

**Report Summary**  
Kansas Citys, Missouri and Kansas, Flood Risk Management Project  
Final Feasibility Report

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**STUDY INFORMATION**

**Study Authority:** Section 216 of the 1970 Flood Control Act provides continuing authority to reexamine completed civil works and determine whether the projects are providing benefits as intended. Section 216 reads as follows:

*The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects, the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying structures or their operation, and for improving the quality of the environment in the overall public interest.*

**Study Sponsor:** The non-Federal sponsors are the Kaw Valley Drainage District of Wyandotte County, Kansas (Armourdale Unit and Central Industrial District Unit – Kansas Section) and the City of Kansas City, Missouri (Central Industrial District Unit – Missouri Section).

**Study Purpose and Scope:** The purpose of this study is to reexamine the existing Kansas Citys, Missouri and Kansas, Flood Risk Management Project and recommend any advisable modifications or improvements. The Kansas Citys Project provides local flood risk management for the metropolitan areas of Kansas City, Missouri, and Kansas City, Kansas. The Kansas Citys Project is a unit of the Missouri River basin comprehensive plan authorized and modified by the 1936, 1944, 1946, and 1954 Flood Control Acts. The last major modification, which raised some of the levee units comprising the Kansas Citys Project, was authorized in 1962.

In order to reexamine the existing Kansas Citys Project in an efficient and orderly manner within available funding, the study team, in coordination with the project sponsor and the vertical review team, made the decision in 2006 to separate the study into Phase 1 and Phase 2 efforts. Phase 1 and Phase 2 are complementary efforts that together form one complete Kansas Citys Project system. At the time the phasing decision was made, hydrology and hydraulics modeling and analysis was complete for the entire system. However, structural and geotechnical analysis

and calculations were not complete for all units. Recommendations for those units with completed structural and geotechnical analyses were included in Phase 1, which was the subject of the Interim Feasibility Report.<sup>1</sup> An Environmental Impact Statement (EIS) was also prepared and published in 2006 that addressed conditions and potential impacts of the proposed projects in all seven units of the system. Those units for which the level of detail desired was not yet fully developed, or significant uncertainties remained, were included in Phase 2 of the study for further evaluation. This Final Feasibility Report (Final Report) documents the findings of Phase 2 of the analysis and addresses the two remaining units: the Armourdale and Central Industrial District (CID) Units.

This Final Report:

- Considers the study area as a whole and thereby provide a uniform level of protection, as directed by guidance<sup>2</sup>;
- Verifies the current performance of the existing system;
- Identifies measures for the Armourdale and CID units to reduce the risk of flooding;
- Evaluates alternatives to increase the overall reliability of the existing system and reduce flood risk and damages over the 50 year period of analysis; and
- Recommends improvements to increase the project performance and reduce the risk of flooding risk to local communities.

**Project Location/Congressional District:** The Kansas Citys project is authorized as a system of seven levee units. The project extends over the lowest 10 miles of the Kansas River (at its confluence with the Missouri River) and over a 20 mile reach of the Missouri River from 6.5 miles upstream to 12.5 miles downstream of the mouth of the Kansas River (Figure 1).

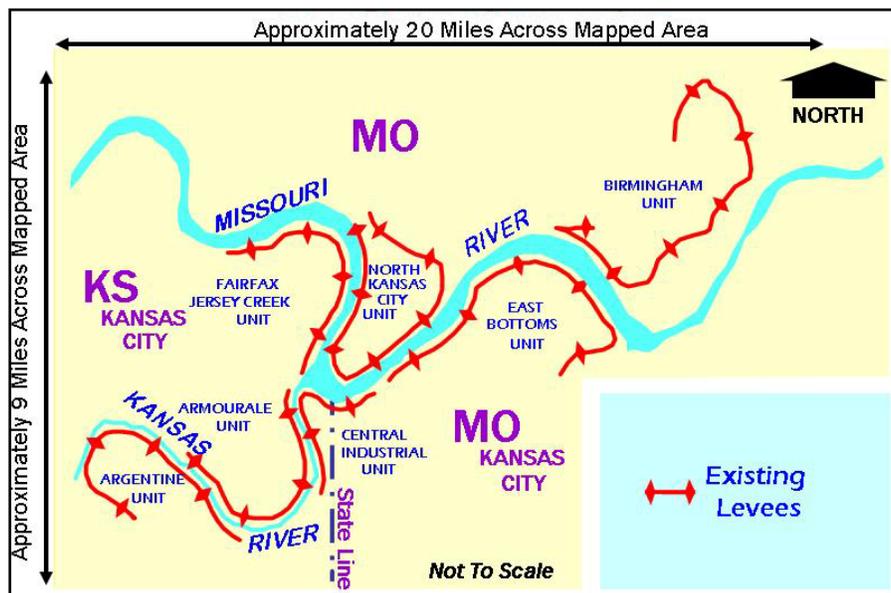


Figure 1: Simplified Kansas Citys System Map

<sup>1</sup> Argentine, North Kansas City, East Bottoms, Fairfax-Jersey Creek, and the Birmingham Units

<sup>2</sup> Memorandum from HQ USACE to Northwestern Division dated 26 July 2000 and Memorandum from Northwestern Division to Kansas City District dated 03 August 2000

These units act in concert to manage flood risks for an area of dense industrial and commercial development and minor areas of farmland, which all together cover about 32 square miles. Five of the seven units protect residential development. Communities within the study area include Kansas City, Missouri; North Kansas City, Missouri; Randolph, Missouri; Birmingham, Missouri; and Kansas City, Kansas. The system provides flood risk management for approximately 20,000 residents, 90,000 jobs, and \$22 billion in urban infrastructure.

Although the project is designed and functions as a coordinated system, its components are located on opposite banks of two major rivers within two states and various political jurisdictions. Thus, the seven levee units are operated and maintained independently by five non-federal sponsors. Within this Final Feasibility Report, the terms “study area” and “project area” refer only to the Armourdale and CID units, unless specifically noted otherwise. The Armourdale and CID units are within the Kansas Third Congressional District (Representative Kevin Yoder) and the CID Unit is also in the Missouri Fifth Congressional District (Representative Emanuel Cleaver II). The Kansas Senators are Jerry Moran and Pat Roberts; Missouri Senators are Claire McCaskill and Roy Blunt.

**Prior Reports and Existing Projects:** The existing Kansas Citys project was created and subsequently modified by the Flood Control Acts authorized in 1936, 1944, 1946, 1954, and 1962. Construction of the first Federal levees began around 1940 and included some incorporation of, and improvements to, previously existing local levees. The Argentine, Armourdale, CID, and Fairfax levees were overtopped and heavily damaged in the 1951 Kansas River Flood leading to the 1954 authorization of the Kansas River basin reservoir system.

The Kansas Citys system, especially along the Kansas River, was re-examined during the post-1951 period as the Kansas River basin reservoirs were being designed and constructed. Modification and raise of the Armourdale, Argentine, and CID Units was authorized by Public Law 87-874 on October 23, 1962 (the “1962 modification”). Construction of these modifications began in 1971. The existing protective works consist principally of levees, floodwalls, bridge and approach alterations, and some limited channel improvement and alteration. Complete effectiveness of the overall project is contingent on adequate reservoir control in the upper Missouri and Kansas River basins.

Multiple reports and studies have been prepared and published at various times including reservoir regulations, post-flood assessments, river hydrology updates, and flood plain hazard evaluations. Two reports, the 2006 Interim Feasibility Report and the EIS incorporate information from the multitude of prior reports and are both directly referenced in this Final Feasibility Report.

Review of Completed Project, Kansas Citys Levees, Missouri and Kansas, Interim Feasibility Report, USACE Kansas City District, August 2006

The Fairfax-Jersey Creek, North Kansas City, and East Bottoms Units on the Missouri River were determined to have adequate height to resist overtopping at the design flood level, but required significant underseepage and structural modifications to maintain acceptable overall

system reliability. Analysis of the Birmingham unit found no geotechnical or structural deficiencies, and no reliability improvements were proposed for this unit.

In addition to similar geotechnical and structural reliability concerns, the entire Kansas River portion of the system was determined to be of insufficient height to provide adequate overtopping protection. The Interim Feasibility Report recommended a raise of the Argentine Unit to a levee height approximately three feet above the 0.2%-chance (500 year) water surface profile. This level of flood risk management benefit is consistent with the Missouri River units, and meets economic project justification criteria.

The Armourdale and CID Units, the focus of this Final Feasibility Report, are located immediately downstream of the Argentine Unit. Consistent with establishing a uniform system level of flood risk management benefit, and to reduce the potential for induced damages between units within the system, it was determined that the development of alternatives for these two units would not consider measures or alternatives greater than the authorized plan for the upstream unit

Final Environmental Impact Statement, Kansas Citys, Missouri and Kansas Flood Damage Reduction Study, Missouri and Kansas Rivers, USACE Kansas City District and U. S. Environmental Protection Agency Region VII, August 2006

All seven levee units of the system were evaluated and addressed in the Final Environmental Impact Statement (FEIS). Tentative preferred alternatives were assessed in the FEIS for the CID and Armourdale Units, including earthen levee raises, floodwall raises, and underseepage improvements. The final preferred alternatives and environmental effects identified in the Final Feasibility Report are consistent with the tentative preferred alternatives and impacts assessed in the FEIS. Review of the study area and existing project has shown that no substantive changes in the environmental conditions have occurred since 2006.

Record of Decision, Review of Completed Project, Kansas Citys Levees, Missouri and Kansas, November 2007

Consistent with the recommendations of the Interim Feasibility Report, the Record of Decision (ROD) signed by the ASA(CW) in November 2007 addressed only those recommendations for the Fairfax-Jersey Creek, North Kansas City, East Bottoms, and Argentine Units. A separate ROD for the proposed recommendations of the Final Feasibility Report will be prepared for ASA(CW) review and approval.

**Flow Frequencies:** Following the flood of July 1993, the Corps of Engineers undertook a major reevaluation of the flow frequency of the upper Mississippi, Missouri and lower Illinois Rivers. The resulting Upper Mississippi River System Flow Frequency Study (UMRFFS) constituted an update of the previous flow frequency estimates then in use for these rivers. On the Missouri River, the previous flow estimates had been completed and published in 1962.

Because it was necessary to fully evaluate the operations of the Kansas River basin reservoir system as part of the UMRFFS study, updated flow information was also generated for the Kansas River. This information was then incorporated into an update of the flow frequency estimates for the Kansas River from its mouth to Manhattan, Kansas.

The revised flow frequency estimates resulting from the UMRFFS study were incorporated into this feasibility study.

**Federal Interest:** Based on historical records, the study area has a history of flooding that produces significant damage and loss of life. The federal interest is established by the beneficial contributions to national economic development associated with urban flood hazard reduction features identified in the analysis. It is within USACE and Federal interest to study the flood risk management issues within the Missouri and Kansas River Basins because there are significant flood damages that result in residential, commercial, and industrial property loss. Impacts from frequent flooding in the past include significant economic costs. Developing a project that will reduce the frequency of these damages and protect human life is within the Federal interest and a primary mission of USACE.

## STUDY OBJECTIVES

**Problems and Opportunities:** This feasibility study identified the following problems within the study area:

- The existing system provides less than the level of performance for which it was designed.
- Project failure due to overtopping, underseepage, or structural inadequacy, presents a significant life safety concern and will cause catastrophic damage to the urban development in the study area.
- The existing system includes components between forty and seventy years of age. While the system has been well maintained and is currently in good working condition, the state of the art of design, construction, and reliability analysis has changed significantly since the original construction. This concern will continue to grow as the system ages.

Probabilities of failure for the most critical features were combined in the economic analysis to determine an overall probability of failure for each unit at the existing condition, shown in Table 1. The current annual probability of failure risk is significantly high in both units: 3.5% annual chance (29-year return interval) for the Armourdale Unit and 0.33% annual chance (303-year return interval) for the CID Unit. The “Conditional Exceedance Probability – Overtop or Breach” represents the probability of levee unit failure from all possible failure modes (overtopping, geotechnical, and structural) while the “Conditional Exceedance Probability – Overtopping Only” represents that portion of the existing failure probability attributable to overtopping failure. Exceedance probabilities are presented for the 1.0% event (100-yr flood), which is the base flood for FEMA flood insurance certification, and the 0.2% event (500-yr flood), the desired level of reliable system performance.

The locations of existing geotechnical and structural features that do not meet the minimum required factor of safety, and their current probability of failure (PoF) with water at the top of the levee (TOL), are summarized in Table 2.

**Table 1: Engineering Performance (Existing Conditions)**

	Armourdale	CID
<b>Annual Exceedance Probability* (median)</b>	3.5%	0.33%
Return interval (years)	29	303
<b>Conditional Exceedance Probability** - Overtop or Breach</b>		
1.0% event	54.5%	11.3%
0.2% event	91.9%	66.6%
<b>Conditional Exceedance Probability - Overtopping Only</b>		
1.0% event	7.9%	6.6%
0.2% event	61.4%	58.8%

\*Annual exceedance probability is the chance of experiencing any flood event - of whatever magnitude - within any year.

\*\*Conditional exceedance probability is the probability that specified flood event would overtop or breach the levee.

**Table 2 Summary of Existing Conditions in Areas of Concern**

<b>ARMOURDALE UNIT</b>				
LOCATION	DESCRIPTION	FS NOT MET	PoF	CONSEQUENCE
Sta. 185+70	5th Street Pump Station	Uplift	100%	Unit will flood
Sta. 129+20	12st Street Pump Station	Uplift/Strength	100%	Uplift: Unit will flood
Sta. 156+75	Mill Street Pump Station	Uplift/Strength	100%	Strength: Post-flood repair
Sta. 222+00	Slope Stability Critical Location	Slope Stability	24%	Unit will flood
Sta. 276+00	Underseepage Critical Location	Underseepage	8%	Unit will flood
<b>CENTRAL INDUSTRIAL DISTRICT UNIT - KANSAS SECTION</b>				
LOCATION	DESCRIPTION	FS NOT MET	PoF	CONSEQUENCE
Sta. 83+52	Ohio Street Pump Station	Strength	100%	Post-flood repair
Sta. 132+20	Closure Structure	Strength	99%	Unit will flood
Sta. 166+31	Closure Structure	Stability	20%	Unit will flood
Sta. 104+51	Closure Structure	Stability	6%	Unit will flood
Sta. 85+00	Underseepage Critical Location	Underseepage	4.5%	Unit will flood
<b>CENTRAL INDUSTRIAL DISTRICT UNIT - MISSOURI SECTION</b>				
LOCATION	DESCRIPTION	FS NOT MET	PoF	CONSEQUENCE
Sta. 19+39 to 22+31	Floodwall	Sliding Stability	100%	Unit will flood
Sta. 63+15	Closure Structure	Foundation Stability	64%	Unit will flood
Sta. 0+00 to 3+49	Floodwall	Strength	14%	Unit will flood

If all geotechnical and structural failure risks listed in Table 2 were addressed, a significant overtopping risk would still remain for the target 0.2% chance flood event. These findings for overtopping risk in the lower Kansas River show that these units do not reliably achieve the authorized 390,000 cfs conveyance target. Similar information was presented in the Interim Feasibility Report on the Argentine Unit. This indicates the need for a general increase in the existing overtopping protection along the lower Kansas River.

Following the problem definition, the following opportunities were identified in the study area:

- Verify current performance of the existing system versus the original design intent and project authorizations.
- Apply current understanding of large river dynamics and design criteria to assess the reliability of the existing system.

- Identify and present recommendations for designing and implementing viable measures to reduce the risk of flooding and improve the overall safety and performance of the system.

**Planning Objectives:** In addition to the Federal objective of contributing to National Economic Development, other project specific planning objectives have been identified, which guided the plan formulation process in this analysis.

- Verify current performance of the existing system:
  - Gather all available data and historical observations, develop updated engineering analysis, and combine with the economic existing conditions to establish a complete Risk & Uncertainty approach to estimating existing conditions flood performance, reliability, and potential consequences of failure. Compare this analysis to the authorized design and intent of the existing system. Achievement of this objective will increase the knowledge and understanding of current system reliability and performance and allow the identification of areas of concern needing to be addressed by alternative measures.
- Identify and present recommendations for reducing the risk of flooding:
  - Identify measures to address the identified reliability and performance inadequacies in the existing system, including hydrologic, geotechnical, and structural concerns; and
  - Develop and evaluate alternatives and recommend a plan to increase the overall reliability of the existing system and reduce flood risk and damages over the 50 year period of analysis.
- Consider the study area as a whole and thereby provide a uniform level of protection, as directed by guidance.

**Planning Constraints:** Measures or alternatives which increase the performance and reliability of any portion of the system should remain consistent with a uniform level of performance throughout the seven-unit system. This essentially means that the study avoids recommending:

- Any measures or plans which would directly or indirectly exacerbate any performance weaknesses (or relative weaknesses) within the system, including any measure or plan that would allow one or more units of the system to provide higher or lower risk management or reliability than the rest of the overall system, and
- Any measures or plans that would contribute to increasing the level of performance of strong components of the system without a commensurate strengthening of weaker components

Very early in the plan formulation process, a general guiding rule was adopted: any measures which negatively impacted the established floodway conveyance should be avoided. This was deemed essential as in most cases levees lie along both banks of the river reaches within the study area, and are often located either upstream or downstream of another unit.

## ALTERNATIVES CONSIDERED

**Plan Formulation Rationale:** Plan formulation has been conducted for this study with a focus on achieving the Federal objective of water and related land resources project planning, which is to contribute to NED consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Plan formulation also considers all effects, beneficial or adverse, to each of the four evaluation accounts identified in the Principles and Guidelines (1983), which are National Economic Development, Environmental Quality, Regional Economic Development, and Other Social Effects.

The federal objective in formulating alternative plans is based largely on contributions to NED, or increases in the net value of the national output of goods and services expressed in monetary units. Contributions to NED are the direct net economic benefits that accrue in the planning area and in the rest of the Nation. NED benefits for flood hazard reduction accrue through the reduction in actual or potential damages associated with land use in the study area.

**Management Measures and Alternative Plans.** This study identified and evaluated alternatives for applicability to each feature of the existing unit and their ability to meet the project objectives. Potential improvements evaluated in this study include: the No Federal Action Plan; non-structural alternatives; and structural alternatives, such as modifications to structural features (pump stations, gatewells, closures, floodwalls, underseepage control systems etc.) and unit raises.

In accordance with current policy it is necessary to fully evaluate the No Federal Action alternative for purposes of comparison to other alternative and future with-project conditions. This measure does not address any of the project's objectives. Evaluation of the No Federal Action plan is closely related to the future without-project condition scenario and requires the projection of what course of action local entities may take given the lack of Federal involvement.

Non-structural plans for flood risk management often include such items as relocation or flood-proofing of affected structures, and reliance upon flood fighting techniques. The dense urban development in the study precludes cost effective consideration of large scale relocations or structure removals. The nature of flooding expected from a unit breach, with resulting flood depths greater than 14 feet, would overwhelm the typical methods for flood-proofing of structures. The need for additional large-scale risk reduction within the study area, especially from system overtopping, far exceeds the normal performance parameters of typical nonstructural measures, including flood fighting. For these reasons, non-structural methods were eliminated from further consideration as potential stand-alone solutions. It may be effective on a limited scale for the project sponsors to implement non-structural measures for protection of critical infrastructure, and these efforts may be pursued separately by the local interests. Floodplain management planning and development controls through ordinances and building codes are recommended to be implemented and maintained by the local governments.

A no-raise structural alternative, addressing only engineering reliability concerns, would result in unacceptable residual remaining risk and is not consistent with the uniform system approach, and was eliminated from further consideration.

The management measures for structural and geotechnical components were evaluated for their feasibility and effectiveness under the hydraulic conditions expected at the 500+3 raise. The alternative plans combining the most effective measures were retained for further cost-estimating and economic analysis.

**Final Array of Alternatives CID Unit:** Six alternative plans for improvements to the CID Unit were retained for the final evaluation. Each plan includes the same raises of the earthen levee and floodwall sections, the same area fill locations, and the same pump station modifications and abandonments as necessary to address the desired future levee height. The differences among the plans are primarily related to a new tieback measure proposing a realignment of a portion of the unit; whether or not this measure is included, where the tieback connection is located along the existing alignment, the effect of the new tieback on the proposed relief well system, and what alignment the tieback is constructed on between the existing unit and the bluff. The six alternatives are described briefly as follows:

- #1 Unit stops at Sta 130+00 and turns to bluff (adds 4 stop log gaps and 15 new relief wells)
- #2 Unit continues to Sta 166+80 (adds 83 relief wells/new pump plant/1 stop log gap)
- #3 Unit stops at Sta 138+95 and turns to bluff (adds 2 stop log gaps and 30 new relief wells)
- #4 Unit stops at Sta 130+00 and turns to bluff (adds 4 stop log gaps/new smaller pump plant)
- #5 Unit continues to Sta 166+80 (adds 83 relief wells/new pump plant/1 stop log gap/header pipe)
- #6 Unit stops at Sta 138+95 and turns to bluff (adds 2 stop log gaps and 30 new relief wells with a new pump plant)

The six plans in the final array for the CID Unit focus on whether or not to modify and raise the existing floodwall upstream of station 130+00, or to shorten the unit by constructing a new tieback to the bluff along the eastern edge of the study area. At the time the alternatives were first developed and screened it was unknown if a new pump station would be needed in order to prevent interior flooding damages as a result of the relief well flows.

**Comparison of Alternatives CID Unit:** Following the initial plan evaluation and cost estimates, further analysis was conducted to determine the technical necessity of a new pump station to handle relief well flows. A review of the existing interior storm drainage system showed that if all proposed new relief wells were installed as surface discharging, there was adequate capacity to carry the expected flows to existing sewer outlets and pumping facilities. Removing the new pump station from the proposed alternative plans eliminates Alternatives Four, Five, and Six from consideration (they are now identical to Alternatives One, Two, and Three, respectively). Furthermore, with no pump station the estimated cost of Alternative Two is reduced.

**Table 3: CID-KS Screening Cost Estimates**

<b>Alternative Plan</b>	<b>Preliminary Cost without new Pump Station (\$M)</b>
#1	\$ 98,624
#2	\$ 121,100
#3	\$ 89,918

Note: October 2008 Prices

In December of 2010, an investigation was conducted of the existing condition of the timber pile floodwall foundations to address existing condition uncertainties. In each reach of existing floodwall, an excavation was made on the landside of the wall to expose the existing timber foundation for inspection and analysis. The results of the inspection and analysis indicated that the existing foundations were in good condition. This led to a revised assumption by the study team concerning the ability of the existing foundations to provide support for floodwall modifications. The previous assumption had been that the foundations would not be able to provide support for modifications and that the existing walls would need complete replacement.

The change from floodwall replacement to modification decreased the cost of all three remaining alternatives, but did not alter their relative ranking. Alternative Three is still the lowest cost alternative plan, thereby maximizing the net economic benefits. Alternative Three was retained as the Recommended Plan for the Central Industrial District Unit.

**Final Array of Alternatives Armourdale Unit:**

In most of the reaches of the Armourdale Unit, initial evaluations resulted in only one alternative plan being identified as technically feasible and effective to implement a levee raise and address the respective impacts to appurtenant structural and geotechnical features. These individual reach measures are thus common to all final alternative plans for the overall unit. Similarly, structural and hydraulic pump station modifications are necessary to address existing conditions and the new unit height and are common to the final array of plans.

The final evaluation of alternatives focused only on those unit reaches where more than one feasible alternative was identified and carried forward. In five separate reaches of the unit, multiple raise alternatives were identified as feasible. These reaches and their alternatives are shown in Table 4.

**Table 4: Armourdale Reaches for Further Evaluation**

Start Station	End Station	Remaining Alternatives
10+00UE	16+48UE	1. Landside levee raise. 2. Riverside levee raise. <b>3. Replace levee with floodwall.</b>
77+80	81+00	1. Landside levee raise 2. T-wall on levee. <b>3. Replace levee with floodwall.</b>
95+00	105+00	1. Landside levee raise. <b>2. T-Wall on levee</b>
120+00		1. Landside levee raise <b>2. Landside levee rise with retaining wall</b>
230+00		1. Landside levee raise <b>2. T-Wall on levee</b>
240+00	257+66	1. Landside levee raise. 2. T-Wall on Levee. <b>3. Replace levee sections with floodwall.</b>
42+50LE	61+00LE	1. Landside levee raise. <b>2. New sandbag gap closure at Sta. 42+50LE.</b>

Note: **Bold font** indicates selected alternative.

In the majority of these remaining reaches, the remaining technically feasible alternatives create access limitations and real estate related conflicts that could require potentially costly relocations. Experience on similar projects in the Kansas City area, and other locations, has shown that real estate access and relocations involving railroads are both very costly and time consuming. This is an important consideration in the final alternative evaluation and selection. Following is a brief discussion of the alternatives in each reach.

Sta. 10+00UE to 16+48UE. A landside levee raise would require relocation of railroad tracks and a riverside levee raise would require modification of two large outfall structures. Replacement of the existing levee with a floodwall eliminates all real estate conflicts. Alternative Three is recommended.

Sta. 77+80 to 81+00. A landside levee raise would require relocation of railroad tracks. A T-wall on the levee limits top of levee road accessibility to this area of the unit. The access cannot be rerouted to the landside due to the railroad tracks. Replacement of the levee with a new floodwall eliminates the real estate conflicts and maintains access. Alternative Three is recommended.

Sta. 95+00 to 105+00. A landside levee raise would encroach upon an area needed for access to an adjacent business. A T-Wall on top of the levee limits top of levee road access, but access could be rerouted on the landside in the same area as the business access. Alternative Two is recommended.

Sta. 240+00 to 257+66. This reach contains two existing levee sections separated by an existing floodwall section. The floodwall has already been identified for replacement as its foundation

cannot support modification for a raise. A landside raise of the levee sections would encroach upon areas used by adjacent businesses for storage and access. A T-Wall on top of the levee would limit top of levee access. Landside access in this reach is already difficult due to the operations of multiple adjacent businesses and the Kansas Ave. bridge approach. Replacement of the levee sections with new floodwall eliminates the real estate conflicts, creates additional area for landside access, and provides for a uniform raise measure for the entire reach. Alternative Three is recommended.

Sta. 42+50LE to 61+00LE. Even though a landside levee raise would be a very short increase in height, access and implementation of the project would conflict with the adjacent railroad track. A new sandbag gap closure at Sta. 42+50 eliminates this minor unit modification and potentially costly real estate conflict. Alternative Two is recommended.

**Comparison of Alternatives Armourdale Unit:** The evaluation of the technical alternatives in each discrete reach of the Armourdale Unit resulted in determining one preferred feasible method of achieving the levee height increase and addressing associated structural and geotechnical impacts for that reach. The combination of alternatives in each reach results in one complete alternative plan for the Armourdale Unit consistent with the desired system uniform performance. Thus, there are no other plans for a cost screening evaluation. The remaining Alternative Plan is the Recommended Plan for the Armourdale Unit.

**Key Assumptions:** For the purposes of evaluating future flood risk management on the Kansas River, it is assumed that some future measures will be in place to address possible river bed degradation, currently under review in a separate study effort, and that the future water surface profile models used for establishing new levee heights will not be significantly impacted. The future findings and results of the degradation study will be monitored and incorporated into actual design of future levee modifications as needed. Any risks and costs associated with degradation study recommendations will be evaluated and addressed as part of that separate study effort.

Field investigation and structural analysis concluded that the existing timber piles of the Central Industrial District floodwall were still capable of providing support to a floodwall raise, thus eliminating the need to consider complete wall replacement, and reducing the number of additional piles needed.

**Designation of the Recommended Plan:** The maximum performance plan desired by the non-Federal sponsors is that plan which provides flood risk management benefits up to three feet above the 0.2% event (500-year flood) water surface profile, or the 500+3 plan. Targeting this level of performance is consistent with the system evaluation approach and the recommendations of the Interim Feasibility Report. Consistent with the Categorical Exemption to NED Plan allowed by ER 1105-2-100, the desired plan has been shown to have higher benefits than lower plans and the remaining residual risk is not unreasonably high. Evaluation of higher plans to identify the NED Plan was not conducted.

The determination that benefits of the 500+3 plan were higher than lower levee raise plans was first established in the 2006 economic screening. This calculation of economic benefits was

derived from overtopping failure impacts only. Geotechnical and structural failure modes identified and evaluated since that time increased the risks and impacts at lower flood elevations, thus increasing both the benefits and the project costs due to the measures required to address these additional concerns. This was recognized as a change in the future with-project conditions requiring a reevaluation of the Recommended Plan. A revised cost and economic evaluation was conducted in 2013 for the lower raise plans. Each individual unit and the combined system continued to show increasing net benefits at the 500+3 water surface profile raise alternative.

The major components of the Recommended Plan are summarized in Table 5.

**Table 5: Recommended Plan Components**

	CID	Armourdale	Total
<b><i>Overtopping/Structural Measures</i></b>			
Levee Raise (LF)	6,495	13,223	19,718
Floodwall Modification(LF)	4,649	4,208	8,857
Floodwall Replacement (LF)	152	2,105	2,257
New Floodwall (LF)	600	5,392	5,992
New T-Wall on Levee (LF)	-	7,715	7,715
<b><i>Closure Structure Measures</i></b>			
New Sandbag Closure	2	3	5
Convert Sandbag to Stop log	1	2	3
Replace Stop log Closure	1	2	3
New Stop log Closure	2	-	2
<b><i>Underseepage Control Measures</i></b>			
New Relief Wells	57	74	131
Area Fill (LF)	3,448	-	3,448
Slurry Cutoff Wall (LF)	-	2,000	2,000
<b><i>Drainage Control Measures</i></b>			
Pump Station Removal	2	2	4
Pump Station Modification	5	7	12

Screening level cost estimates and estimated construction periods for each of the alternatives were developed in accordance with standard Corps of Engineers estimating practice. Interest during construction (IDC) for each alternative was calculated based on the total first cost for each alternative, the starting and completion dates for each phase, assumed equal monthly expenditures during each phase, and the Federal interest rate of 3.5 percent. Appropriate funding was assumed available for each phase.

The total first cost for each alternative includes the estimated construction cost, cost for lands, easements and rights of way, preliminary engineering and design cost, supervision and administration cost, and contingencies. Interest during construction calculated for each alternative was then added to the total first cost to derive the economic cost of each alternative. The economic cost was then annualized for a 50-year period of analysis and a 3.5% interest rate. Other direct costs of project implementation (such as potential induced damages) were determined and included in the total annual project implementation cost (Table 6).

Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) costs were estimated for each alternative and are based on a life cycle cost analysis. The analyses include only the additional OMRR&R costs that the sponsors would be expected to incur based on the proposed unit modifications. Following are the major assumptions used in determining the additional OMRR&R costs that the local sponsors would incur with each alternative.

- New Relief Wells: Each new well is assumed to be maintained every 4 years at an estimated cost of \$5,000 per well. New wells are assumed to be replaced after 40 years at a cost equal to the current construction cost; the replacement cost includes 10% E&D and 7% S&A. The sponsor would continue to incur costs for any existing relief wells but these costs are ongoing for the existing project and are not included in the analysis of the proposed project.
- The levee units in the Kansas Citys project are well-maintained and the sponsors comply with annual inspection requirements. It is assumed that the sponsor's current OMRR&R costs for the existing project will continue.

**Table 6: Project Costs by Category**

Oct 2013 prices; 3.5% interest rate; 50 year period of analysis; \$1000s

	<b>Armourdale</b>	<b>CID</b>	<b>Total</b>
Construction	\$ 153,198.0	\$ 52,049.0	\$ 205,247.0
Lands and Damages (LERRD)	\$ 2,024.0	\$ 1,730.0	\$ 3,754.0
Planning, Engineering & Design (PED)	\$ 11,934.0	\$ 4,188.0	\$ 16,122.0
Construction Management (S&A)	\$ 10,724.0	\$ 3,643.0	\$ 14,367.0
Contingencies	\$ 54,769.0	\$ 19,142.0	\$ 73,911.0
<b>Total First Cost</b>	<b>\$ 232,650.0</b>	<b>\$ 80,752.0</b>	<b>\$ 313,402.0</b>
Interest During Construction (IDC)	\$ 52,388.5	\$ 18,488.5	\$ 70,877.0
OMRR&R	\$ 191.6	\$ 144.9	\$ 336.5
<b>Total Annual Costs</b>	<b>\$ 12,343.8</b>	<b>\$ 4,375.9</b>	<b>\$ 16,719.7</b>

Total first costs - PED + LERRD + construction + S&A

Annual costs = ((Total first costs + IDC) x I&A factor of 0.004457) + OMRR&R

Annual OMRR&R costs include only additional costs over and above existing costs

Economic analyses identified the expected economic impact of future flooding with the existing project. To aid in comparison of the alternatives, additional economic analysis was conducted to develop a risk-based evaluation in terms of benefits, costs, and performance of the alternatives under the future with-project condition. The analysis encompasses all flood-prone properties within the study area. The economic performance of the Recommended Plan is presented in Table 7.

Extensive economic surveys of the whole Kansas Citys Levees study area were completed in 2002. Economic data developed for this analysis includes values, elevations and depth-damage relationships for homes, businesses, public facilities, roads, and railroads in the study area. Furthermore, a follow up survey was conducted in early FY2012 to update the economic field data. Conditions are evaluated in terms of a base year of 2026 when the project would be operational and a future without-project conditions year of 2049. The same data set was used for both 2026 and 2049 conditions.

**Table 7: Economic Performance of the Recommended Plan**

Oct 2013 prices; 3.5% interest rate; 50 year period of analysis; \$1000s

Unit	Equivalent Annual Damages			Probability EAD Reduced		
	Without Plan	With Plan	Damage Reduced	0.75	0.50	0.25
Armourdale	\$55,392.04	\$3,935.00	\$51,457.05	\$36,287.34	\$49,899.39	\$63,998.28
CID	\$ 8,867.90	\$3,638.32	\$ 5,229.58	\$ 1,583.39	\$ 3,769.20	\$ 7,442.57
<b>Total</b>	<b>\$64,259.94</b>	<b>\$7,573.32</b>	<b>\$56,686.63</b>	<b>\$37,870.73</b>	<b>\$53,668.59</b>	<b>\$71,440.85</b>

It can be seen in Table 8 that in addition to the strong benefit-cost ratio for the Kansas River portion of the system-wide project, each unit is also individually justified. The combined Phase 2 portion of the total system has a benefit-cost ratio of 3.3, while Armourdale unit's benefit-cost ratio is 4.1 and the CID portion stands at 1.2. With Phase 2 net benefits of \$39.5 million, the project represents a strong contribution to national economic outputs. As computed in the HEC-FDA risk analysis model and shown in Table 8, equivalent annual damages (EAD) is reduced by nearly \$56.7M for the Phase 2 study area.

**Table 8: Economic Analysis**

Oct 2013 prices; 3.5% interest rate; 50 year period of analysis; \$1000s

Levee Unit Alternative	Annual Costs	Annual Benefits	Benefit-Cost Ratio	Net Benefits
<b>Armourdale</b>				
Nominal 500+3 Raise	\$ 12,343.8	\$ 51,457.1	4.2	\$ 39,113.2
<b>Central Industrial District</b>				
Nominal 500+3 Raise	\$ 4,375.9	\$ 5,229.6	1.2	\$ 853.7
<b>Total Phase 2 Study Area</b>	<b>\$ 16,719.7</b>	<b>\$ 56,686.6</b>	<b>3.4</b>	<b>\$ 39,966.9</b>
Argentine 500+3 Raise	\$ 3,821.5	\$ 18,180.0	4.8	\$ 14,358.5
<b>Kansas River System</b>	<b>\$ 20,541.2</b>	<b>\$ 74,866.6</b>	<b>3.6</b>	<b>\$ 54,325.4</b>

The with-project (residual) flood risks and damages are shown in Table 9. The residual risk results address all three major aspects of the levee performance analysis: overtopping (hydraulic), geotechnical, and structural. The with-project performance provides a very significant decrease in the flood risk for each of the respective units.

**Table 9: Engineering Performance - With Project Conditions**

	Armourdale	CID
Annual Exceedance Probability* (median)	0.12%	0.12%
Return interval (years)	833	833
<b>Conditional Exceedance Probability** - Overtop or Breach</b>		
1.0% event	1.39%	0.73%
0.2% event	34.79%	28.88%

Notes:

\*Annual exceedance probability is the chance of experiencing any flood event - of whatever magnitude - within any year.

\*\*Conditional exceedance probability is the probability that specified flood event would overtop or breach the levee.

Tables 1 and 9 compare the future without and with-project assurance statistics for the two levee units. The median annual exceedance probability – currently as much as 3.5% for Armourdale and 0.3% for CID in their existing conditions – would improve to 0.12% for both units. In other

words, there would be a 0.12 percent chance of a damaging flood in any year following project implementation.

In the 1 percent-chance flood event, both Phase 2 units would have between an 11 percent and 55 percent chance of experiencing damage from overtopping or breach failure. These probabilities would be improved to roughly 1 percent in the with-project condition. The long-term risk of a damaging flood in both of the Phase 2 units over 50-year period would be less than 1 in 10, compared to a current 50-year risk exceeding 1 in 2 in Armourdale and approximately 1 in 5 in CID.

**Systems/Watershed Context:** The existing Kansas Citys system lies at the confluence of the Kansas River watershed with the Missouri River. Both watersheds contain a larger system of Corps of Engineers constructed flood risk management features, including levees and reservoirs, within which the Kanas Citys system was previously authorized and modified. River flows used in the analysis of this study have been established within the context of the overall watershed system and the multiple purposes for which these rivers are managed.

Within these very large watersheds, other Federal agencies conduct various efforts for a number of purposes, including the Bureau of Reclamation, the Federal Emergency Management Agency (FEMA), and the Environmental Protection Agency (EPA). FEMA has designated multiple areas within these watersheds, including Kansas City, for development of new flood risk hazard mapping. These efforts are currently pending the issuance updated guidance. At present, no other efforts are underway within the immediate vicinity of the Kansas Citys levee system. The EPA accepted an invitation at the beginning of the study to be a designated Cooperating Agency and assisted with the development of information and data included in the EIS.

The seven authorized units of the Kansas Citys system are owned and operated by five separate non-Federal sponsors. The two units addressed in the Final Feasibility Report are owned and operated by two of these sponsors, but all are stakeholders in the outcomes of the Recommended Plan. Each sponsor operates and maintains their area of responsibility in accordance with unit specific Operations and Maintenance manuals. Collectively, these separate manuals represent a total system operations plan. The Sponsors each have their own floodplain management plans and they are currently engaged in the preparation of a coordinated system wide plan. During emergency operations, the Sponsors follow their established emergency action plans and coordinate their activities among themselves, and with the Corps of Engineers, to ensure proper operation of the total system.

**Environmental Operating Principles:** The proposed project integrated Environmental Operating Principles (EOP), as required, in affirming the Corps' commitment to include environmental considerations into the plan formulation and engineering design processes. These principles foster unity of purpose on environmental issues, reflect a new tone and direction for dialogue on environmental matters, and ensure that employees consider conservation, environmental preservation and restoration in all Corps activities.

An existing project in an urban area such as Kansas City, with permanent structural features dating back several decades, has inherent limitations to the inclusion of viable environmental

improvements. The flood risk management engineering measures included in the Recommended Plan were developed in a manner which sought to preserve, improve and sustain the environment by preserving the continuity and value of habitat along and adjacent to the Kansas River bank line areas within the metropolitan area. The Recommended Plan has minimal impacts on existing habitat and wetlands and serves to protect the environmental and community fabric that has developed behind the existing levee system.

**Peer Review**

**ATR:** Agency Technical Review (ATR) conducted as defined in the project’s Review Plan and the requirements of EC 1165-2-214. The ATR was led by the Louisville District for all components of the project analysis and documentation and verified that the study utilized justified and valid assumptions consistent with law and existing US Army Corps of Engineers policy. The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be appropriate and effective. All comments resulting from the ATR have been resolved. ATR for the DRAFT Final Feasibility Report was completed and certified by the ATR lead, Kansas City District, and the Flood Risk Management Planning Center of Expertise (FRM-PCX) on September 9, 2013. Certification of ATR for the Final Feasibility Report was completed March 28, 2014.

A separate ATR Certification Report has been prepared by the ATR Team Lead and reviewed and approved by the FRM-PCX.

**IEPR:** Independent External Peer Review was conducted on project documentation prior to the Alternative Formulation Briefing and the DRAFT o Final Feasibility Study. The IEPR panel was managed by Battelle under contract to the FRM-PCX. All IEPR comments have been resolved and the IEPR panel produced a separate final report detailing the process, comments, and issue resolutions.

**EXPECTED PROJECT PERFORMANCE**

**Project Costs:** Table 10 summarizes the project cost estimate.

**Table 10: Cost Summary  
Kansas Citys, Missouri and Kansas  
(October 2013 Price Level, 1000’s)**

<u>Construction Item</u>	<u>Cost</u>			
	<b>Armourdale</b>	<b>CID-KS</b>	<b>CID-MO</b>	<b>Total</b>
Lands & Damages	\$ 2,647	\$ 2,268	\$ 0	\$ 4,915
Elements				
Relocations	\$ 1,816	\$ 323	\$ 0	\$ 2,139
Floodwalls and Levees	\$ 190,779	\$ 64,816	\$ 498	\$ 256,093
Pumping Plants	\$ 7,772	\$ 2,584	\$ 0	\$ 10,356
Subtotal	\$ 200,368	\$ 67,723	\$ 498	\$ 268,589
Preconstruction, Engineering, and Design	\$ 15,611	\$ 5,450	\$ 41	\$ 21,098

(PED)				
Construction Management	\$ 14,026	\$ 4,740	\$ 35	\$ 18,801
<b>Total First Cost</b>	<b>\$ 232,650</b>	<b>\$ 80,177</b>	<b>\$ 575</b>	<b>\$ 313,402</b>

**Equivalent Annual Costs and Benefits:** Table 11 summarizes the project economic analysis.

**Table 11: Recommended Plan Economic Summary  
Kansas Citys, Missouri and Kansas**

(October 2013 price level, 50-year period of analysis, 3.5 percent discount rate, 1000's)

<b>Investment Costs</b>	
Total Project Construction Costs	\$313,402,000
Interest During Construction	\$70,877,000
<b>Total Investment Cost</b>	<b>\$384,279,000</b>
<b>Average Annual Costs</b>	
Interest and Amortization of Initial Investment	\$16,383,200
OMRR&R	\$336,500
<b>Total Average Annual Costs</b>	<b>\$16,719,700</b>
Average Annual Benefits	\$56,686,600
Net Annual Benefits	\$39,966,900
Benefit-Cost Ratio	3.4
Benefit-Cost Ratio (at 7%)	1.6

**Cost Sharing:** Cost share apportionment is summarized in Table 12. Of the two non-Federal sponsors, the Kaw Valley Drainage District of Wyandotte County, Kansas (KVDD), is responsible for the largest non-Federal share. KVDD will be responsible for the non-Federal shares of work in both the Armourdale Unit and the Kansas Section of the Central Industrial District Unit. Total estimated costs for these two project components is \$312,827,000 and the total non-Federal share is \$114,076,000. KVDD will continue to be responsible for annual operation and maintenance costs including the approximately \$336,500 in annual costs added by this project. In a letter to the Kansas City District Corps of Engineers dated March 4, 2014, KVDD has asserted their support for these two project components.

The City of Kansas City, Missouri, is responsible for non-Federal cost sharing of the recommended plan in the Missouri Section of the Central Industrial District Unit, with an estimated total cost of \$575,000. The non-Federal cost share responsibility is estimated to be \$201,000. The City will continue to provide annual budgets for levee operations and maintenance in accordance with current practice. This project is not expected to create additional operations and maintenance costs. The City expressed its support for the recommended plan in a letter to the Kansas City District dated February 27, 2014.

**Table 12: Cost Sharing  
Kansas Citys, Missouri and Kansas**

(October 2013 price level, \$1000's)

Item	Federal Cost	Non-Federal Cost	Total
Flood Risk Management (FRM)			
Armourdale Unit			
PED	\$ 10,147 (65)	\$ 5,464 (35)	\$ 15,611

LERRD			\$ 4,463		\$ 4,463
FRM	\$ 138,174		\$ 74,402		\$ 212,576
<b>Subtotal</b>	<b>\$ 148,321</b>		<b>\$ 84,329</b>		<b>\$ 232,650</b>
CID Unit – Kansas Section					
PED	\$ 3,543	(65)	\$ 1,908	(35)	\$ 5,450
LERRD			\$ 2,591		\$ 2,591
FRM	\$ 46,888		\$ 25,248		\$ 72,136
<b>Subtotal</b>	<b>\$ 50,431</b>		<b>\$ 29,747</b>		<b>\$ 80,177</b>
CID Unit – Missouri Section					
PED	\$ 27	(65)	\$ 14	(35)	\$ 41
LERRD			\$ 0		\$ 0
FRM	\$ 347		\$ 187		\$ 534
<b>Subtotal</b>	<b>\$ 374</b>		<b>\$ 201</b>		<b>\$ 575</b>
<b>Total Project</b>	<b>\$ 199,126</b>	<b>(65)</b>	<b>\$ 114,277</b>	<b>(35)</b>	<b>\$ 313,402</b>

**Project Implementation:** The Non-Federal sponsors, the Kaw Valley Drainage District and the City of Kansas City, Missouri, will provide 35 percent of the cost associated with construction of the Recommended Plan, including provision all required lands, easements, rights-of-way, and necessary relocations (LERRD; and will pay 100 percent of the OMRR&R costs associated with the project.

Temporary easements will be used for borrow, equipment storage, construction vehicles and staging areas. Temporary access road easements will vary in width along the different work areas but are generally 15 to 30 feet wide. Duration of the temporary easements will also vary for each of the individual work areas, generally running from 1 year to 2.5 years. The Recommended Plan does not require acquisition of an off-site disposal area.

**Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R):**

Operation, maintenance, repair, replacement and rehabilitation of the project will remain the responsibility of the non-Federal sponsors. Operation and Maintenance (O&M) manuals will be prepared (or updated as appropriate) by the Corps of Engineers and provided to the sponsors following each implementation contract or phase. Proper and timely non-Federal Sponsor operation is required to ensure the integrity and performance of the levee system as designed. Non-Federal sponsor requirements for coordination, operations, maintenance, and training, are established and governed by the existing Operations and Maintenance Manuals of each levee unit, as well as multiple existing national and local regulations and policies, and are monitored through established Corps of Engineers inspection and oversight programs.

Several closure structures are being converted from sandbags to stoplogs and new structures of both types are being added to the system. The necessary coordination and operational considerations of closure structures are already well understood by the sponsor and the affected stakeholders from past experience. Any changes in the recommended closure plans, i.e. notifications, timing, river elevation action levels, etc., will be documented in revisions to the Operations and Maintenance Manuals. For locations where new stoplog gaps are being placed, stoplog storage locations will be identified and the necessary easements or property requirements coordinated through the LERRD process.

The majority of the sponsor O&M concerns and costs will remain the same as the current condition. There will be some savings in costs related to pump station removals, although most of the stations slated for removal are already essentially abandoned and not being fully operated, maintained or upgraded. There will be an overall net increase in the number of relief wells in the system, requiring periodic testing and rehabilitation, repairs as needed, and eventual replacements. While these relief well costs are the driver in overall changes to the O&M costs, evaluation of their impact on an annual basis indicates little overall change as shown in Table 11.

**Table 11: Annual Operation & Maintenance Cost for Phase 2 Recommended Plan**

Levee Sponsor	Average Annual O&M Costs	Incremental Annual O&M Cost for Recommended Plan
Kaw Valley Drainage District	\$1,700,000	+\$336,500
Kansas City Missouri	\$875,000	+\$0

**Key Social and Environmental Factors:** An extensive analysis of the affected environment was conducted for the 2006 FEIS. The Kansas and Missouri River systems and their adjacent floodplains were significantly altered by human activities in the past. These same types of activities continue now and are expected well into the future. As a result, resource agencies have expressed concerns about cumulative and secondary impacts on these river systems. Major impacts to the riverine environment began with modification of the Missouri river channel and stabilization of the river bank to improve navigation. As industrial and residential development continued along the river, upstream reservoir and local levee systems were developed to provide flood risk management and allow continued economic development.

Previous modifications to the river systems and their floodplains have been through multiple Federal and private initiatives resulting in a changed environment within and along the river and specifically within urban areas bordering these rivers. The cumulative impact of these activities (navigation, flood risk management, industrialization, and residential development) has resulted in a dense, heavily industrialized floodplain protected by levee systems within the Kansas City reach, and a channelized river system showing higher flood stages than the free flowing systems of over a century ago. Development is expected to continue within these urban areas into the foreseeable future as demand for products, services, and flood risk management continues.

Based on determinations within the FEIS, environmental impacts of the Recommended Plan are limited within the project area. Environmental impacts to the project area are considered minor or not significant with many impacts temporary in nature during construction activities. Cultural resource assessment of the project area showed no significant archaeological sites or historic structures impacted by the Recommended Plan; thereby resulting in no significant impacts. However, if significant archaeological or cultural materials are discovered as the project progresses, then appropriate measures for coordination, documentation, and preservation, if needed, would be undertaken. No significant long term socio-economic impacts were identified for the populations within the project areas. Temporary impacts associated with construction activities would occur but are considered not significant. Based on the environmental analysis, implementation of the Recommended Plan would result in no significant impacts to the

environment. The selected plan has been found to be in conformance with Federal, State, and local statutes and policies.

Given the industrial and commercial nature of the study area, the presence of contamination was anticipated, investigated, and addressed throughout the planning process. Available details of the sites identified and investigated in the Phase 2 units were included in the 2006 Environmental Impact Statement. A more complete HTRW assessment was completed in 2007 and is included in the Hazardous, Toxic, and Radioactive Waste (HTRW) Appendix. Potentially contaminated areas that may be impacted by the Recommended Plan are summarized below.

Central Industrial District Unit: Potential HTRW concerns have been identified within the study area between station 40+31 and 51+00. Potential encroachment into this area associated with the levee raise is proposed to be avoided by steepening the landside levee slope rather than extending the landside toe. No other locations of HTRW concerns have been identified at this time.

Armourdale Unit: Potential HTRW concerns have been identified within the study area between stations 43+00 to 63+00, 110+00 to 130+00, and 278+00 to 293+00. Furthermore, a former Superfund site is located between stations 130+00 and 157+00. Measures included in the Recommended Plan were chosen to avoid encroachments and impacts to these areas.

While measures were chosen to avoid impacts to known areas of HTRW, and impacts are not expected to occur, there remains a risk that contamination may have spread or that undocumented contamination may be present. Additional soil sampling and testing will be conducted as part of the design phase, as well as close monitoring of material excavated during the project construction, to ensure that any HTRW uncovered is properly handled and disposed. Any and all removal of contaminated soils or other contaminated materials will be 100% local sponsor responsibility (including cost). All removal of contaminated soils or other contaminated materials must be completed prior to construction.

**Stakeholder Perspectives.** The non-Federal sponsors strongly support the Recommended Plan. On a daily basis, each of the sponsors accomplish the numerous actions necessary for keeping the project in good condition as evidenced by recent annual inspection reports and by the evaluations undertaken in the feasibility study. The sponsors will continue to provide full cooperation and are prepared to meet the necessary financial obligations associated with the Recommended Plan.

The sponsors are fully aware of and in agreement with the requirements of the model Project Partnership Agreement. Both sponsors have previous experience on similar projects with Kansas City District that have utilized the model agreement with no requests for special conditions. It is anticipated that no special requirements will be requested or required for implementation of the Recommended Plan.

**Environmental Compliance.** In accordance with the Council on Environmental Quality regulations for implementing NEPA, 40 CFR Part 1502.9(c)(1), a review of the 2006 EIS was conducted to document any change in the scope of work and/or impacts to resources within these

levee units, and any potential changes to existing resources, that may have occurred since the EIS was finalized. Review of the project areas has shown no changes in the environmental conditions of the project area since publication of the EIS, nor have there been changes in status, standards, or other factors that would affect the conclusions of the EIS. Based on this review a new or supplemental EIS has not been prepared for the recommendations of this report.

**Certification of Peer, Agency, Cost and Legal Review:**

ATR Certification (Draft Report)	09 September 2013
ATR Certification (Final Report)	28 March 2014
IEPR Completion	27 January 2014
Armourdale Unit Cost Certification	25 October 2013
CID Unit Cost Certification	18 October 2013
Legal Review Certification	7 March 2014

**Policy Compliance Review:**

**System Integration.** Together the Interim Feasibility Report and this Final Feasibility Report represent a comprehensive and coordinated approach to the improvement of the reliability and performance of the overall metropolitan system. Each phase of this feasibility study has produced recommendations for improvement within the existing system that are technically complete and effective, acceptable to the Non-Federal sponsors and the public, economically justified, and that minimize adverse impacts to the natural environmental and the existing community infrastructure. It is important to recognize the overarching systems approach to metropolitan flood risk management within this Final Feasibility Report by providing an update on the current status of Phase 1 economic costs and benefits, summarized in Table 13.

**Table 12: Updated Phase 1 Economic Analysis**

<b>Interim Feasibility Report Recommendations</b>	<b>First Cost</b>	<b>Annual Costs</b>	<b>Annual Benefits</b>	<b>Benefit/Cost Ratio</b>	<b>Net Benefits</b>
<i>New Work/Reconstruction</i>	\$ 88,356	\$ 4,487	\$ 33,278	7.4	\$ 28,792
<i>Design Deficiency</i>	\$ 12,044	\$ 560	\$ 8,175	14.6	\$ 7,616
<b>Total Phase 1</b>	<b>\$\$100,401</b>	<b>\$ 5,046</b>	<b>\$41,454</b>	<b>8.2</b>	<b>\$ 36,408</b>

*\$1000's, Oct 2013 Price Level, 3.5% Interest Rate*