Jordan Creek FRM Study–Springfield, MO

Report Synopsis –May 22, 2013
Prepared by the Little Rock District Corps of Engineer

1 STAGE OF PLANNING PROCESS

This is a feasibility study. It is a one of five national pilot studies and has completed Decision Point One – Federal Interest determination, Decision Point Two - Agency agreement on the Tentatively Selected Plan and is preparing for Decision Point Three– Civil Works Review Board. The Recommended Plan is the National Economic Development (NED) Plan.

2 STUDY AUTHORITY

This report was prepared as an interim response to the White River Basin, Arkansas and Missouri Comprehensive Study Resolution passed on 11 May 1962 by the US Senate Committee on Public Works.

The resolution states the following:

> *Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 12, 1902, be and is hereby, requested to review the reports on the White River and Tributaries, Missouri and Arkansas, printed in House Document Numbered 499, Eighty-third Congress, second session, and other reports, with a view to determining the advisability of modifying the existing project at the present time, with particular reference to developing a comprehensive plan of improvement for the basin in the interest of flood-control, navigation, hydro-electric power development, water supply, and other purposes, coordinated with related land resources.*

The Conference Report recommendation accompanying the Energy and Water Development Appropriations Act, 2002, Public Law 107-66, 12 November 2001, included $100,000 for a General Investigation for Watershed Restoration in Springfield, Missouri.

In response to the study authority, the Section 905(b) analysis was initiated 18 March 2002 with a meeting between the City of Springfield officials and the Little Rock District. A Reconnaissance Report, completed on 31 October 2002, recommended a feasibility study.

The approved Reconnaissance Report indicates a Federal interest in both Flood Risk Management and Ecosystem Restoration. However, upon further analysis, it was determined that any ecosystem restoration benefits would be ancillary to the flood risk management benefits due to the objectives of the local sponsor. This report does not recommend a standalone ecosystem restoration project. Also,

the Federal Water Project Recreation Act of 1965 (Public Law 89-72), as amended, requires an agency to fully consider recreational features that may be associated with Federal flood risk management projects. Recreation was examined in the planning process, but recreational features were not justified so they were not included in the plans.

2.1 LOCATION OF THE STUDY AREA/ CONGRESSIONAL DISTRICT

The study area is located within the White River Basin, extending approximately six miles along Jordan Creek. Jordan Creek, including North Branch and South Branch Jordan Creek, has a 13.75 square mile drainage basin. The project area is generally centered on the Chestnut Expressway between US Highway 65 to the east and US Highway 160 to the west in the northern half of the City of Springfield, Missouri. The study area (shown in Figure 1-1 - Study Location Map) includes Jordan Creek, North Branch Jordan Creek, South Branch Jordan Creek and the upstream portion of Wilsons Creek. Wilsons Creek is a tributary of the James River, which eventually flows into White River. Springfield is located in Missouri's 7th Congressional District

Figure 1 - Study Location Map

3 SPONSOR

The sponsor is the City of Springfield, MO. They signed a feasibility cost share agreement in 2004 and have contributed to development of the H&H analysis as part of their work-in-kind.

4 PROBLEMS AND OPPORTUNITIES

Urbanization and high peak flows cause flooding along the Jordan Creek Corridor in Springfield, MO. Opportunities exists to reduce flood damages, reduce safety risks to motorists and pedestrians during floods with little or no warning and address some ecosystem degradation factors, such as storm water runoff in the Jordan Creek riparian corridor.

Jordan Creek is an urban stream that is prone to flash flooding. The time to peak flood heights for a critical 1-hour storm is 30 minutes. This means, that almost simultaneously, the water is rising in the urban areas as the rain is falling. The flooding events are quick and unpredictable, preventing the City from constructing a flood warning system. The water backs up along the creek and spreads throughout the floodplain rapidly. During large flood events, the City has to block busy thoroughfares inhibiting the delivery of police, fire and street department resources to occupants. An opportunity exists to implement a flood risk management system that uses both structural and nonstructural measures.

Over the last decade, Springfield has had a flood that causes significant damage to its downtown and its infrastructure every few years. From the existing conditions modeling, it is estimated that the flows through downtown are between five and six feet deep with a velocity of about six feet per second. At this velocity, it takes less than 14-inches of water to push a full size truck off the road. There exists an opportunity to reduce damage to the existing buildings and contents as well as damage to infrastructure within the floodplain.

Another problem, directly related to channel design, is the ecological condition of Jordan Creek. There is little instream habitat in Jordan Creek because a majority of the creek is a concrete-lined channel. An opportunity exists to remove concrete in the channel and reduce total flow for frequent storm events. Removing concrete in the channel increases residence time, allows contact of storm water with sunlight and vegetation and allows the natural stream processes to improve water quality and aquatic habitat.

5 Planning Goal and Objectives

5.1 Goal

The goal of this project is reduce the flood risk along Jordan Creek in Springfield Missouri.

5.2 Objectives

The water and related land resource problems and opportunities identified in this study are stated as specific planning objectives to provide focus for the formulation of alternatives and development of criteria. These planning objectives reflect the problems and opportunities and represent desired positive changes in the without project conditions. The base year, the year the project is assumed to be fully operations, is 2020, and the period of analysis is through the year 2070. The planning objectives are specified as follows:

- Reduce overall flood damages in the project area from 2020 to 2070.

- Reduce residual risk to property by removing properties from the flood plain in the project area from 2020 to 2070.
- Reduce risk to transportation and life, health, and safety by reducing flood levels in the project area from 2020 to 2070.

To evaluate these objectives, detailed hydrology and hydraulics will be required. A Hydrologic Engineering Center – Flood Damage Assessment (HEC-FDA) model will be used to determine the property damages per flood event. Residual flooding will be determined by evaluating the hydrology and hydraulics.

6 Planning Constraints

Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. The planning constraints identified in this study are as follows:

- Avoid potential contamination sites
- Minimize structure and infrastructure relocations.
- Avoid interruption to railroad service.
- Avoid adverse impacts to historic properties.

7 Alternatives Considered

A wide variety of management measures were developed that would address one or more of the planning objectives. These measures were then evaluated and screened. Alternative plans were then developed which comprised one or more of the management measures.

7.1 Management Measures Analysis

Management Measures were screened on Flood Risk Reduction Effectiveness, Development Cost, Positive Environmental Impacts, and Acceptability. See Table 1: Management Measures for a list of the screened measures.

Table 1: Management Measures

Measures removed From Consideration	Measures Retained
Elevate Structures	Channel
Flood Warning/ Flood Forecasting	Detention Basins
Levees	Buy-Outs
Flood Proofing	Diversions
	Relocate buildings
	Flood Walls

From the management measure analysis, it was determined channel modifications and detention basins will make up the bulk of the alternatives.

The channel alignment generally followed the existing alignment. There is a short area through downtown where the channel is realigned due to infrastructure and real estate constraints.

7.2 Preliminary Array of Alternative Plans

The preliminary array of plans was formulated using a combination of measures. Four different iterations of formulation occurred before selection of the final plans for analysis.

Iteration 1: For the first iteration of formulation, the following alternative plans were considered.

- No Federal Project (No Action Plan)
- Detention Basins Only
- Nonstructural (Buyouts) – Consisted of buying out structures that sustained high damage and removed them from the floodplain.
- Detention Basins and Buyouts
- Detention Basins and Channels (Plan A) – Provided property protection against the 1/100 ACE storm.

Plan A and the Detention Basins Only plan were complete, economically efficient plans. A HEC-FDA model and a preliminary cost estimate were created for Plan A. Analysis of Plan A determined which measures to eliminate based on economic efficiency.

Iteration 2: The purpose of Iteration 2 was to determine an efficient scale for a plan. Plan B protected structures to approximately the 1/100 ACE. Three more scales of Plan B were created to examine how different sizes of channels and bridges affected the efficiency. A HEC-FDA model and an MII cost estimate were created to compare the plans.

- Plan B – Similar to plan A, but with modifications to increase efficiency, including removing two railroad bridges, one vehicle bridge, channel work and bridge replacements through a park and reducing the amount of underground box culvert through the downtown area.
- Plan C – Based on the Plan B analysis but offered protection against the 1/50 ACE storm. This plan included detention basins and smaller channels than Plan B.
- Plan D – Based on the Plan B analysis but offered protection against the 1/500 ACE storm. This plan included detention basins and larger channels than Plan B.
- Plan E – Based on the Plan B analysis but offered protection against the 1/25 ACE storm. This plan included detention basins and the smallest channels of all the plans.

Iteration 3: To create additional high-performance plans, a reach-by-reach analysis was completed with the varying levels of protection. A HEC-FDA model and an MII cost estimate were created to compare the plans. Plans F and G were created by combining the reaches from Plans B-through-E to optimize for both performance and efficiency. The remaining risk to people, roads and structures, incidental flooding, resiliency and the frequency of high damages for any given event were considered. Those plans are listed below:

- Plan F – Offers protection against property damage for a 1/500 ACE in Reach E1 and a 1/100 ACE in Reaches E3 and E6. This plan contains detention basins and channel improvements.
- Plan G – Offers protection against property damage for a 1/500 ACE in Reach E1 and a 1/25 ACE in Reaches E3 and E6. This plan contains detention basins and channel improvements.

Iteration 4: One last iteration of analysis occurred on Plan G. Plans G2 through J are variations of plan G. The analysis in Iteration 4 created a better understanding of how the different components in plan G performed. A HEC-FDA model and an MII cost estimate were generated to compare the plans.

- Plan G2 – Offers protection against property damage for a 1/500 ACE in Reach E1 and a 1/25 ACE in Reaches E3 and E6. This plan contains detention basins and channel improvements. Unlike Plan G, this plan does not contain the Main Street or Boonville Street Bridge.
- Plan H – Similar to Plan G, but it does not contain the Phelp's Street culvert, which is costly.
- Plan I – Similar to Plan G, but it does not contain the detention basins.
- Plan J – Contains only the detention basins and the 1/500 ACE protection for Reach E1.

8 Plan Comparison

Table 2: Matrix of How the Plans Meet the Objectives shows how Plan F and Plan G meet the original planning objectives. The plans are compared against one another for their ability to fulfill the objectives of the project. A thorough discussion of each objective is below.

Reduce Overall Flood Damages in the Project Area - Plan J reduced 65 percent of the average annual damages, and plan G2 reduced 89 percent of the average annual damages. Plan J more efficiently reduced damages than Plan G2, because Plan J reduced the high-frequency damages at a third of the cost of Plan G2. Detention basins only provided a 15 percent reduction in average annual damages, much lower than either Plan J or Plan G2.

Reduce Residual Risk to Properties by Removing Properties from the Floodplain - Removing properties from the floodplain reduced risk to the people who, during flood events, transverse the floodplain to other destinations. While 50 percent (81) of the buildings were removed from the 1 percent ACE floodplain in Plan G2, only 25 percent (41) of the buildings were removed with the Plan J. With the Detention Basin Only Plan, 10 percent of the properties were removed, which was dramatically less than Plan J or Plan G2.

Table 2: Matrix of How the Plans Meet the Objectives

Objective	No Action Plan	Plan J	Plan G2	Detention Basins Only Plan
Reduce overall flood damages in the project area from 2020 to 2070.	Increased flooding over time. $4.6 million in EAD.	Reduced 65 percent of the damages, but started to incur significant damages at 1/5 ACE. $1.9 million in EAD.	Reduced 89 percent of the damages, but still incurred considerable damages before 1/25 ACE. $900,000 in EAD.	Reduced 15 percent of the damages. Not effective. $3.9 million in EAD.
Reduce residual risk to property by removing properties from the floodplain.	Increased risk over time. Flooded 162 buildings at 1/100 ACE.	Removed 25 percent (41 buildings) from 1/100 ACE. Better than detention alone, but not as good as Plan G2.	Removed 50 percent (81 buildings) from 1/100 ACE floodplain.	Removed 10 percent (16 buildings). Did not meet this objective.
Reduce risk to transportation and life, health and safety by reducing flood levels.	Began inundating city streets at 1/2 ACE. Incurred downstream damages at 1/10 ACE.	Began inundating city streets at 1/5 ACE. Virtually eliminated Reach E1 damages.	Began inundating city streets at 1/25 ACE. Virtually eliminated Reach E1 damages.	Began inundating city streets at 1/5 ACE. Incurred Reach E1 damages at 1/10 ACE.

Reduced Risk to Transportation and Life, Health and Safety - The channel plans were designed to protect building contents from specific flood events while allowing roadways and parking lots to flood. Road inundation increases the probability of loss of life. Residual flooding was significantly less with Plan G2 than with Plans J and the Detention Basin Only. Using the hydrology from 2003, at the 1/100 ACE, there was 2- to 3- foot drop from Plan J to Plan G2 in the downtown area, but at the 1/10 ACE, it could be anywhere from 3 to 6 feet. There was a large reduction at the 1/10 ACE because most of the water was carried by the channel. With Plan G2 there was no flooding of the streets until about the 1/25 ACE, but with Plan J, there was flooding at about the 1/2 ACE. Plan J and the detention basins performed similarly through the downtown area. Plan J and Plan G2 performed the same in the lower reaches of the watershed and far outperformed the Detention Basins Only Plan.

The Detention Basins Only Plan did not sufficiently remove risk; therefore, it was removed from consideration.

8.1 Economic Viability of the Plans

The costs and benefits within the Federal interest of the plans are presented in Table 3: Costs of Plans G2 and J. The total project costs were significantly lower with Plan J. Plan J, would deliver two-and-a-half dollars of return for every dollar spent. The addition of channelization through downtown (the difference between Plans J and G2) would yield a 60-cent return for every dollar spent. Building the channels through the downtown did not make economic sense.

The net benefits for Plan J far exceeded those of Plan G2 because the channels through the downtown area were not incrementally justified. The net benefits for Plan G2 were $921,000. The net benefits for Plan J were $1,856,000 per year. Plan J provided almost $1 million net benefits a year more than Plan G2.

Table 3: Costs of Plans G2 and J

	Plan G2	Plan J
Fully Funded Total Project Cost	$ 55,717,000*	$ 21,873,000*
Annual OMRR&R Costs	$ 927,000	$ 234,000
Annualized Cost	$ 3,231,000	$ 1,173,000
Annualized Benefits	$ 4,153,000	$ 3,029,000
BC Calculation	1.3	2.6
Net Benefits	$ 921,000	$ 1,856,000

*** Investment cost was used for the economic analysis as shown in Table 4.**

9 PROJECT IMPACTS

The biological environment of the Jordan Creek area is not conducive to performing the usual habitat evaluations such as USFWS Habitat Evaluation Procedures (HEP) due to the poor quality of existing habitat, as well as the lack of opportunity for any environmental restoration since any such actions would be detrimental to the flood risk reduction nature of this particular project. A modified Missouri and Arkansas Charleston Method, used and approved for Corps Regulatory wetland and stream corridor impact assessment, was also evaluated by the environmental team as a method to determine the amount of impacts that would occur to the streams from channel alterations and wetland impacts that would occur during detention basin construction and use. Since there was no dredge and fill material associated with the proposed project, the vertical team questioned the applicability of this method of impacts determination for this project. Due to the highly developed, urban environment of the project footprint, and the fact that channel construction activity has been confined to the highly industrialized lower reach, the resulting environmental impacts are minimal. No compensatory mitigation being required.

Within the one economic reach affected by construction there are four HTRW sites with suspected or documented environmental issues. In April 2012 Seagull Environmental Technologies provided a range

of cost estimates for cleanup of these sites. Low range cost of cleanup was $62,500 and the high range was $340,000. Not all properties may be in the actual construction footprint, so actual costs may be substantially lower. The city is working with the Missouri Department of Natural Resources with on the HTRW issues and is required to provide a clean corridor for channel construction.

There are no known cultural resource sites in the lower reach in the proposed channel construction footprint. A project concurrence letter was received on 7 February 2013.

Construction of the proposed five detention basins, totaling approximately 36 surface acres, has the greatest environmental benefits. The proposed basins could provide ground water recharge.

10 PLAN SELECTION

10.1 Rationale for Designation of the NED Plan

Federal policy requires that the feasibility study must identify the plan that reasonably maximizes net national economic development (NED) benefits consistent with protecting the environment. That plan, the "NED plan," must be recommended for implementation unless there are overriding reasons for recommending another plan.

The NED plan was determined by looking at the Net Economic Benefits for each separable reach. The NED plan is Plan J.

10.2 Rationale for Recommended Plan

The recommended plan is the NED plan because it provides the greatest net benefits. Plan J leaves considerably more residual risk in the floodplain than Plan G2; however, the additional increment of work in reaches 3 and 6 has negative net benefits.

10.3 Description of the Recommended Plan

In Plan J, channel improvements only occur in Reach E1 and were designed to keep structural damage from a 1/500 ACE to a minimum. On Wilsons Creek, approximately 2,100 feet of channel widening will occur. Modification to Scenic Bridge will likely be required because of channel excavation beneath the bridge. The modification may include installing reinforcement of the piers and a mat foundation. Because the railroad bridge over Wilsons Creek at the southeast corner of the ball fields causes a restriction to stream flow, it will be replaced. No recreational improvements are planned along with the channel modification because of the real estate restrictions on either side of the creek.

A flood diversion structure will be constructed adjacent the Archimica plant to prevent water from flowing over a low point on Bennett street into the manufacturing facility. The flood diversion structure completes the Archimica plants floodwall and protects it from flood damage. Channel work will end approximately 350 feet north of the Bennett Street Bridge.

Reach E1 contains three HTRW areas, two of which are City-owned sites of former municipal landfills. The sponsor is responsible for cleaning the site to a level suitable for channel widening.

Five regional detention basins are included in the NED plan. Those basins are B6, B7, B9B, B11 and B11C.

Due to the highly developed, urban environment of the project footprint, and the fact that channel construction activity will be confined to the highly industrialized lower reach, the resulting environmental impacts are minimal. No compensatory mitigation is required.

11 PEER REVIEW

District Quality Control (DQC) is a continual process. Products were DQC'd when a critical point was reached. Four Agency Technical Reviews (ATR) were conducted. Continual Quality Assurance (QA) is provided by Southwestern Division. Most comments from the previous reviews have been resolved or have a path toward resolution.

The ATR, Independent External Peer Review (IEPR), Office of Water Project Review (OWPR) and Public review were held concurrently in February. No significant comments were provided by OWPR. One significant comment was provided by the ATR, and it was resolved. Three significant comments were given by the IEPR team. All of the comments were concurred with and resolved.

12 PROJECT COSTS AND TIMELINE

12.1 Costs and Benefits

The annualized costs, annualized benefits, net economic benefits and the benefit-to-cost ratios are shown in Table 4. These values are based on October 2012 price levels, an interest rate of 3.75 percent, a 50-year period of analysis, and a 3-year construction period.

During the formulation of an alternative, USACE computes benefits within the project area to compare the plans to one another. However, benefits may accrue upstream of the project area's limit of Federal interest. The NED benefits that accrue upstream of the limit of Federal interest in this project were calculated, included in the final analysis and reported in Table 4. Those benefits include flood damage reduction benefits accrued by the neighborhoods immediately downstream of the detention basins, which are located upstream of the limit of Federal interest. Some of these houses receive damages at the 1/1 ACE.

Table 4: Economic Analysis for Plan J

Item	Benefits within the Federal Interest	Benefits Including Upstream of the Limit of Federal Interest
Interest Rate,%	3.750%	3.750%
Interest Rate, Monthly	0.307%	0.307%
Construction Period, Years	3.0	3.0
Period of Analysis, Years	50	50
Project First Cost	$20,479,000	$20,479,000
Interest During Construction	$1,142,000	$1,142,000
Investment Cost	$21,621,000	$21,621,000
Annual Cost		
Amortized Cost	$939,000	$939,000
OMRR&R	$234,000	$234,000
Total Annual Cost	$1,173,000	$1,173,000
Annual Benefits		
Structures, Contents, Other	$2,968,000	$3,065,000
Infrastructure	61,000	69,000
Total Annual Benefits	$3,029,000	$3,134,000
Benefit-to-Cost Ratio	2.6	2.7
Net Benefits	$1,856,000	$1,961,000

Plan J, as the Recommended plan and NED plan, has an investment cost of $21,621,000; an annual cost of $1,173,000 (including operations, maintenance, repair, rehabilitation and replacement costs of $234,000 per year); annual benefits of $3,029,000; net benefits of $1,856,000; and a benefit-to-cost ratio of 2.6 at an interest rate of 3.75 percent. Including NED benefits upstream of the limit of Federal interest, the net benefits are $1,961,000 with a benefit-to-cost ratio of 2.7.

The fully funded total project cost is estimated to be $21,873,000 with a sponsor contribution of $7,656,000 and a federal contribution of $14,217,000. The estimated cost of Lands, Easements, Rights-of-way, Relocations and Disposal areas (LERRD) is $6,470,000. The sponsor's required cash contribution is $1,094,000, and the sponsors total cash contribution is estimated to be $1,186,000. The sponsor is responsible for 100 percent of the OMRR&R costs.

12.1.1 Sensitivity of the Recommended to the Future Conditions

The benefits are based on assumptions about the future; however, there is a possibility that the future conditions may never occur. There is a large increase in the estimated damage from the existing conditions to the future without project conditions. Sensitivity analysis, conducted on the NED plan, shows it is not sensitive to the future without project conditions assumptions. The NED plan is justified in the existing conditions.

12.2 Timeline

Assuming full funding, the project will be fully constructed in the year 2020 as displayed in Table 5: Project Schedule

Table 5: Project Schedule

Task	Date
Release Draft Report	January 31, 2013
Concurrent Reviews	February 1 – March 1, 2013
Decision Point 3 (Civil Works Review Board)	May 2013
Decision Point 4 (Chief's Report)	August 2013
Water Resources Development Act	2014
Planning, Engineering and Design	2014-2015
Construction	2016-2020