project is built.

No detailed cost estimates were developed for the proposed project. However considering the extent of the land acquisition involved in construction of this 4,500-acre detention basin, it is estimated that the expected costs will be on the order of tens of millions of dollars. The area subject to inundation by the floodwaters in both states consists mostly of prime agricultural land. It is not advisable to impose this undo burden on the farmers managing these lands in order to lower the flood crest in the urban areas downstream.

This alternative is effective in reducing some agricultural damages and most of the property damages occurring in the City of Decatur. However, it does not entirely eliminate all of the remaining damages in Fort Wayne and vicinity (such as the damages occurring in the upper reaches of the Fairfield Ditch, Junk Ditch, Spy Run, and St. Joseph River). Considering the funding constraints related to the required high initial and total costs of the plan as well as the institutional problems involved with the implementation of the plan, further study and consideration of this plan is not recommended.

k. RESTORATION OF JUNK DITCH BYPASS CAPACITY

Candidate Plan Component "k" calls for increasing the existing magnitude of the St. Marys River's overflow (Junk Ditch cut-off) to the Wabash River Basin to approximately 30% of the 100-year flood peak discharge of the St. Marys River.

This plan provides for the restoration to the estimated 1913 conditions of the capacity of Junk Ditch in diverting the St. Marys River flood flows to the Wabash River Basin during a 100-year flood. According to a 1974 study by the COE, approximately 5000 cfs (about 30% of the St. Marys River 100-year flood) spilled over from the St. Marys River into the Little River in the Wabash River Basin along the Junk Ditch during the 1913 flood. The report also stated that a recurrence of the 1913 flood under present-day conditions would result in a diversion of St. Marys River flows of only 3300 cfs to the Wabash River Basin by way of Junk Ditch. According to the report, obstructions in the floodway of the Junk Ditch have reduced the diversion capacity.

Because of the lack of reliable hydrologic and hydraulic models to analyze the nature and extent of the overflow from the Basin during the 100-year event, it is not possible to accurately predict the impact of the proposed increase in the diversion capacity. However, if the proposed increase is to be about 1700 cfs as the COE's report seems to suggest, this will constitute at least a 50% increase over the present-day Basin overflow. Such an increase may not be absorbed by the Little River as it exists today. Although the proposed Little River Wetlands project, with its eventual goal of reclaiming up to 10 square miles of land, will have a slight positive effect in the reduction of peak discharges in both the Little River and Junk Ditch, its effectiveness in absorbing the proposed additional diversion is very limited. The increased flood flows to the Wabash River Basin, which has its own flooding problems, will not be institutionally acceptable and will also violate this study's technical criteria which calls for no increased stages elsewhere as a result of a project.

Furthermore, the reduction of the 100-year flood stages in other study reaches as a result of only 1700 cfs of increased diversion is not expected to be significant. Many of the study reaches with high damage potential are located in areas which will be virtually unaffected by such a diversion rendering the project also economically unsound.

Based on the level of information available at this time, further study and consideration of this plan is not recommended. However, it is important to note that the existing waterway acts as a natural spillway for the St. Marys River. To avoid future increases in the potential flood damages in Fort Wayne and vicinity, every effort should be made to keep this natural spillway open and avoid further encroachments in the Junk Ditch floodplain.

l. RESTORATION OF TRIER DITCH BYPASS CAPACITY

Candidate Plan Component “l” calls for the construction of a Trier Ditch cut-off that would carry 20 percent of the 100-year flood peak discharge of the St. Marys River.

This plan provides for the restoration of the diversion capacity of the Paul Trier and Trier Ditches for a 100-year flood, to the estimated 1913 conditions. According to a 1974 study by the COE, approximately 3000 cfs (about 20% of the St. Marys River 100-year flood) spilled over from the St. Marys River into the Maumee River along the Trier Ditch spillway during the 1913 flood. The report also stated that a recurrence of the 1913 flood under present-day conditions would result in a diversion of St. Marys River flows of only 1500 cfs to the Maumee River by way of Trier Ditch. According to the report, obstructions in the floodway of Trier Ditch have reduced the diversion capacity. A recent analysis by SEG Consultants, performed for the MRBC, indicates that in the existing condition of the waterway, only about 1300 cfs would be diverted during a 100-year event in the St. Marys River.

The restoration of the diversion capacity represents a significant increase in the present-day estimated 100-year flood flows in the Paul Trier and Trier ditches during the 100-year flood. Therefore, it is expected that the project extent and the expenses associated with a project to accomplish the needed increase in the diversion capacity would be similar to the 40% Trier cut-off (Candidate Plan “h”), except for slightly lower channel excavation costs.

Since the effectiveness of this plan in reducing the flood stages in the Fort Wayne area will be significantly less than the 40% cut-off version, it is concluded that the 20% plan is technically and economically inferior to the larger scale 40% diversion plan. Further study and consideration of this plan is, therefore, not recommended. However, it is important to note that the existing waterway acts as a natural spillway for the St. Marys Rive. To avoid future increases in the potential flood damages in Fort Wayne and vicinity, every effort should be made to keep this natural spillway open and avoid further encroachments in the Trier Ditch and Paul Trier Ditch floodplains.

m. RIVER RESTORATION OF SELECTED STREAMS

Candidate Plan Component "m" calls for the river restoration (large-scale clearing and snagging) of selected streams in the Basin to reduce agricultural flood damages resulting from a 5-year flood.

In order to evaluate the effectiveness of such river restoration projects in significantly reducing the existing agricultural flood damages in the Basin, a hydraulic study was performed for the entire length (approximately 20 river miles) of the St. Marys River in Adams County, as a pilot project. This study reach was chosen because a recent hydraulic model prepared by SEG Consultants for the MRBC was readily available and also because the MRBC had already developed and submitted to the IDNR in June of 1993, a report documenting the location as well as means of removing various obstructions from the St. Marys River channel throughout the Adams County.

The current hydraulic models (HEC-2 files) for the entire St. Marys River, as well as the magnitude of 5-year discharges at different locations on the river was obtained from SEG Consultants. Upon detailed evaluation of these models, it became clear that the models in their original form were not appropriate for evaluating a river restoration project. For evaluating the effects of river restoration projects, accurate presentation and distribution of channel and overbanks roughness coefficients (Manning "n" values) are of primary importance.

Complete detail or explanation of the calibration of the models were not available. However, it appears that the calibration of the model to historical high water marks, from the Adams-Allen County Line upstream to north of Decatur, had been achieved by increasing the "n" values of the channel overbanks to a value of about 0.10 (usually, indicative of a severely obstructed overbank area) while the channel "n" values were generally kept at a value of about 0.031 (usually, indicative of a regular and clean channel). Upstream reach (south of Decatur) "n" values were also assumed to be about 0.1 in the overbanks and 0.035 in the channel.

This representation and distribution of "n" values has, according to the SEG report (dated November, 1994), resulted in an acceptable match of the calculated water surface elevations when compared to the observed flood stages and is therefore comparable to the expected flood elevations appropriate for the Flood Insurance Study purposes. However, the distribution of "n" values do not appear to be indicative of the current maintenance and land use conditions of the channel and the overbanks. Considering that most of the model within Adams County was calibrated to the July 1992 high water marks, the resultant elevations should fairly representative of the effects of logjams and other obstructions in the stream. However, for the model to be useful in evaluating channel modifications that affect the roughness coefficient in the channel area, it is essential that the "n" values correspond, as closely as possible, to the current maintenance and land use conditions of the channel and its overbanks.

In order to prepare the model to simulate the effect of the proposed channel clearing and snagging project, the channel and overbank"n" values were modified to reflect, to the extent possible, the current conditions of the channel and overbanks while keeping the 5-year flood elevations resulting from the original calibrated model essentially the same.

A review of the available floodplain mapping and available information on the land use of the overbank areas seems to indicate that, for each cross section, at least one of the overbanks (usually the right overbank) is often an open area with cultivated, mature row or field crops land use. Therefore, the first change to the 5-year flood model included lowering the right overbank "n" values from 0.1 to 0.06, when appropriate. The second change to the 5-year flood model consisted of increasing the channel "n" value at the identified location of existing major logjams in the channel (7 locations) by 0.01 to 0.02 and adjusting some other cross sections' "n" values by 0.005 to 0.01 to reflect more minor logjams or felled trees. These adjustments resulted in 5-year flood elevations which were essentially the same as those calculated through the original model. However, the adjusted model was judged to correspond more closely to the current conditions and locations of various channel obstructions.

The adjusted 5-year flood HEC-2 model was then used as a base model for evaluating the effects of two scenarios of activities affecting the channel. According to the first scenario, only the seven (7) major logjams, identified in the MRBC's 1993 study, were assumed to be removed from the channel. This condition was simulated by reducuing the channel "n" values by 0.01, only at the locations of the logjams noted above. This scenario attempted to quantify the hydraulic effects of type of activities that were recommended as a Master Plan Component earlier in this report (Recommended Plan Component "c"). The second scenario attempted to quantify the hydraulic effects of a large-scale river restoration project, as earlier proposed by the MRBC in their June 1993 study. This condition was simulated by reducing the channel "n" values by 0.01 at the locations of major logjams and by 0.005 in the rest of the reach.

Table 24 summarizes the results of the hydraulic analyses noted above as well as typical 5-year flood depths for the overbank areas, for a few representative locations of the St. Marys River in Adams County. As illustrated in the table, the proposed large-scale river restoration project in Adams County would reduce the expected 5-year flood stages between 0.1 feet to 0.4 feet north of Decatur and by about 0.5 feet from the north side of Decatur to the Indiana/Ohio State Line. Removing only the major logjams (seven locations) from the stream, will result in similar stage reductions north of Decatur and between about 0.1 feet to 0.2 feet of stage reduction from the north side of Decatur to the Indiana/Ohio State Line.

Comparing these estimated flood stage reductions to the approximate 5-year flood depths for the overbank areas (provided in the last column of Table 24) seem to indicate that the overall effect of these channel clearing activities on reducing the existing flood damages would be minimal. The percentage of reduction in the 5-year flood depths are between 5% and 15%. The amount of reduction would not be enough to significantly reduce the flooded acreage along the river.

TABLE 24

SUMMARY OF RESULTS FOR THE ST. MARYS RIVER RESTORATION/MAINTENANCE ACTIVITIES

APPROXIMATE LOCATION	RIVER MILE (DISTANCE ABOVE MOUTH)	5-YEAR FLOOD STAGE REDUCTION (FEET)		APPROXIMATE 5-YEAR FLOOD DEPTH FOR THE OVERBANK AREAS (FEET)
		SCENARIO 1	SCENARIO 2	
Allen/Adams County Line	19.41	-0.1	-0.1	2.0
0.35 Miles d/s of C.R. 36 1/2 West Bridge	21.90	-0.2	-0.2	4.0
1.8 Miles d/s of C.R. 4 South Bridge	23.40	-0.4	-0.4	3.5
North of Washington St. in Decatur	30.00	-0.1	-0.5	4.0
South side of Decatur at its Corporate Limits	32.35	-0.1	-0.5	3.5
1.7 Miles d/s of S.R. 101 Bridge	35.60	-0.2	-0.5	6.0
0.45 Miles d/s of Indiana/Ohio State Line	39.70	-0.2	-0.5	5.0

Based on the above analyses, the following conclusions may be made:

1. Although the river restoration activities similar to those proposed by MRBC in 1993, may have limited benefits in improving drainage from agricultural lands and in improving some recreational opportunities (canoeing) in the Basin's streams, they do not appear to eliminate or significantly reduce the present level of agricultural damages expected to occur as a result of a 5-year flood in the Basin.

2. The limited-scope, case-by-case, maintenance activities such as those proposed earlier in this report (recommended Plan Component "c") seem to offer comparable flood stage reductions without the cost and environmental concerns associated with the large-scale river restoration activities. As indicated earlier in this report, annual maintenance activities are effective in preventing future increases in the flood damage potentials in the Basin.

3. The most effective way to eliminate or significantly reduce the present level of agricultural flood damages in the Basin is to carry on the measures recommended earlier as the Plan Component “f”.

Implementation of large-scale river restoration activities do not appear to achieve the objectives set forth by the Maumee River Basin Commission stated in the beginning of this report and therefore are not recommended to be pursued further as part of this Master Plan.

PLAN COMPONENTS SELECTION

The following two tables summarize the results of the detailed screening of the considered candidate plans described in the previous sections. For each alternative, the plan description, positive features, and negative features are summarized along with an indication as to whether or not the plan is being recommended as a Master Plan component. Table 25 compares those candidate plans whose primary focus are on preventing further increase in the potential damages in the Basin rather than reducing the existing level of potential damages. Table 26 compares those candidate plans whose primary focus are to reduce or eliminate the present level of potential damages in the Basin.

TABLE 25

COMPARISON OF CANDIDATE PLANS DESIGNED TO PREVENT FURTHER INCREASE IN THE POTENTIAL DAMAGES
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

PLAN I.D.	PLAN DESCRIPTION	POSITIVE FEATURES	NEGATIVE FEATURES	RECOMMENDED ?
a	Adoption of uniform floodplain, stormwater, and erosion control ordinances by all the communities and counties in the Basin.	• Prevents further increase in the potential damages; • Provides uniform approach to control of floodplain development; • Insures eligibility for the National Flood Insurance Program; • Cost is relatively small; • Can be implemented immediately.	• Does not reduce the existing damage potentials; • Permitting process adds to bureaucracy and incurs costs; • Requires adoption by all Basin's communities and counties; • Its effectiveness depends on proper enforcement.	YES
b	Preservation, restoration, and enhancement of wetlands in the Basin when effective towards the overall master plan flood control objectives; where possible with willing land owners and cooperation of local drainage boards.	• Provides additional flood storage; • Reduces land area subject to flood damages; • Improves water quality; • Provides fish and wildlife habitat; • Provides aesthetic benefits; • Has the potential to be supported and funded by several entities.	• Removes land from productive use; • Requires cooperation of landowners and local drainage boards; • Implementation could take years; • Requires significant cooperation between several entities; • Relatively expensive.	YES
c	Implementation of an ongoing stream maintenance and debris removal (e.g., logjams, felled trees, trash, etc.) program for the affected streams in the Basin.	• Removes obstructions to flow that increase flood elevations and damage; • Improves outdoor recreation possibilities (canoeing) and aesthetics; • Prevents the need for extensive river restoration work.	• Does not reduce the existing damage potentials; • Requires, sometimes hard to get, access easements unless done by land owners themselves.	YES
d	Implementation of an ongoing public education/awareness program as well as consideration of improved flood warning systems for outlying communities such as Auburn and Decatur, etc..	• Keeps public informed of ongoing activities and requirements; • Enlists public's support and cooperation; • Improved flood warning can reduce the existing damage potentials; • Relatively inexpensive.	• Implementation adds to "bureaucracy"; • Flood warning system could induce unwarranted sense of security in public exposed to flooding threat.	YES

TABLE 26

COMPARISON OF CANDIDATE PLANS DESIGNED TO MITIGATE THE PRESENT LEVEL OF THE POTENTIAL DAMAGES
MAUMEE RIVER BASIN FLOOD CONTROL MASTER PLAN

PLAN I.D.	PLAN DESCRIPTION	POSITIVE FEATURES	NEGATIVE FEATURES	RECOMMENDED ?
e	Reach by reach evaluation and selection of a combination of non-structural (buyouts & floodproofing) and limited promising structural solutions (if any) in the damage reaches identified in the "Maumee River Basin Damage Inventory Report".	• Most effective course of action is selected for each reach; • Variation in approach adds to diversity; • No negative environmental impact; • Benefits are realized even with small amount of funding each year; • Funding can be incremental and shared by different entities; • Promotes effective floodplain management.	• Mixed strategies may be confusing to general public; • Design and engineering efforts generally greater than required for a single uniform strategy; • Floodproofing does not reduce the street flooding; • Buyout would relocate families.	YES
f	Support, promotion, and funding of land acquisition, flowage easements, land set-aside programs, alternative flood-tolerant crops and land use in the flood prone agricultural properties for erosion control and flood damage mitigation purposes.	• Eliminates damages incurred by the farmer; • Alternative land uses will have multi-purpose benefits; • Reduces soil erosion; • Creation of "Woodland Mitigation Banking" is a proactive approach in reducing future environmental damages.	• Land owners may be reluctant to participate; • Land acquisition costs could be substantial; • Implementation could take years; • Removes land from productive use.	YES
g	Removal of the unapproved Yost Levee or construction of a bypass channel through the area downstream of Decatur on the St. Marys River (for reducing flood stages at Decatur).	• Structure was never formally approved by State; • Removal may seem to public to be a desirable activity.	• Has very little impact on the 100-year flood stages at Decatur; • Potential benefits do not appear to justify the time and expenses involved; • Facility's owner may be reluctant to give up business.	NO

h	Construction of a Trier Ditch cut-off that would carry 40 percent of the 100-year flood peak discharge of the St. Marys River with no further channel modifications (for reducing flood stages in Fort Wayne and vicinity).	• Significantly reduces flood flows and the 100-year flood stages in Fort Wayne damage area; • Will minimize buyout and floodproofing efforts in many of Fort Wayne and vicinity damage areas.	• The estimated 75 million dollars costs is unlikely to be funded in the near future; • Has negative environmental impacts; • Project is opposed by communities along Trier Ditch and New Haven area; • Does not eliminate all the flooding damages in several damage reaches; • Costs as much as three (3) times as the recommended plan "e".	NO
i	Construction of a major retention/ detention basin on Cedar Creek in DeKalb County .	• Significantly reduces flood damages in Waterloo and Auburn; • Could provide recreational benefits.	• Damage reduction does not justify the large expenses of the project; • May have negative environmental impacts; • Unlikely to be funded and time to realize project may be excessive.	NO
j	Construction of a major retention/ detention basin on the St. Marys River upstream of Decatur (for reduction of flood stages in Decatur and Fort Wayne as well as for reduction of downstream agricultural damages).	• Effectively reduces some agricultural damage and most property damages in Decatur; • Reduces flood flows and 100-year flood stages in Fort Wayne and vicinity.	• Very expensive and unlikely to be funded in the near future; • Displaces large area of agricultural land; • Has negative impacts on environment and flooding upstream, some in Ohio; • Does not eliminate all the flooding damages in several damage reaches.	NO
k	Restoration of Junk Ditch bypass capacity by constructing a cut-off that would carry 30% of the 100-year flood peak discharge of the St. Mary's River to the Wabash River Basin.	• Reduces flood flows downstream of the diversion point.	• Damage in several study reaches remain unchanged; • Diverted flows may exacerbate flooding in Little River and Wabash River Basin.	NO
l	Restoration of Trier Ditch bypass capacity by constructing a cut-off that would carry 20 percent of the 100-year flood peak discharge of the St. Marys River to Maumee R.	• Reduces flood flows in St. Marys River.	• Ineffective in reducing downstream flood stages significantly; • Generally inferior to the 40 percent diversion plan (plan "h").	NO

m	River restoration of selected streams in the Basin to alleviate the agricultural damages resulting from a 5-year flood.	• Removes obstructions to flow that increase flood elevations and damages; • Improves outdoor recreation possibilities (canoeing) and aesthetics; • May reduce the duration of inundation and thus help the field drainage.	• Does not significantly reduce the existing damage potentials; • Requires permanent access easements; • Potentially involves long and drawn out permitting process due to environmental concerns; • Potential benefits do not appear to justify the time and expenses involved; • Project does not appear to compete, in terms of effectiveness, with the recommended Plan Component "f".	NO

FUNDING CONSIDERATIONS

It is not the intention of this report to discuss or develop the funding sources and arrangements for the proposed Master Plan projects. The specific recommendations related to the funding of the proposed plan will be the subject of a separate study. This funding related study has been separately contracted by the MRBC to another consultant. The following paragraphs point out some general observations in regards to some funding considerations as they relate to the projects being suggested in this Master Plan report.

Based on earlier discussions in this report, the most effective component of the Maumee River Basin Flood Control Master Plan for reduction of damages in the Basin's urban areas is considered to be Plan "e". As indicated earlier, the plan mainly consists of voluntary buyouts and floodproofing of residential and non-residential structures within the 100-year floodplain of the studied streams. The total capital cost of the plan is estimated to be about thirty (30) million dollars for the entire Basin. Because of the nature of the plan several cost-share funding arrangements are possible.

The most effective Master Plan component for reduction of flood damages in the Basin's agricultural areas is considered to be Plan "f" which consists mainly of selective and voluntary land acquisition, flowage easements, and participation in the land set-aside programs. Because of the lack of reliable data, no cost estimates were developed for this plan. However, noting the extent of the acreage involved, it is expected that his plan could also cost as much as plan "e". The implementation of the plan component "f" may be implemented in phases to initially address the farmlands being flooded by a 5-year flood, thereby reducing the more frequent flooding damages with limited funds.

It is important to not that the implementation of these plans would be undertaken over a several-year time frame, perhaps a 10 – 20 year horizon, so not all the anticipated expenses need to be funded now or at one time. Also, due to the nature of projects being recommended in this plan, a variety of funding and cost-sharing arrangements are possible. Therefore, as opposed to large scale structural solutions, the entire estimated cost of the mainly non-structural plans proposed in this report does not have to be borne by only one or two entities or in a relatively short amount of time.

One way to reduce the direct cost of the community is to coordinate with another agency's program. For example, the buyouts and floodproofing as well as one of the two structural solutions suggested in this report may be funded by the Department of Housing and Urban Development's Community Development Block Grant (CDBG) as several of the affected neighborhoods are occupied by low or moderate income families. Also, the Federal Emergency Management Agency (FEMA) may fund the buyout of properties meeting certain criteria. Some of these funds may become available only after the property is actually flooded. These and other "life estate" type of arrangements should be further investigated during the course of the Funding Study.

In order to more efficiently use the community's financial resources and also give the property owner a stake in the project, the floodproofing expenses should also be shared by the property owners. Available information on similar projects in the nation indicates that the owner cost-shares have typically been in the range of 10% to 50%

Several funding sources are also available for buying flowage easements, land acquisition, or land set-aside of agricultural lands in the floodplain areas. These include various Federal and state agencies' programs as well as programs that are available through several private foundations and conservation groups, or grant programs such as the North American Waterfowl Management Plan.

Another funding tool worthy of being considered and investigated further in the planned Master Plan Funding Study, is the concept of "Wetland or Woodland Mitigation Banking". If proper guidelines are developed that would insure that the program is not abused, establishment of such banks may also provide for a proactive approach to protect existing floodplain storage and prevent potential rezoning and development of prime woodlands in the area.

SUMMARY AND CONCLUSIONS

Based on the most recent U.S. Army Corps of Engineers' (Corps') studies and the Basin's Damage Inventory Report, prepared as part of this Master Plan study by CBBEL, there are currently about 4,900 structures subject to damage in the 100-year floodplain of the studied streams in the Basin's damage areas. The majority of these structures, about 3,190, will be protected by the COE's Fort Wayne diking project which covers ten (10) of the 82 damage reaches identified in the Basin. In addition, it is estimated that approximately 32,000 acres of agricultural land in the entire Basin are subject to 100-year flood damages. The objective of this study was to identify and recommend the most appropriate and effective plan to control/mitigate the 100-year flood damages to the remaining 1,711 structures as well as to the flooded agricultural lands throughout the Basin.

An array of suggestions and possible solutions, ranging from total evacuation of all floodplain areas to the total protection of these areas by flood control levees and floodwalls, was identified through a review of previous Basin flood studies, information gathered at public meetings held in the early project stages, and review of similar studies in other basins by CBBEL. These alternatives were evaluated against the study criteria and constraints. Based on this preliminary screening process, a short list of promising solutions was complied. The thirteen (13) short-listed solutions (Candidate Plan Components) were subjected to a more detailed evaluation for hydraulic effectiveness, economic advantage, social and institutional impacts, and environmental feasibility.

Based on the detailed screening of the candidate plans, six (6) are recommended to be adopted as Master Plan components (plan components "a" through "e"). Of these six (6) recommended plan components, the following three (3) recommended plans seem to offer the most significant and immediate impact on reducing the existing and future potential flood damages in the Basin:

- Adoption of uniform floodplain, storm drainage, and erosion control ordinances by all the communities and counties in the Basin (plan component "a");

- Voluntary structure buyouts and floodproofing in forty four (44) study reaches and levee/floodwall protection of two (2) other study reaches (plan component "e"); and

- Support, promotion, and funding of land acquisition, flowage easements, land set-aside programs, alternative flood-tolerant crops, and conversion to an alternative land use (woodland, wetland, or a park corridor) in the flood prone agricultural properties for erosion control and flood damage mitigation purposes (plan component "f").

The total capital cost required to address the structural property damages in the entire Basin is about 30.7 million dollars, of which about 26.5 million dollars is estimated to be required for the mitigation of residual damages in the Fort Wayne and its vicinity. Of the total 1,711 structures remaining subject to 100-year flood damages in the Basin (after the Fort Wayne diking project is built), 278 are recommended to be bought out. Approximately 1,101 structures are recommended to be floodproofed and 179 others are recommended to be protected by construction of levees and floodwalls along small portions of the St. Marys River and Junk Ditch in Fort Wayne. 153 other structures, located in two (2) Fort Wayne damage reaches, are being independently addressed by the City of Fort Wayne.

It is important to note that the implementation of these plans would be undertaken over a several-year time frame, perhaps a 10 – 20 year horizon, so not all of the anticipated expenses need to be funded now or at one time. Also, due to the nature of projects being recommended in this plan, a variety of funding and cost-sharing arrangements are possible. Therefore, as opposed to large scale structural solutions, the entire estimated cost of the mainly non-structural plans proposed in this report does not have to be borne by only one or two entities or in a relatively short amount of time.

Further studies are needed to identify possible sources of funding appropriate for each of the recommended plan components and develop appropriate cost-sharing arrangements.

Also needed, are additional detailed hydrologic and hydraulic investigations in several areas in the Basin, in particular, the Fairfield Ditch and Junk Ditch systems. Of the 278 residential structures being recommended to be eligible for buyout, approximately 100 are included because they are indicated, by the latest FEMA maps, to be in the floodway of Fairfield Ditch. According to the IDNR, the accuracy of the existing floodway determinations in the Fairfield Ditch area appears to be questionable. A new study and consequent potential map revisions may reduce the number of residential structures subject to buyout and offer significant savings.

For the study reaches where property acquisitions have been recommended, further information, such as property parcel data and mapping, need to be developed and/or evaluated. Such information can help identify additional properties which may also be acquired so that a contiguous riparian corridor (open space / greenway area) may be established.

As in most planning processes, flood control master planning is a dynamic process. Successful implementation of any plan is contingent upon its accuracy and validity at the time of implementation. The Maumee River Basin Flood Control Master Plan (including the recommended implementation plan which will be presented in the next section of the report) needs to be continually updated to reflect the changed circumstances occasioned by additional data, new regulations, funding considerations, new policy directions, and experience gained in the initial stages of plan implementation.

IMPLEMENTATION PLAN

The projects recommended in this report are proposed to be implemented as follows:

1. **Public Education/Awareness Programs:**

    - Develop and implement a strong public awareness program to educate community officials about Master Plan components and model ordinance requirements. This will facilitate the implementation of the Master Plan and acceptance of the proposed ordinances.

2. **Adoption of Model Ordinances for Flood Hazard Areas, Storm Drainage, and Erosion Control:**

    - Finalize (customize) the two draft model ordinances and send the finalized flood hazard areas ordinance to IDNR for approval (each community and each county). The IDNR will review and approve the flood hazard areas ordinance on behalf of FEMA. Approval will be subject to adoption by the communities or counties.

    - It is recommended that all the counties and communities within the Maumee River Basin adopt their ordinances by a mutually agreeable date. This will ensure the uniformity of the ordinance implementation.

    - It is further recommended that any future disbursement of funding and assistance to the counties and communities be made contingent upon the community's adoption of the uniform ordinances.

3. **Additional Mapping, Data Collection, and Studies:**

    - Initiate a study to identify possible sources of funding appropriate for each of the recommended plan components and develop appropriate cost-sharing arrangements.

    - Initiate a detailed hydrologic and hydraulic investigation of Fairfield Ditch and Junk Ditch and proceed with the floodplain Boundary and Floodway Map revisions as needed.

    - Delineate, based on the most recent hydraulic models, the 5-year floodplain limits on the best available mapping in the agricultural areas.

    - Initiate the project development phase of each recommended plan component and collect and develop additional data and mapping required for implementation of recommended plan components as needed.

4. **Improvement of Flood Warning Systems:**

- Evaluate the adequacy of the existing early warning systems in Fort Wayne and the outlying communities and upgrade the systems as needed.

5. **Annual Stream Clean-up and Maintenance Programs:**

- Initiate the project development phase of this plan component, contacting the appropriate permitting agencies and developing acceptable guidelines on performing limited annual maintenance and stream clean-up programs (including the removal of existing and future logjams) either by the county drainage boards or by the landowners themselves.

- Develop priorities based on the need, severity of logjam or obstruction, easement requirements and availability, and required permits.

- Disburse funds according to the guidelines.

6. **Floodproofing Assistance:**

- Develop priorities based on the need, severity of flooding, condition of structure, and geographical area.

- Develop a floodproofing cost-share assistance program, using the MRBC's 1991 draft program as a starting point.

- Contact all involved municipalities and property owners and provide technical guidance and financial assistance as funds become available.

7. **Buyouts (Voluntary):**

- Develop priorities based on the need, severity of flooding, condition of structure, geographical area, etc.

- Develop a buyout program that describe the policies, process, and the desired post-buyout land uses.

- Contact all involved municipalities and property owners.

- Proceed with property purchases based upon funding availability, establishment of ownership and maintenance responsibilities, and voluntary sale by property owner.

8. **Levee/Floodwall Protection for the Fort Wayne Study Reach "E1JD" (east bank of the Junk Ditch from the west of Edgerton Street to the south of Jefferson Boulevard):**

    - Upon availability of funds, contact the City of Fort Wayne and affected property owners.

    - Develop preliminary design and obtain preliminary approvals from the appropriate permitting agencies.

    - Prepare final design plans and specifications. Obtain necessary permits.

    - Obtain assistance from the City of Fort Wayne to gain the necessary land rights and easements.

    - Construct improvements.

9. **Levee/Floodwall Protection for the Fort Wayne Study Reach "W6SM" (west bank of the St. Marys River from the north of Taylor Street to the south of Hale Avenue):**

    - Upon availability of funds, contact the City of Fort Wayne and affected property owners

    - Develop preliminary design and obtain preliminary approvals from the appropriate permitting agencies.

    - Prepare final design plans and specifications. Obtain necessary permits.

    - Obtain assistance from the City of Fort Wayne to gain the necessary land rights and easements

    - Construct Improvements.

10. **Flowage Easements, Conversion of Land Use, and Land Set-aside Programs for Agricultural Lands (Voluntary):**

    - Initiate a study to identify more accurately the Basin's agricultural areas subject to 5-year and 100-year flood damages, collect more detailed information on them, and recommend the appropriate course of action in each case.

    - Contact all involved government jurisdictions and interested parties to develop an overall "woodland/wetland/park corridor" plan for each county.

- Develop priorities based on need, severity of flooding, and magnitude of damages.

- Contact all involved parties and proceed with implementing the recommended measures based upon funding availability and voluntary easement, sale, or donation by property owner.

11. **Land Acquisition in Urban Areas (Voluntary):**

    - Contact all involved government jurisdictions and interested parties to develop an overall "greenway" plan to complement the buyout plan in each study reach.

    - Contact all involved municipalities and property owners.

    - Proceed with property purchases based upon funding availability, establishment of ownership and maintenance responsibilities, and voluntary sale by property owner.

12. **Wetland Preservation, Restoration, and Enhancement (Voluntary):**

    - Coordinate with the IDNR and other appropriate agencies and conservation groups to establish priorities.

    - Explore the possibility of reaching agreements between Federal, State, and local government agencies to allow the concept of wetland or woodland mitigation banking based on sound and acceptable guidelines to insure that program will not be abused. If agreement is reached for such a wetland/woodland acquisition funding program, proceed with developing acceptable guidelines for the program.

    - Proceed with property acquisition upon funding availability, establishment of ownership, and maintenance responsibilities, and voluntary sale or donation by property owners.

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41. MRBC’s files on its proposed 1991 Floodproofing Cost-Share Assistance Program obtained in March, 1994.

42. “Retrofitting Flood-Prone Residential Structures, Design Manual”, FEMA 114, dated September 1986.

43. “Maumee River Basin Hydraulic Report, Phase ll, St. Marys River, Yellow Creek and Blue Creek in Allen and Adams Counties, Indiana”, prepared by SEG, Inc., November 20, 1994.

44. “River Restoration of St. Marys River in Adams County”, letter of request from Tim Ehlerding, MRBC Executive Director, to the IDNR-Division of Water, dated June 1993.

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