# FEASIBILITY REPORT
# FLOOD DAMAGE REDUCTION
# FOR
# DES MOINES AND RACCOON RIVERS PROJECT
# DES MOINES, IOWA

## WITH INTEGRATED
## ENVIRONMENTAL ASSESSMENT

**VOLUME 1**

**December 2005**

US Army Corps
of Engineers ®
Rock Island District

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
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# Executive Summary

The primary purpose of this study is to evaluate and determine the feasibility of implementing flood damage reduction improvements for the City. The USACE, Rock Island District and the City have completed this feasibility report for flood damage reduction with integrated Environmental Assessment. The report contains results of a comprehensive investigation of the flooding problems along the Des Moines and Raccoon Rivers and primary tributaries within the city limits of Des Moines.

This study was prepared in response to a resolution adopted by Congress on July 1, 1958, following appropriation of funds in the Energy and Water Development Appropriations Act of 1998, and under the authority of Section 216 of the 1970 Flood Control Act (Public Law 91-611). This act provides authority for the Secretary of the Army to review the operation of projects completed by the Corps of Engineers when found advisable due to significantly changed physical or economic conditions, and to report to Congress with recommendations for modifying structures or their operation for improving the quality of the environment or in the overall public interest. The completed project under review is Des Moines, Iowa, (also known as the Des Moines Local Flood Protection Project) which was authorized for construction by Section 10 the Flood Control Act of 1944 (Public Law 78-534).

The City of Des Moines has been subject to frequent flooding that impacts large numbers of residential, commercial, and industrial properties. During the Great Flood of 1993, Polk County suffered more than $152,000,000 in flood damages, mostly in the Des Moines metropolitan area. In addition, Des Moines was without water service for more than a week causing closure of most businesses and industries in the city. More than 3,000 properties were damaged in this event.

The Birdland Park and Central Place levees failed during the 1993 flood event and do not provide reliable flood protection, placing nearly 200 homes and businesses at risk. Downtown Des Moines also flooded in 1993 due to incomplete installation of levee closures. This levee system has a large number of closures which decreases the reliability of the system, increasing the flood threat for hundreds of commercial, industrial, and residential structures. Improvements to closures and reduction in the number of closures in the downtown levee system would reduce operation and maintenance costs and improve safety during flood events. Project implementation would be coordinated with proposed recreational improvements to enhance the riverfront in downtown Des Moines. Homes and businesses along selected portions of Walnut Creek, Fourmile Creek, and Leetown Creekway are also subject to frequent flash floods.

Alternative plans were developed and evaluated for each of the 11reaches included in the study. Alternatives included levees and floodwalls, reservoirs, channel improvements, and nonstructural measures such as flood warning systems and relocation/removal of existing structures. Preliminary screening focused detailed analysis on plans that provided the most benefits and potential to be economically justified. Alternatives that were developed and evaluated in detail include:

- three levee alignments at three levee heights for an improved levee to protect the Birdland Park area;
- an improved and extended recreational trail at Birdland Park;
- three levee heights for an improved levee to protect the Central Place area;
- raising the levees and floodwalls of the existing downtown levee system;
- improving the closures in the existing downtown levee system; and
- constructing new levees along portions of Walnut Creek and Fourmile Creek.

No modifications or improvements were economically justified in 6 of the 11 reaches evaluated.

The recommended plan consists of 7,700 feet of earthen levee and associated structures to provide 500-year flood protection to the Birdland Park area; an asphalt-surfaced recreational trail on the Birdland Park levee; 5,900 feet of earthen levee and associated structures to provide 500-year protection to the Central Place area; elimination of 7 closures and improvements to 12 closures in the existing downtown flood protection system; and development of 18 to 21 acres of open water, riparian, and wetland habitat as environmental mitigation. The recommended plan would provide improved flood protection to over 850 residential properties and 650 commercial/ industrial properties along the Des Moines and Raccoon Rivers in Des Moines with estimated 500-year flood damages of over $325 million. Because there were no significant issues affecting the natural and human environment, an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) were prepared for this project.

| **Estimated Implementation Costs:** (October 2005 price level) | **Recreation** (50% Cost Share) | **Flood damage Reduction** (65%-35% Cost Share) | **Total Share** |
|---|---|---|---|
| Federal Share | $127,000 | $6,655,000 | $6,782,000 |
| Non-Federal City of Des Moines Share | $127,000 | $3,582,000 | $3,709,000 |
| **Total Project Cost** | $254,000 | $10,237,000 | **$10,491,000** |

5 1/8 discount rate over a 50-year evaluation period

The recommended plan's Benefit-Cost Ratio is 2.7. The recommended plan, which is also the locally preferred plan, reconstructs 13,600 feet of levee at Birdland Park and Central Place, improves the reliability of closures in the downtown area by eliminating 7 and reconfiguring 12 other closures and constructs a recreational trail on top of the levee connecting the Neal Smith Trail with Riverview and McHenry Parks.

# PREFACE

The City of Des Moines, Iowa (City) surrounds the confluence of the Des Moines and Raccoon Rivers in Polk County, in central Iowa. These rivers drain almost 10,000 square miles in northern and central Iowa and in southwestern Minnesota. Des Moines has experienced periodic severe flooding since floods were first recorded in 1851. Between 1851 and 1903, major floods occurred every 3 to 11 years, mostly in the months between April and July. Major floods occurred in both 1902 and 1903, while additional flooding occurred in 1947, 1965, 1969, and, most recently, in 1993.

The Great Flood of 1993 was unprecedented in magnitude and severity across Iowa, with seven deaths. The greatest economic losses occurred in cities on the floodplain. Des Moines, located in the center of the flood region, became the largest U.S. city to lose its water supply when its water treatment plant flooded. More than 250,000 people lost drinking water for 19 days in the summer. Water pipes, contaminated by floodwaters carrying sewage and agricultural chemicals, had to be flushed out before the municipal water supply was reconnected. Economic losses in Des Moines totaled approximately $716 million.

The fall and winter of 1992 had record rains, with the fifth wettest November on record. Heavy rains in March 1993 combined with snowmelt in the northern Mississippi Basin, which raised water levels throughout the northern and central basin. Throughout Iowa, repeated heavy thunderstorm events in the spring of 1993 coincided with the third highest June precipitation in 121 years. Portions of downtown, the Birdland Park Neighborhood, and the Central Place Neighborhood were flooded, causing damages to numerous homes and businesses. The downtown west levee protected area was flooded when floodwaters entered along a railroad sandbag closure location. The downtown east levee was almost breached when a tree growing near the levee tipped over and the levee scoured quickly. In July, the Saylorville Reservoir reached flood stage and ultimately overflowed the emergency spillway. Fourmile Creek and Walnut Creek, tributaries to the Des Moines River and Raccoon River, also experienced moderate to major flash flooding in July from an additional 3 to 5 inches of rain in a narrow band from Des Moines westward along I-80, contributing further to flooding. The flood was officially declared over in October 1993.

In 1996, the City requested that the U.S. Army Corps of Engineers (USACE) conduct a reconnaissance plan to evaluate alternatives for flood damage reduction, environmental restoration, and related water and land resources. A reconnaissance study was initiated in 1998 as a result of the provision of funds for this purpose in the Energy and Water Development Appropriations Act of 1998. The reconnaissance study recommended that a detailed feasibility study be conducted. The USACE, Rock Island District (District) and the City signed a Feasibility Cost Sharing Agreement (FCSA) in September 1999, initiating the feasibility study that is the subject of this report.

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# FEASIBILITY REPORT
# DES MOINES AND RACCOON RIVERS PROJECT
# FLOOD DAMAGE REDUCTION
# DES MOINES, IOWA

## 1. STUDY AUTHORITY

This report was prepared in response to a Congressional resolution, which reads as follows:

*"Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on the Des Moines River, contained in House Document 651, 78th Congress, with particular reference to the Upper Des Moines River and the tributaries thereof, to determine the feasibility and justification of improvements for flood control and related purposes."* (Adopted July 1, 1958)

The report was also prepared in response to the provision of funds in the Energy and Water Development Appropriations Act of 1998, under the authority of Section 216 of the 1970 Flood Control Act, which reads:

*"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 significant changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest."*

The completed project under review is Des Moines, Iowa, (also known as the Des Moines Local Flood Protection Project) which was authorized for construction by Section 10 the Flood Control Act of 1944 (Public Law 78-534) which reads:

*"The project on the Des Moines River for local flood protection of Des Moines, Iowa is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 651, Seventy-eighth Congress, second session, at an estimated cost of $270,000."*

The Letter of the Chief of Engineers, United States Army, dated December 13, 1943, included in House Document No. 651 recommends *"the construction of local improvements for flood control at the city of Des Moines, Iowa in general accordance with the plans of the district engineer as shown on the accompanying drawings at an estimated first cost to the United States of $270,000; subject to the condition that responsible local agencies give assurances satisfactory to the Secretary of War that they will (1) provide without cost to the United States all lands, easements, and rights-of-way necessary for construction of the works, (2) bear the expense of repairs and provision of gates on existing drains and of raising the railroad bridges, (3) hold and save the United States free from damages resulting from construction of the improvements, and (4) maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of War including insurance against encroachments on, and obstructions of, the flood channel which would detract from the flood-control value of the improvements;"*

The recommended project is further described in the Survey of Des Moines River, Iowa included in House Document No. 651 as: *"approximately 18,900 feet of new levees, 16,300 feet of reconstructed levees, and 2,400 feet of concrete curb wall."*

The reconnaissance phase was initiated on April 15, 1998 and resulted in the finding that there was a federal interest in conducting a feasibility study. The U.S. Army Corps of Engineers (USACE) approved the Section 905(b) reconnaissance report on December 14, 1998. The City, as the non-federal Sponsor (the Sponsor), and the USACE, Rock Island District (District) initiated the feasibility study on September 13, 1999, by executing a feasibility cost-sharing agreement. This report presents the results of the feasibility study.

# 2. REPORT PURPOSE AND SCOPE

The primary purpose of this study is to evaluate and determine the feasibility of implementing flood damage reduction improvements for the City. The USACE, Rock Island District (the District), and the City has completed this feasibility report for "Flood Damage Reduction" with integrated Environmental Assessment. The report contains results of a comprehensive investigation of the flooding problems along the Des Moines and Raccoon Rivers and primary tributaries within the City limits of Des Moines. The official name of this effort is "Des Moines and Raccoon Rivers Project (DMRR), Des Moines, Iowa". The investigation includes evaluating current and anticipated water problems and community needs in an array of alternatives that appears to have potential feasibility. The criteria used to evaluate the alternatives are economic, balance between cost and benefit, a reduction or mitigation of environmental impacts, and engineering construction feasibility.

The federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other federal planning requirements. The Federal Government views prospective projects from a national point of view, including two requirements for federal participation. The primary requirement calls for substantial benefits to flood control. The second requirement is to produce net benefits which exceed costs. "Federal Interest" in the project is identified when both requirements are satisfied. Environmental impacts are reduced with alternative designs or mitigated by replacement. The federal objective is stated in terms of an expressed desire to alleviate problems and realize opportunities related to the output of goods and services or to increased economic efficiency. The planning process consists of a series of steps that identifies or responds to problems and an opportunity associated with the federal objective and specific State and local concerns, and culminates in the selection of a recommended plan. The process involves an orderly and systematic approach to making determinations and decisions at each step so that the interested public and decision makers in the planning organization can be fully aware of the basic assumptions employed; the data and information analyzed; the areas of risk and uncertainty; the reasons and rationales used; and the significant implications of each alternative plan. This report documents federal interest in flood damage reduction improvements or other water resources improvements within the City, covering a period of analysis of 50 years.

## 2. A. REPORT CONTENT

This report has three volumes: Volume 1, the main report; Volume 2, technical appendices; and Volume 3, engineering drawings or plates. Volume 1 discusses the overall study process and plan formulation and contains the recommendation of the District Engineer. Also in the main report is an account of the participants in the study, in addition to the coordination that occurred among the public, local officials, environmental groups, outside agencies, etc. Volume 2 consists of 10 appendices, supplementing information in the main report with detailed data and analysis. Volume 3 consists of the engineering drawings, which supplement information in the main report.

## 2. B. DESCRIPTION OF THE STUDY AREA

The study area is the City in Polk County, Iowa. Specifically the geographic scope of the study is the incorporated City limits of Des Moines, Iowa, that experience flood damage from the Des Moines and Raccoon Rivers, Walnut Creek, Fourmile Creek, and Leetown Creekway (formerly known as 7th Ward Ditch), as shown below in Figure 1.

The upper Des Moines River watershed consists of 6,245 square miles; draining areas in north central Iowa and southwest Minnesota (Figure 1). Saylorville Dam, constructed in 1975 on the Des Moines River, largely mitigates flood damages from the Des Moines River, but significant storm events can still cause flooding throughout the City.

The Raccoon River enters the Des Moines River from the west near the Des Moines central business district and has a drainage area of 3,629 square miles. With no large flood-regulating reservoirs, the Raccoon River exhibits great fluctuations in its flows.

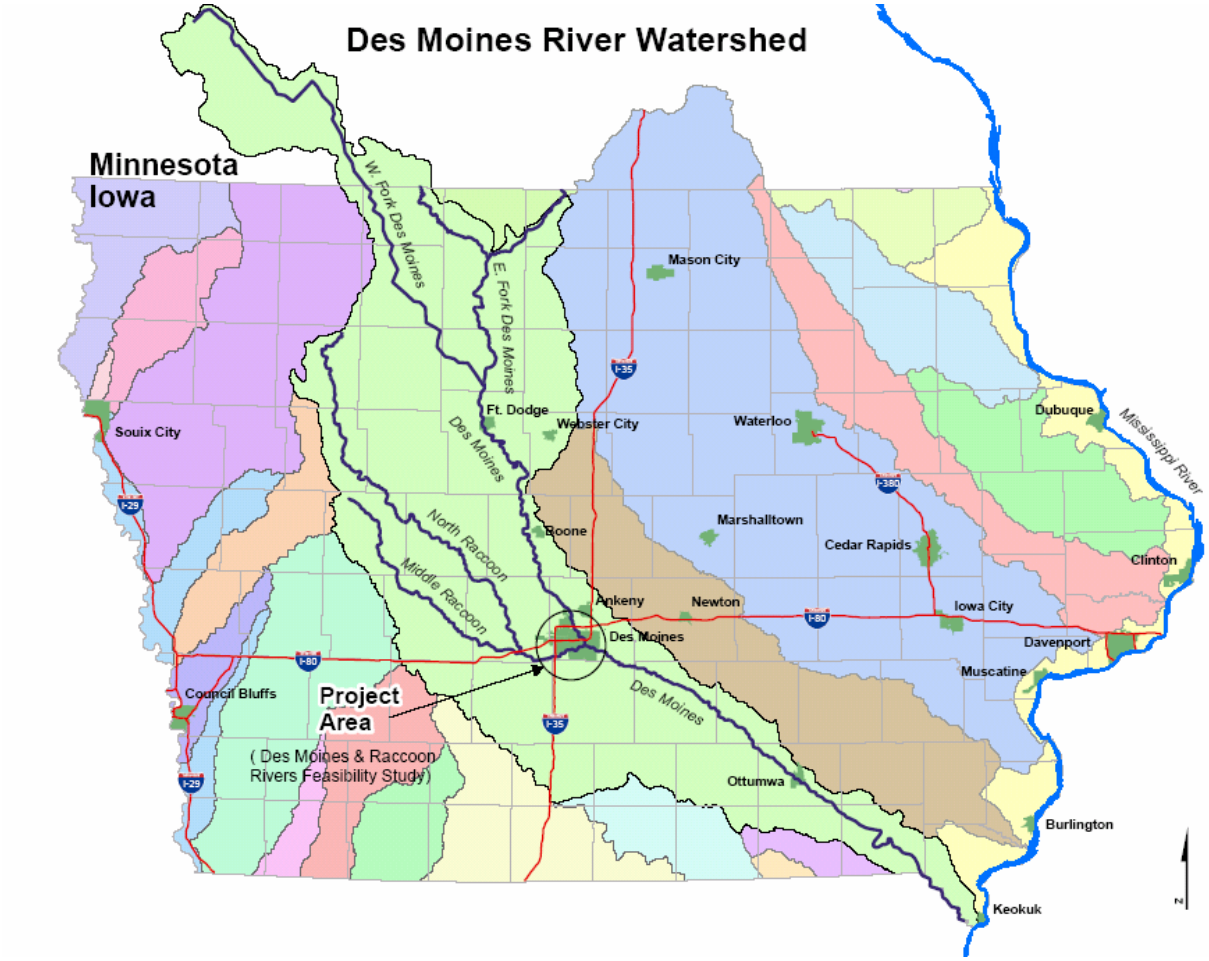


**Figure 1: Des Moines River Basin**

Other small tributaries of note are Walnut Creek, Fourmile Creek, and Leetown Creekway. Walnut Creek, a tributary of the Raccoon River, confluent approximately 3.5 miles upstream from the confluence of the Des Moines and Raccoon Rivers. This creek, which drains about 85 square miles, has a relatively small floodplain. Fourmile Creek is a major tributary, flowing into the Des Moines River approximately 6 miles below the confluence with the Raccoon River. Leetown Creekway is a smaller tributary of

Fourmile Creek, flowing into Fourmile Creek approximately 1 mile upstream of the confluence with the Des Moines River.

## 2. C. DESCRIPTION OF REACHES

For this report, there are 11 economically separate project reaches, related to flood damage reduction (Figure 2). In varying degrees, each reach has problems with flooding. Reaches 1 through 8 have existing levees and the remaining three reaches are areas along tributaries to the Des Moines or Raccoon Rivers that experience periodic flooding. The reaches are described below:

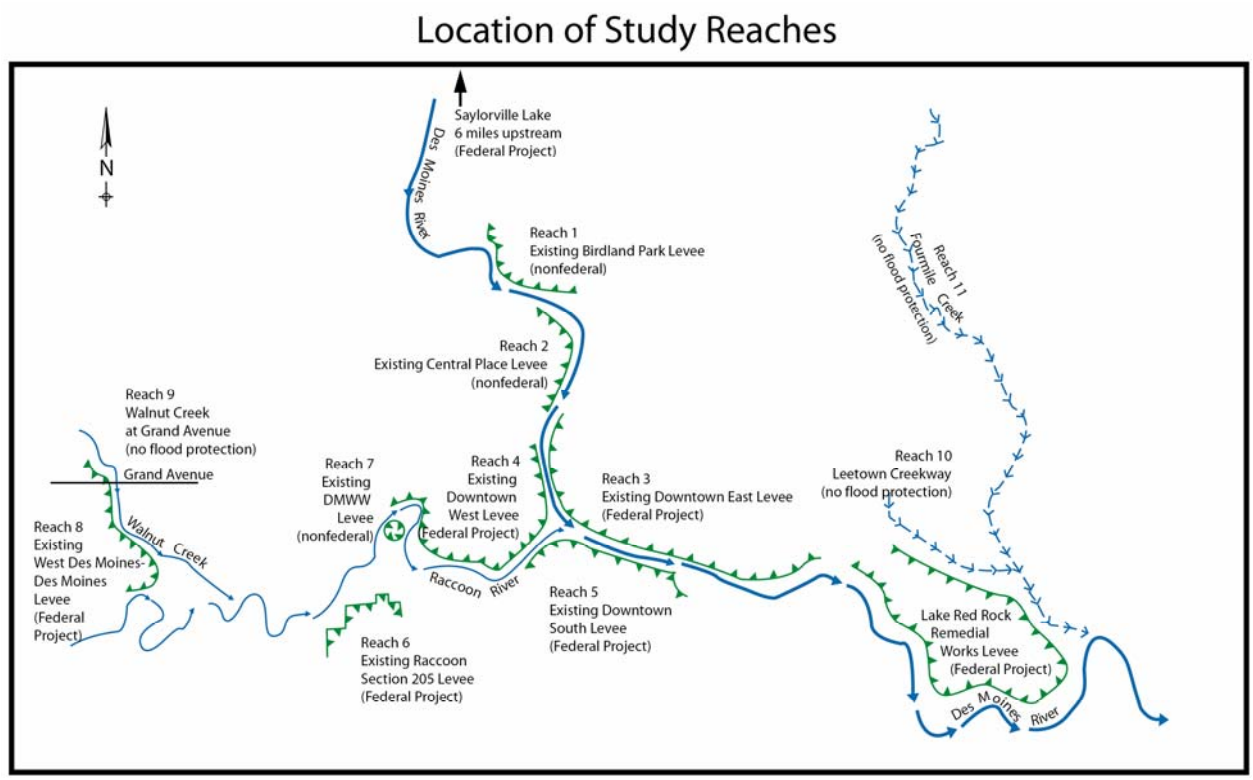


**Figure 2: Location of Existing Projects in Study Areas**

**Reach 1**: Birdland Park Levee on the eastern bank of the Des Moines River approximately 2.7 miles upstream of the confluence with the Raccoon River. The levee here was constructed by the City in the early 1950s (Figure 3). The existing levee ties to high ground at each end and is not physically connected to any other levee. University Avenue, elevation 840 feet National Geodetic Vertical Datum (NGVD), isolates Reach 1 from Reach 3.

**Reach 2**: Central Place Levee on the western bank of the Des Moines River approximately 2 miles upstream of the confluence with the Raccoon River. This levee was constructed by the City in the early 1950s (Figure 10). The existing levee ties to high ground at each end and is not physically connected to any other levee. Center Street (elevation above 805 feet NGVD) isolates Reach 2 from Reach 4.

**Reach 3**: Downtown East Levee on the eastern bank of the Des Moines River, upstream and downstream of the confluence with the Raccoon River. This levee was constructed as part of the Des Moines Local Protection Project authorized by the 1944 Flood Control Act. The project was designed to provide 100-year flood protection and was completed in 1970 (Figure 13). The existing levee ties to high ground at each end.

**Reach 4**: Downtown West Levee on the western bank of the Des Moines River and the Northern bank of the Raccoon River, at their confluence. This levee was constructed as part of the Des Moines Local Protection Project authorized by the 1944 Flood Control Act. The project was designed to provide 100-year flood protection and was completed in 1971 (Figure 14). The existing levee ties to high ground at each end and is not physically connected to any other levee.

**Reach 5**: Downtown South Levee on the south bank of the Des Moines River and the Raccoon River. This levee was constructed as part of the Des Moines Local Protection Project authorized by the 1944 Flood Control Act. The project was designed to provide 100-year flood protection and was completed in 1971 (Figure 15). The existing levee ties to high ground at each end and is not physically connected to any other levee.

**Reach 6**: Raccoon River Section 205 Levee is a federal levee completed in 2000 under the authority of Section 205 of the Flood Control Act of 1948. The project is located along the south bank of the Raccoon River upstream of Fleur Drive in Des Moines and was designed to provide 100-year flood protection (Figure 16). The existing levee ties to high ground at each end and is not physically connected to any other levee.

**Reach 7**: Des Moines Water Works Levee surrounds the Des Moines Water Works and was constructed by the City in the 1960s and further improved in 1994 (Figure 17). The existing levee is a ring levee that surrounds the water works and does not connect to high ground.

**Reach 8**: West Des Moines – Des Moines Project levee along the northern bank of the Raccoon River and western bank of Walnut Creek was constructed by USACE in 1998 under the authority of the Water Resource Development Act of 1986 (Public Law 99-662). The project was designed to provide 100-year flood protection (Figure 18). The existing levee ties to high ground at each end and is not physically connected to any other levee.

**Reach 9**: Walnut Creek Reach at Grand Avenue is on the east bank of Walnut Creek near Grand Avenue, opposite Reach 8 (Figure 19). There is no existing structural flood protection in this reach.

**Reach 10**: Fourmile Creek Reach is along both banks of Fourmile Creek south of I-80 (Figure 21). There is no existing structural flood protection in this reach, except the Red Rock Remedial Works levee along the western bank of Fourmile Creek downstream of Leetown Creekway.

**Reach 11**: Leetown Creekway Reach is along both banks of Leetown Creekway south of Dean Avenue (Figure 22). There is no existing structural flood protection in this reach, except the Red Rock Remedial Works levee along the southern bank of Leetown Creekway downstream of Fourmile Creek.

## 2. D. FLOOD HISTORY

There are 27 gaging stations within the Des Moines River and Raccoon River Basins. Historical data and gage records indicate that flooding usually occurs between May and July. The rivers will rise in March and April due to snowmelt or early spring showers, which saturate the basin. Flooding can follow in May, June and July as precipitation continues.

Major floods occurred on the Raccoon River in 1917, 1926, 1947, 1958, 1960, 1973 and 1993. Walnut Creek had a major flood in 1973. The primary flood hazard along Walnut Creek is along the right bank where the 100-year flood would inundate the commercial and industrial areas between Center Street and Grand Avenue and a residential area downstream of Grand Avenue.

The Great Flood of 1993 established the flood of record on most streams in the Des Moines metropolitan area. The metropolitan area suffered more than $716,000,000 in flood damages as more than 3,000 structures were inundated. The City was without water and sewer service for more than a week, causing the closure of businesses and industry throughout the county.

# 3. PRIOR STUDIES, REPORTS, and EXISTING WATER PROJECTS

## 3. A. PRIOR STUDIES

The USACE and other federal, state, and local entities have conducted numerous studies that are relevant to this planning and design report, including:

| | | |
|---|---|---|
| *Des Moines River, Iowa* | 15 December 1930 USACE | Report from the Chief of Engineers concluded that improvement of the Des Moines River for navigation, irrigation, waterpower, and flood control, or any combination thereof, was not deemed advisable. The report was submitted in compliance with Section 1 of the River and Harbor Act approved January 21, 1927 directing that surveys be made of certain streams for navigation, flood control, power development, and irrigation, in accordance with House Document 308, 69th Congress, 1st Session; and under the provision of Section 10 of the Flood Control Act approved May 15, 1928. |
| *Survey Report for Flood Control, Des Moines River, Iowa* | August 15, 1941 USACE | This report recommended construction of Red Rock Reservoir and construction of a system of levees and flood walls to protect the city of Des Moines. This report was included with the Letter of the Chief of Engineers, United States Army, dated December 13, 1943, in House Document Numbered 651, 78th Congress, 2nd Session. |
| *Review Report for Flood Control, Des Moines River, Iowa Interim Report, Main Report* | 31 May 1953 USACE | This report recommended construction of the Saylorville Reservoir on the Des Moines River. It also investigated potential flood control reservoir locations on the Raccoon River, but no economically justifiable site was found. |
| *Interim Report on Interior Drainage, Des Moines, Iowa, Local Flood Protection Project* | 8 November 1962 USACE | Recommended that interior drainage considerations be investigated in the interest of flood damage reduction and plans and specifications be prepared accordingly. |
| *Design Memorandum No. 1, General Design Memorandum, Des Moines River at Des Moines, Iowa, Local Flood Protection* | 21 February 1963 USACE | This document was completed following authorization of the Des Moines Local Protection Project by the Flood Control Act of 1944 (Public Law 78-534), as recommended by the Survey Report for Flood Control, Des Moines River, Iowa, dated August 15, 1941 and approved December 13, 1943 (House Document 651, 78th Congress, 2nd Session). The report recommended improvements to levees in Reaches 3, 4, and 5 in downtown Des Moines. |

| | |
|---|---|
| *Supplement No. 1 to General Design Memorandum, Des Moines River at Des Moines, Iowa, Existing Riverwall Sewers and Review of Closing Levee, Reach 5,*<br><br>18 September 1964 USACE | Recommendation is made in this report to build a levee along Edison Avenue, to provide unimpeded drain to a ponding area, and add a sandbag closure in the freeboard zone at Hillside Avenue. |
| *Supplement No. 2 to General Design Memorandum, Des Moines River at Des Moines, Iowa, Modifications in Stage II, Reach 4 and Stage III, Reach 5,*<br><br>29 September 1967 USACE | Proposed modifications to the design of the flood protective works on Fleur Drive are described in this report. |
| *Detailed Project Report for Flood Control under Section 205 of the 1948 Flood Control Act, as amended, Fourmile Creek in Des Moines, Iowa*<br><br>May 1975 USACE | The Report reviews past proposals and programs identifying feasible flood damage reduction and recreation features and recommended no structural improvements or further studies are performed. |
| *Des Moines River Basin, Iowa and Minnesota*<br><br>June 1975 USACE | This report recommended 100-year flood protection for portions of West Des Moines and Des Moines along the Raccoon River, Walnut Creek, and Jordan Creek. The report concluded that flood control reservoirs on the Raccoon River at Jefferson and on Walnut Creek were not justified. This report was included with the Letter of the Chief of Engineers, United States Army, dated July 22, 1977, in Senate Document No. 96-36, 96th Congress, 1st Session. The report was submitted in compliance with a resolution adopted by Congress on July 1, 1958. |
| *Information Report, Review of a Completed Project at Des Moines, Iowa*<br><br>September 1978 USACE | This report reviewed the project at Des Moines, Iowa, (also known as the Des Moines Local Flood Protection Project) which was authorized for construction by the Flood Control Act of 1948 (Public Law 78-534). The investigation revealed no economic justification for any of the alternatives considered and the project was concluded. |
| *Reconnaissance Study for Section 205 Flood Control Project, Raccoon River, Des Moines, Iowa*<br><br>May 1986 USACE | This report identified three feasible flood damage reduction alternatives and recommended a detailed project study for the area near Valley and Fleur Drives. |
| *Definite Project Report, Section 205, Flood Control Project, Raccoon River, Des Moines, Iowa*<br><br>May 1988 USACE | This report recommended a 100-year levee to protect the mixed residential, commercial and light industrial neighborhood located the area near Valley and Fleur Drives. This levee was built in 1995. |

| | | |
|---|---|---|
| *Reconnaissance Report, Section 205 Flood Damage Reduction Project, Des Moines River, Des Moines, Iowa, Birdland Levee* | | Structural and non-structural alternatives were considered for Birdland Levee system but were not economically justified. |
| December 1988 | USACE | |
| *General Reevaluation Report for Flood Control Project, Raccoon River and Walnut Creek, West Des Moines and Des Moines, Iowa* | | This report was completed following authorization of the project for flood control: Des Moines River Basin, Iowa and Minnesota (also known as the West Des Moines – Des Moines Project) in the Water Resources Development Act of 1986 (Public Law 99-662). The document recommended a plan to provide 100-year protection along the north bank of the Raccoon River, west bank of Walnut Creek, and east bank of Jordan Creek. This report was subsequently amended by a letter report dated March 1994. |
| July 1989 | USACE | |
| *Expedited Reconnaissance Study, Section 905(b) WRDA 1986 Analysis, Des Moines and Raccoon Rivers, Des Moines, Iowa* | | This document recommended a more detailed investigation of flood damage reduction measures for the City. |
| 16 November 1998 | USACE | |
| *Regulated Frequency Curves and Pool Elevation Frequency Estimates for Des Moines and Iowa River Basins* | | Des Moines based on Regulated Frequency Curves and Pool Elevation Frequency Estimates for Des Moines and Iowa River Basins |
| Jan 2002 | USACE | |

## 3. B. EXISTING PROJECTS

The following federal and local flood protection projects within the study area have been completed and are contributing to flood damage reduction in and adjacent to the City of Des Moines:

### 3.B.1. Des Moines, Iowa

(Also known as Des Moines Local Flood Protection Project) This federal flood protection project was authorized by the Flood Control Act of 1944 (Public Law 78-534). The project is located along both banks of the Des Moines River and mouth of the Raccoon River in downtown Des Moines and is designed to provide 100-year flood protection. It includes a system of levees, floodwalls, bridge raises, and gate wells and was completed in 1971. The project was constructed in three separate reaches, designated Reaches 3, 4, and 5, which coincide with the reaches designated in this report.

### 3.B.2. Red Rock Dam, Iowa

This federal project was authorized by the Flood Control Act of 1944 (Public Law 78-534). The project is located on the Des Moines River downstream of Des Moines, Iowa and is a unit of the comprehensive plan for flood control and other purposes in the Upper Mississippi River region. The 110-foot tall dam has been in operation since 1969 and forms a 19,000-acre lake. The Red Rock Remedial Works levees were constructed along the upper portions of the lake along the east bank of the Des Moines River, the

western bank of Fourmile Creek, and the southern bank of Leetown Creekway to protect existing properties in this area from flooding during high reservoir stages.

### 3.B.3. Saylorville Lake, Iowa

This federal project was authorized by the Flood Control Act of 1958 (Public Law 85-500) to supplement flood storage in Lake Red Rock and to reduce flooding in the city of Des Moines. The project is located on the Des Moines River approximately 6 miles upstream of Des Moines and has a conservation pool covering about 5,400 acres and a total capacity of 676,000 acre-feet. The 126-foot tall dam was completed in 1975, and the project has been in operation since 1977.

### 3.B.4. Des Moines River Basin, Iowa and Minnesota

(Also known as the West Des Moines – Des Moines project) This federal project was authorized by the Water Resources Development Act of 1986 (Public Law 99-662). The project is located along the Raccoon River, Walnut Creek, and Jordan Creek in the cities of West Des Moines and Des Moines and is designed to provide 100-year flood protection. The project includes a system of levees, floodwall, pumping plants, closure structures, and gate wells and was completed in 1998. This project has been designated Reach 8 for the purposes of this study.

### 3.B.5. Raccoon River, Des Moines, Iowa

This federal project was authorized under Section 205 of the Flood Control Act of 1948. The project is located along the south bank of the Raccoon River upstream of Fleur Drive in Des Moines and is designed to provide 100-year flood protection. The project includes a system of levees, floodwall, closure structures, and gate wells and was completed in 2000. This project has been designated Reach 6 for the purposes of this study.

### 3.B.6. Des Moines Recreational River and Greenbelt, Des Moines River, Iowa

The Des Moines Recreational River and Greenbelt (Greenbelt) was authorized by Congress in the Supplemental Appropriations Act of 1985 (Public Law 99-88) to provide central Iowa with recreation facilities along the Des Moines River. Additional legislation is contained in the Water Resources Development Act of 1986 (Public Law 99-662), the Fiscal Year 1987 Continuing Resolution Act (Public Law 99-500), and the Energy and Water Development Appropriations Act of 1988 (Public Law 100-202). Implementation of projects included in the Greenbelt authority is underway as described in the 2005 Annual Program Management Report, Des Moines Recreational River and Greenbelt, Des Moines River, Iowa, dated January 2005. Completed Greenbelt projects in the Des Moines area include the Simon Estes Amphitheater located on the east bank of the Des Moines River downstream of Locust Street. Additional riverfront recreation facilities are proposed in downtown Des Moines as part of the Principal Riverwalk. These facilities will be designed in coordination with the existing flood protection facilities and any improvements that may be recommended because of this feasibility study.

## 4. PLAN FORMULATION

In order to formulate a feasible flood protection project and assess the effects of the project, a full array of potential flood protection strategies and plans were considered. Plan comparison evaluations were done initially at a low level of detail in a Reconnaissance Study. This initial study focused on determining what plan, if any, is in the federal interest. If both federal and local interests are found, then a more detailed feasibility study will be prepared.

When formulating a plan for flood damage reduction, it is important to inventory the problems and concerns of the stakeholders and to develop specific measures to address problems. It is also important to identify key existing water resources to determine if there are opportunities to improve or protect them.

Flood protection plans must be found to be economically, environmentally, and socially feasible and are evaluated further in a progressive screening process until a single National Economic Development (NED) plan is defined and documented. The NED plan is the alternative that has the greatest net benefits and is the plan that the Federal Government is most supportive of constructing. Net benefits are defined as the average annual project benefits minus the average annual project costs. Those plans with average annual benefits greater than the average annual costs are considered economically feasible. The Sponsor may identify an alternate plan, provided it is economically feasible. Any additional project features or "betterment" costs within the Locally Preferred Plan will be borne solely by the local Sponsor.

The study team is comprised of representatives from the District and from the City. Study disciplines include planning, engineering, geotechnical, hydrology and hydraulics, economic analysis, surveying, real estate, environmental/cultural, social analysis, and public involvement. A list team members' education and experience can be found in Section 6. D.

## 4. A. RECONNAISSANCE STUDY FINDINGS

A reconnaissance study that recommended preparation of this feasibility study was initiated in April 1998 and approved in December 1998. The major findings of the reconnaissance study were:

- Existing levees at Birdland Park and Central Place are inadequate to protect the City from large flood events.
- Updated hydraulic modeling is needed to accurately reflect changed hydrologic and physical conditions in the Des Moines area.
- There are opportunities for environmental restoration of wildlife and aquatic habitat due to the degraded habitat in some locations, namely, Fourmile Creek and, Des Moines River.
- Reduction of maintenance costs, elimination of safety hazards and improved interior drainage need to be addressed.
- Structural alternatives for reducing flood damages in Des Moines are feasible and are likely to be economically justified.

## 4. B. FEASIBILITY STUDY PLAN FORMULATION

Following completion of the reconnaissance study, the District and the City entered into a feasibility cost sharing agreement in September 1999. The study was conducted as a partnership to identify opportunities for flood damage reduction within the City. This partnership approach was critical to successful completion of the study by improving coordination between the District, the City, the public, and numerous stakeholders.

The feasibility study was conducted in two phases: Phase 1 focused on gathering information about the five primary streams identified in the reconnaissance study as causing substantial flood damage within the City; Phase 2 consisted of analysis and evaluation of data. The following streams and watersheds were evaluated:

- Walnut Creek
- Fourmile Creek
- The Des Moines River

- The Raccoon River
- Leetown Creekway

The study team sought to develop/evaluate planning objectives and alternatives for a comprehensive flood damage reduction system in Des Moines. Systemic flood damage reduction alternatives from previous studies were reviewed and reevaluated to determine if any of these alternatives were effective and economically justified. No systemic alternatives such as storage reservoirs or channel modifications were found that appeared to be economically justified. A summary of measures eliminated from further analysis can be found in Table 6. Initially, it was believed that a uniform level of protection throughout the City would be most desirable. As the study progressed, however, it was found that different levels of protection were appropriate for each reach based on the economic benefits to the city and reduction of areas to flood fight. The plan formulation strategy evolved to one of developing optimum flood damage reduction alternatives for each reach that could be combined together into a coordinated flood damage reduction project.

The Phase 2 activities resulted in identification of the recommended plan for each reach. There was much overlap between the Phase 1 and Phase 2 activities since Phase 2 activities for each reach were started as soon as the Phase 1 information for that particular area became available (table 1).

Early coordination efforts with the City focused on identification of specific flooding problems and opportunities for ecosystem restoration and recreation:

Flood damage reduction efforts resulted in the identification of nine specific separable areas that had either experienced substantial flooding (such as Birdland Park, Central Place, and Fourmile Creek) or where substantial flood damages were possible (such as the Downtown levees). One area, the Des Moines River Levee between SE 6$^{th}$ and SE 14$^{th}$ Streets, was eliminated from further consideration because it was damaged in 2002 during a flood event and subsequently reconstructed to Federal Standards. Three, the Raccoon River Section 205 Project Levee (Reach 6), the Des Moines-West Des Moines Levee along the Raccoon River (Reach 8) and Leetown Creekway (Reach 11), were added for reevaluation following the finding that the Raccoon River flood discharges had increased. This resulted in eleven areas (reaches) being identified for inclusion in the study. A number of other areas were also considered for addition to the study, but were eliminated because of the very low potential for economic feasibility as a federal project.

**Table 1: Inventory of Data Developed for the Study**

| Inventory | Location Evaluated Units |
|---|---|
| Digital topographic mapping from Aerial Services, Inc, Cedar Falls, Iowa at a scale of 1"=100' with 2' contour intervals<br><br>Purpose: to give more accurate indications of areas that would flood and update flood insurance mapping | Approximately 16,500 acres |
| Levee elevation surveys performed by the City Des Moines<br><br>Purpose: to provide data for alternative development for geotechnical design | Birdland Park and Central Place levees |
| Hydrologic modeling to determine estimated peak flood discharges, performed by the Rock Island District<br><br>Purpose: to use the longest period of record and to examine increases due to urbanization | Fourmile Creek (The Des Moines and Raccoon had been published by HEC at Davis the year the study started) |
| Surveyed stream cross sections and bridge openings by the City<br><br>Purpose: to provide more accurate input to HEC-RAS model for streams | 352 cross sections & 50 bridges |
| Prepared digital hydraulic models of the Des Moines River, Raccoon River, Walnut Creek, Fourmile Creek, & Leetown Creekway to determine flood profiles, performed by the Rock Island District<br><br>Purpose: to determine water surface elevation use for design and damages prevented | 34.9 stream miles |
| Mapped floodplain, performed by the Rock Island District<br><br>Purpose: to show inundation limits of 10, 25, 50, 100, 250, and 500-year flood events; use for city planning and possible update flood insurance study | Study Area |
| Detailed levee inspection including borings, performed by the Rock Island District and Terracon Consultants of Des Moines, Iowa<br><br>Purpose: to determine condition of the levee and provide input to geotechnical design analysis | Study Area |
| Evaluation of habitat and specie by Rock Island District, USFWS, and the Iowa Department of Natural Resources (Iowa DNR)<br><br>Purpose: to provide input to environmental impact analysis | Birdland Park, Central Place and Chichaqua mitigation site |
| Cultural Surveys, performed by Great Lakes Archeological Research Center<br><br>Purpose: to determine the presence and significance of cultural sites | Chichaqua environmental mitigation site, Birdland Park, Central Place and downtown closures |
| Phase I Environmental Site Assessments, Stanley Consultants Inc.<br><br>Purpose: to determine if there is a high probability of the presence of hazardous contamination in soil and ground water | Study Area |
| Phase IIA Environmental Site Assessments, Missman-Stanley and Assoc<br><br>Purpose: to sample soil and ground water in suspected areas identified in Phase I site assessment | 38 water samples<br><br>76 soil samples |
| Economic analysis of past and potential flood damage of structures and contents, performed by the Rock Island District<br><br>Purpose: to provide information to develop B/C ratios | Study Area |

Attempts to identify areas within the City for ecosystem restoration of wildlife and aquatic habitats were unsuccessful because of a lack of local financial support for sponsoring an ecosystem restoration project. There was no ecosystem restoration opportunity associated with flood damage reduction.

Recreational opportunities exist at all the levees due to the extensive trail system in the surrounding Des Moines area and will be evaluated with each reach that has a flood damage reduction project with a positive benefit to cost (B/C) ratio. More discussion of plan formulation can be found at each specific reach in this section.

#### a) Public Involvement

Throughout the feasibility study, the study team strived to inform, educate, and involve the many groups with an interest in the study. This coordination was paramount in assuring that all interested parties had an opportunity to be part of the study process. The public and interested agencies were involved in scoping, developing alternatives and reviewing products of this study. Affected landowners and other stakeholders continued to be part of the planning process as decisions were made.

The public involvement process was used to exchange information with various segments of the public in order to reduce unnecessary conflict and to achieve consensus. This public involvement and coordination helped to open and maintain channels of communication in order to consider public views and information in the planning process.

The public involvement plan for the study included the following techniques for providing information to the public and receiving feedback during the study: newsletters, study website, and a public open house. The newsletters provided study information and points of contact for the publics' questions and comments. The study website was created as a tool for additional information sharing. The open house was held in January 2003 to provide an opportunity for the public to meet one-on-one with study team members to discuss the study status and to offer comments. Additional information about the newsletters, website, and public open house is included in Appendix H.

## 4. C. ASSESSMENT OF WATER AND RELATED RESOURCES

The local watershed around the city of Des Moines was assessed as a system, which includes all of the previously described reaches, to determine if systemic flood damage reduction features, such as reservoirs, would contribute to more than one reach. The following existing conditions viewed from a systemic perspective helped the team to understand the interrelationships among the reaches. Additional assessments can be found in the appendices and in Section 6 of this report. Detailed conditions of each reach can be found in the reach-by-reach evaluations found in Sections 4.B. through 4.L.

### 4.C.1. General Existing Conditions

#### a) Flooding and Flood Protection

The annual precipitation for the region averages approximately 35 inches, with most of this falling as rain in the spring and summer months. Because of its location at the confluence of several streams, the City experiences frequent flooding. Hydrologic studies were conducted for the Des Moines River, Raccoon River, Walnut Creek, Fourmile Creek, and Leetown Creekway. These studies determined that the flood discharges for the Raccoon River and Des Moines River below the confluence with the Raccoon River were much higher than previously determined, but that the flood discharges in the Des Moines River above the confluence with the Raccoon River were about the same. The flood discharges for Fourmile Creek also showed a substantial increase. A summary of the updated flood discharges compared to the 1988 Flood Insurance Study (FIS) discharges and the estimated peak discharges from the 1993 flood is shown in the table below.

Digital topographic maps were developed using aerial photographs taken in 1996, 1997, and 2002. From the digital topographic maps and surveyed stream cross-sections, hydraulic models were prepared to compute water surface profiles and to develop floodplain maps for the above streams, and to update flood discharges. A summary of these hydrologic and hydraulic studies is included in Appendix A and Table 2.

**Table 2: Flood Discharge Summary Cubic Feet per Second**

| River/Stream | 1988 FIS 100-year | New 100-year | New 500-year | Peak 1993 Flood |
|---|---|---|---|---|
| Des Moines River, NW 2nd Avenue | 33,000 | 37,000 | 52,000 | 55,000 |
| Des Moines River, SE 14th Avenue | 63,900 | 87,000 | 132,000 | 116,000 |
| Raccoon River | 46,300 | 61,300 | 85,900 | 71,000 |
| Walnut Creek | 17,000 | 15,900 | 24,300 | 6,460 |
| Fourmile Creek | 6,140 | 8,290 | 10,700 | 4,200 |
| Leetown Creekway | 1,304 | 1,585 | 1,880 | - |

The City has aggressively pursued flood protection, especially since the flooding in 1993. Reaches 6, 7, and 8 have been improved and a number of storm sewers and storm water detention basins have been constructed. New pump stations, reducing flooding from interior drainage, were constructed to federal standards along with other measures to reduce flood damages. In addition to construction activities, a total of $ 2,352,664 has been spent by the City in a voluntary home buyout program, resulting in the purchase of 26 homes in flood-prone locations. Even with these improvements, portions of the City remain vulnerable to flooding, particularly from larger flood events. Based on information gathered and evaluated in Phase 1 of the study, the following summary of existing flood protection shows that Birdland Park and Central Place do not provide the level of protection that was once thought, see Table 3.

**Table 3: Flood Protection Provided by Existing Levees in Des Moines**

| Reach | Name | Federal or Nonfederal | Level of Protection |
|---|---|---|---|
| 1 | Birdland Park [1] | Nonfederal | Less than 10 year |
| 2 | Central Place [1] | Nonfederal | Less than 10 year |
| 3 | Downtown East [2] | Federal | Slightly more than 100 year |
| 4 | Downtown West [2] | Federal | Slightly more than 100 year |
| 5 | Downtown South [2] | Federal | Slightly more than 100 year |
| 6 | Des Moines Water Works [2] | Nonfederal | Slightly more than 250 year |
| 7 | 205 Raccoon River Levee [2] | Federal | Slightly more than 100 year |
| 8 | West Des Moines Levee [2] | Federal | Slightly more than 100 year |
| 9 | Walnut Creek | No Levee | - |
| 10 | Fourmile Creek | No Levee | - |
| 11 | Leetown Creekway | No Levee | - |

Note: In this table, the term *level of protection* is assumed to mean during a flood event that the levee would provide protection for "most" (95 percent) of, for example, 100-year flood events.
[1] Levees were evaluated to fail just above landside toe of levee thus reducing their previously thought level of protection.
[2] Levee assumed to fail at levee crest.

In the downtown areas (Reaches 3, 4 and 5) that are currently protected by federal levees, the large number of closures that must be made reduces the level of protection. During flood-fighting events, the City must construct more than 26 street and railroad closures in the downtown levee systems, many of

which are constructed of sandbags. These numerous closures increase the risk of failure of the existing downtown flood protection system. In addition, the City must operate a large number of gatewells and pump stations to minimize damages from interior flooding. Because of the massive amount of labor and materials required to fight large flood events, heroic efforts are frequently necessary to protect the City.

The City utilizes an Automated Local Evaluation in Real Time (ALERT) flood warning system that provides City emergency personnel with advanced flood information via computer. Installed in 1990, the system is managed through an agreement among the cities of Des Moines, West Des Moines and Clive, and the National Weather Service (NWS). Currently, the ALERT system consists of 15 stream gages that measure water levels and rainfall rates. Sensors on the gages measure water levels and rainfall rates. The sensors are connected to data collection processors that transmit field data to the NWS base station. Transmission occurs via FM-line-of-sight radio signals or phone modem. The data is uploaded from the base station to a City of Des Moines server, where Des Moines, West Des Moines, Clive, and the NWS can access it. Software known as DiadVisor is used to monitor rising water elevations, rain gages, and gage status. Continued maintenance and updating of all the ALERT system equipment is imperative for the continued success of the flood warning system.

#### b) Recreation

The City has an extensive, well-used, recreational trail system. One of the primary trails in this system, the Neal Smith Trail, runs along the east bank of the Des Moines River through the downtown area (Reach 3) north and then on and adjacent to the Birdland Park levee (Reach 1). The trail system links many of the City's recreation facilities, including the Botanical Center, Sec Taylor Stadium, the Iowa Events Center, Gray's Lake, and Waterworks Park. Work is underway as part of the Greenbelt plan for additional recreation facilities in the downtown area and Greenbelt Region, covering nine counties. The City has developed a master plan for its recreational trails, which is found at http://www.ci.des-moines.ia.us/departments/PR/trails.htm. McHenry Park, a quarter mile from the Neal Smith recreational trail, is not connected. Residences in the Birdland Park community have requested that the City of Des Moines develop a hub connecting McHenry Park, Riverview Park and the Neal Smith Trail to provide a rest area and trail access.

#### c) Hazardous, Toxic, and Radioactive Waste (HTRW)

An environmental contamination baseline survey was performed consisting of two phases. A Phase I Environmental Site Assessment includes both a records search of ownership, land use, etc. and a walking site survey looking for evidence of soil or water contamination. A Phase IIA Environmental Site Assessment analyzes ground water and soil samples when contamination is suspected.

The Phase I assessment revealed that Reach 1 Birdland Park, Reach 2 Central Place, Reach 3 Downtown East, and Reach 4 Downtown West project areas included many commercial, light industrial and heavy industrial properties. A Phase IIA investigation was conducted for areas of environmental concern to assess the condition of soil and ground water. The HTRW assessment revealed recognized environmental conditions in the following locations: Birdland Park, Central Place (including the mitigation site), Downtown West, and Downtown East project areas. The HTRW assessment revealed no evidence of recognized environmental conditions, such as hazardous substances, HTRW , or other regulated contaminants in connection with the Walnut Creek project area, the Downtown South project area (Leetown Creek (the 7$^{th}$ Ward Ditch) project area, the Fourmile Creek project area, and the wetland mitigation site. The results are summarized in the evaluation of each reach and in Appendix E.

#### d) Environmental and Cultural Resources

The existing upland and bottomland forests on and adjacent to the existing levees have structural diversity such as snags, canopy cover, understory, and downed logs, indicative of habitat for a variety of species.

Emergent wetlands and open water lagoons within the project area also provide wildlife habitat and other functions and values including sediment and nutrient retention and bankline stabilization.

The U.S. Fish and Wildlife Service (USFWS) furnished a list (Table 4), of threatened and endangered species that may be found in the study area. Of the four species, suitable habitat only appears available for the bald eagle and Indiana bat.

**Table 4: List of Federal Threatened and Endangered Species**

| Common Name | Classification | Habitat |
|---|---|---|
| Bald eagle | Threatened | Winters along major rivers and reservoirs |
| Western Prairie fringed orchid | Threatened | Wet Prairies |
| Prairie bush clover | Threatened | Dry Gravelly Prairie soils |
| Indiana bat | Endangered | Caves, mines, and small stream corridors with developed riparian woods; upland forests (foraging) |

Any bald eagle roosting tree(s) would be avoided to the extent possible during preparation of plans and specifications; however, it is expected that the removal of one or a few roosting trees would have no appreciable adverse effect on the species. Tree clearing shall be limited to that which is absolutely necessary for construction of the project. There is also potential for suitable summer habitat for the Indiana bat within the wetland and upland forest project areas. Informal consultation between the USFWS and the District determined that a biological assessment would not be required for these species under the proposed project. If it is determined that one of the above species would be affected by any proposed project in this report, the appropriate actions would be taken according to Figure 23: Endangered Species Clearance Flowchart. No State-listed threatened or endangered species are known to be present in the project area. Environmental resource details can be found in the evaluation of each reach and in Section 6. A

The District queried the most current version of the District Archeological Site and Survey Geographic Information Systems (GIS) databases (current as of April 2004) and determined that there is one previously recorded archeological site within the project area. Reaches 1, 2, and 5 have not been surveyed previously and there are no previously recorded sites within the levee construction, closure construction, and/or wetland mitigation areas. Portions of Reaches 3 and 4 have been surveyed and one archeological site, 13PK61, is located in Reach 4, adjacent to a proposed railroad bridge closure structure.

The 19 proposed closure structures are located within the Civic Center Historic District: eleven closures in Reach 3, six closures in Reach 4, and two closures in Reach 5. The Civic Center Historic District is a National Register of Historic Places (NRHP) multiple property listing based on thematic areas of significance including architecture, community planning and development, and landscape architecture dating from 1892 to 1938. The nomination includes seven contributing structures, six contributing buildings, and five noncontributing structures. Two proposed levee closures are adjacent to the Court Avenue Bridge, a contributing resource to the NRHP Civic Center Historic District nomination, and two closures are proposed for the Des Moines Union Railway Bridge, a noncontributing structure that has been determined individually eligible for inclusion on the NRHP. Finally, four closures in Reach 4 are located within the recorded boundaries of NRHP eligible archeological site 13PK61. Site 13PK61, Fort Des Moines No. 2, is a multi-component prehistoric and historic archeological site. Numerous investigations have evaluated portions of the site and it was formally determined eligible for inclusion on the NRHP in 2000.

#### e) Social and Economic Conditions

The City, located in Polk County, is the state capitol of Iowa. The Des Moines River and Raccoon River trisect the City. In the year 2000, the City had a population of 198,700, while the Des Moines Metropolitan Statistical Area (MSA) has a year 2000 population of 483,000. Table 5 depicts historical and projected trends.

**Table 5: Des Moines, Iowa MSA Population Trends**

| | 1970 | 1980 | 1990 | 2000 | 2010 |
|---|---|---|---|---|---|
| **Population** | 364,700 | 392,800 | 418,000 | 483,000 | 534,000 |

The 2000 census data indicates that the Des Moines area labor force is concentrated in the service industries, wholesale/retail trade, and insurance/finance industries. Mean household income for year 2000 was $78,200 in the Des Moines area, compared to $65,600 for the State of Iowa, and $77,600 for the United States. Major state and federal highways, the Interstate Highway system, railway, and airline networks serve the metropolitan area.

In general, the existing condition floodplain in Des Moines is densely developed. Reach 4, Downtown West, has substantial growth and redevelopment. Since unprotected areas of the floodplain are regulated, at-risk structures are not expected to increase. The City has an ongoing floodplain property buyout program to purchase frequently damaged structures in unprotected areas. Further details regarding economic conditions can be found in Appendix B.

### 4.C.2. General Future Conditions without Project

Over the next 50 years, flood damage potential expressed as expected annual flood damages in certain study reaches would continue to adversely impact the City (Appendix B), and businesses and residences would continue to be vulnerable to flooding. Recreational needs would continue to increase according to City trends and increase in population. Hazardous contamination is not likely to change in the near future. Environmental habitats would continue to mature, agricultural land uses would slowly be urbanized, and the population of the metropolitan area is likely to expand to 650,000.

### 4.C.3. Summary of Problems and Opportunities

Following is a summary of specific problems and opportunities identified as part of this study. The study objectives are to identify optimized alternatives that solve these specific problems and take advantage of the opportunities when possible.

| Specific Reach | Problem/Opportunity |
|---|---|
| Reaches 1 & 2, Birdland Park and Central Place levees | Existing levees do not provide reliable flood protection. Are there cost-effective measures to reduce potential flood damages? |
| Reaches 3, 4 & 5 Downtown levee systems closures | Numerous closures decrease the reliability of current flood protection systems. Will increases in flood protection height and redesign of closures be cost effective? |
| Reaches 6, 7, 8 Other levee systems, Raccoon River 205, Water treatment plant and West Des Moines | Flooding can occur above the 100-year level. Are there flood damage alternatives that are cost effective? |
| Reaches 9, 10 and 11, Walnut Creek, Fourmile Creek and Leetown Creekway | No flood protection exists and the areas are subject to frequent flooding. Are there any cost effective measures to reduce damages? |

### 4.C.4. Planning Constraints

The planning constraints identified for this study were requirements that the plan alternatives be economically and environmentally feasible and qualify for federal interest under existing laws. Further, plan formulation must provide safe conditions in the interest of public safety and be socially acceptable to the community. Increased urbanization has led to higher land values and is encroaching on possible reservoir sites.

### 4.C.5. Description of Initial Measures Eliminated from Further Analysis

The *"Des Moines River Basin, Iowa and Minnesota Feasibility Study" dated July 22, 1977* was reevaluated using updated hydrology to determine if any conditions had changed that would make constructing reservoirs, dry dams or other water retention or channel widening features economically feasible. The following projects were briefly reconsidered during this study:

- Constructing reservoirs in the Raccoon River and Walnut Creek watersheds
- Channel and bridge modifications on Raccoon River and Walnut Creek

In addition, constructing a reservoir on Fourmile Creek was considered. The following table summarizes measures eliminated from further analysis in the study. Table 6 provides a more detailed description.

**Table 6: Summary of Measure Eliminated from Further Analysis**

| Measure | Reason for Elimination |
|---|---|
| Reservoirs | 1. The Des Moines River has two large reservoirs up and down stream of the City<br>2. Much of the watershed is flat with development in remotely suitable areas |
| Channel Modification<br>By-Pass Channels | 1. The Des Moines River contains two dams; increasing the cross-sectional area by deepening the channel is not possible.<br>2. Existing levees flank both banks; increasing the cross-section by widening the cross-section would mean condemning downtown real estate and rebuilding the levees.<br>3. Environmental mitigation would be required and would be cost prohibitive. |
| Non Structural measures<br>Flood Warning<br>Buy-out program | 1. Flood warning system already exists<br>2. Flood proofing is cost prohibitive because of the large numbers of properties in Reaches 1-11.<br>3. Reaches 1-8 already have some type of flood control and are heavily populated; buy-out measures are not feasible. Reaches 9 & 10 have a low number of affected structures and lower flood damages that do not warrant a buy-out program. Reach 10 was the only reach with a possibility of having economic justification for a buy-out program, as discussed in Section 4. N. |
| Ecosystem Restoration | No opportunities were found to combine ecosystem restoration with viable flood damage reduction measures. |

The following is a description of the measures eliminated from further evaluation:

#### a) Constructing Reservoirs

This type of flood damage reduction measure generally requires a large site and topography such that water can be stored in the area without inducing damages on nearby property. There are already two reservoirs on the Des Moines River, upstream of the city is Saylorville reservoir and downstream from the city is Red Rock reservoir. Based on a reevaluation of previous studies on the Des Moines River,

building additional reservoirs and modifications to the existing reservoirs were again eliminated from further consideration. Saylorville reservoir currently provides substantial flood damage reduction benefits; modification of the dam to further increase storage is not feasible.

Reservoirs have been widely proposed as a solution to reduce flooding in Fourmile Creek. An upstream reservoir sites identified in the USACE May 1975 study determined that reservoirs were not cost effective and presently are no longer available due to industrial development adjacent to Fourmile Creek in the Ankeny area. Additional reservoir sites in the Fourmile Creek watershed are not available due to the relative flat topography in northern Polk County and southern Story County. A relatively large site would be needed to store enough runoff to effectively reduce flooding. A reservoir to reduce the discharge of a 1 percent annual chance (100-year) flood to that of a 10 percent annual chance (10-year) flood would need approximately 6,600 acre-feet of storage. If such a site were available, this reservoir would cover 660 acres to an average depth of 10 feet.

The City has very successfully reduced flooding through the development of stormwater detention basins in the Leetown Creekway watershed. Very little potential for additional detention basin development is available within the heavily developed watershed.

Reservoirs in the Raccoon River watershed, which includes Walnut Creek, were also eliminated in the USACE 1975 Des Moines River Basin report and confirmed in this study. The report concluded; "Upstream reservoirs would have to be supplemented by other resources at the Wes Des Moines / Des Moines area because the dam sites are too far upstream of the area to effect significant reductions in the flood profiles." No reservoir sites are available that warrant further consideration for providing flood damage reduction to the City of Des Moines metropolitan area.

#### b) Channel modifications and bypass channels

Channel modifications to increase the stream channel's capacity to carry flood flows, such as enlarging, straightening, and smoothing stream channels and removing channel obstructions, such as log jams and bridge piers, is rarely viable. As one control point is removed, another either exists or is created downstream which causes water to back up. Alluvial sand, soil, and rock deposited by the river removed to enlarge or deepen the channel would be replaced in time, requiring constant maintenance, which is expensive. Environmental habitat is nearly always disrupted, causing channel modification to be expensive for little long-term benefit. The USACE 1975 Des Moines Basin Report found no cost-effective channel modifications, the most feasible measures having preliminary benefit-to-cost ratios of less than 0.1. During this planning effort, new floodwater profiles of the existing channel were developed. No measures were identified that would cost-effectively reduce flood damages; therefore channel modification was eliminated from further analysis. Bypass channels were identified as infeasible and were eliminated from further analysis.

#### c) Non-structural measures

Nonstructural measures reduce flood damages without significantly altering the nature or extent of flooding, either by changing the use made of the floodplains or by accommodating existing uses to the flood hazard. Some examples of nonstructural measures include flood proofing; modifying or elevating structures to minimize flood damages; permanent evacuation of structures; flood warning/preparedness systems; and regulation of floodplain uses. Reaches one through eight have levees and are heavily populated; non-structural measures would not be cost effective due to the number of structures. Reaches nine through eleven have no economically feasible non-structural measures.

Flood damage along portions of Walnut Creek is not severe enough to economically justify a buy-out program nor is it acceptable to the city. Flood proofing of selected individual structures is likely a cost-effective solution, but was not considered for implementation as a federal project for any of these three reaches. Reach 10-Fourmile Creek's floodplain is currently in a buy-out program and many of the

structures have been removed. Several homes and a mobile home park, which had the most frequent and highest damages, were evaluated and found to have B/C ratios less than 0.35 (see the evaluation of Reach 10-Fourmile Creek starting on page 58). Continued buy-outs of flood-prone structures is encouraged.

The City of Des Moines' "ALERT" flood warning system is in place and is providing nearly real time data to city emergency management. The City continues to improve and update this system as needed. Major improvements to the system are unlikely to substantially reduce damages and were eliminated from further evaluation.

#### d) Ecosystem Restoration Opportunities

Due to the existing urban land uses, relatively high property values, and city funding priorities, no ecosystem restoration opportunities would be utilized and is therefore eliminated from further analysis.

### 4.C.6. Description of Available Measures for Individual Reaches

Only two flood damage reduction measures are still available for evaluation, buy-out program and the construction of levees. The buy-out program has already discussed, however a levee system has not until now. The term levee includes levees, floodwalls, dikes, associated drainage structures, ponding areas, pump stations, and closure structures. For Reaches 1 through 11 new levees could be constructed to protect areas without flood protection, and existing levees could be reconstructed or modified to provide an improved level of protection.

## 4. D. REACH EVALUATION SUMMARY

A summary of economic findings is presented in Table 7.

**Table 7: Economic Summary, highlighted preferred plan (May 2004 price level)**

| Reach and Plan | Top of Levee | Project Cost Estimate | Interest During Const. | Total First Costs | Annualized First Costs | Annual O & M Costs | Total Annual Costs | Total Annual Benefits | Benefit Cost Ratio | Net Annual Benefits | Residual Flood Damages |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reach 1 Birdland Park Study Area** | | | | | | | | | | | |
| *Alignment 1* | | | | | | | | | | | |
| 500 year | | 6,679,000 | 575,000 | 7,254,000 | 436,000 | 14,000 | 450,000 | 437,000 | 0.97 | -13,000 | 11,000 |
| *Alignment 2* | | | | | | | | | | | |
| 100 year | 803.3 | 3,618,000 | 343,000 | 3,961,000 | 238,000 | 14,000 | 252,000 | 255,000 | 1 | 3,000 | 181,000 |
| 250 year | 806.3 | 4,048,000 | 372,000 | 4,421,000 | 266,000 | 14,000 | 279,000 | 312,000 | 1.1 | 32,000 | 130,000 |
| 500 year | 809.5 | 4,984,000 | 437,000 | 5,421,000 | 326,000 | 14,000 | 340,000 | 437,000 | 1.3 | 97,000 | 11,000 |
| *Alignment 3* | | | | | | | | | | | |
| 500 year | | 6,434,000 | 506,000 | 6,940,000 | 417,000 | 14,000 | 431,000 | 437,000 | 1 | 6,000 | 11,000 |
| **Reach 2 Central Place Study Area** | | | | | | | | | | | |
| 100 year | 802.3 | 3,156,000 | 240,000 | 3,396,000 | 204,000 | 15,000 | 219,000 | 667,000 | 3.1 | 448,000 | 235,000 |
| 250 year | 805.3 | 3,420,000 | 258,000 | 3,678,000 | 221,000 | 15,000 | 236,000 | 764,000 | 3.2 | 528,000 | 139,000 |
| 500 year | 808.7 | 3,839,000 | 287,000 | 4,126,000 | 248,000 | 15,000 | 263,000 | 895,000 | 3.4 | 632,000 | 8,000 |
| **Reach 3 Downtown East Levee** | | | | | | | | | | | |
| Closure Improvements | | 642,000 | 37,000 | 679,000 | 41,000 | 0 | 41,000 | 156,000 | 3.8 | 115,000 | 252,000 |
| 500 year levee | | 11,440,000 | 1,070,000 | 12,510,000 | 752,000 | 10,000 | 762,000 | 113,000 | 0.2 | -649,000 | |
| **Reach 4 Downtown West Levee** | | | | | | | | | | | |
| Closure Improvements | | 260,000 | 15,000 | 275,000 | 17,000 | 0 | 17,000 | 74,000 | 4.5 | 57,000 | 160,000 |
| 500 year levee | | 4,943,000 | 529,000 | 5,472,000 | 329,000 | 10,000 | 339,000 | 97,000 | 0.3 | -241,000 | |
| **Reach 5 Downtown South Levee** | | | | | | | | | | | |
| Closure Improvements | | 31,000 | 2,000 | 33,000 | 2,000 | 0 | 2,000 | 30,000 | 15.3 | 28,000 | 46,000 |
| 500 year levee | | 6,175,000 | 577,000 | 6,752,000 | 406,000 | 10,000 | 416,000 | 29,000 | 0.1 | -388,000 | |
| **Reach 6 Raccoon River Section 205 Levee** | | | | | | | | | | | |
| Plan 1 | Evaluate reliability of existing Federal levee. Levee improvement plans were eliminated during plan formulation. | | | | | | | | | | |
| **Reach 7 Des Moines Water Works Levee** | | | | | | | | | | | |
| Plan 1 | Evaluate reliability of existing Federal levee. Levee improvement plans were eliminated during plan formulation. | | | | | | | | | | |
| **Reach 8 Des Moines-West Des Moines Levee** | | | | | | | | | | | |
| Plan 1 | Evaluate reliability of existing Federal levee. Levee improvement plans were eliminated during plan formulation. | | | | | | | | | | |
| **Reach 9 Walnut Creek at Grand Avenue** | | | | | | | | | | | |
| Plan 1 | | 2,481,000 | 143,000 | 2,624,000 | 158,000 | 0 | 158,000 | 50,200 | 0.32 | -108,000 | |
| **Reach 10 Fourmile Creek** | | | | | | | | | | | |
| Plan 1 | MH Park Buyout | 2,150,000 | 124,000 | 2,274,000 | 137,000 | 0 | 137,000 | 47,000 | 0.35 | -89,000 | |
| Plan 2a | Levee LB-2 | 3,790,000 | 213,000 | 4,003,000 | 241,000 | 3,000 | 244,000 | 13,000 | 0.06 | -230,000 | |
| Plan 2b | Levee LB4 | 2,690,000 | 151,000 | 2,841,000 | 171,000 | 3,000 | 174,000 | 12,000 | 0.07 | -162,000 | |
| Plan 2c | Levee RB3 | 571,000 | 32,000 | 603,000 | 36,000 | 1,000 | 37,000 | 1,000 | 0.03 | -36,000 | |
| Plan 2d | Levee RB4 & RB5 | 1,420,000 | 80,000 | 1,500,000 | 90,000 | 2,000 | 92,000 | 0 | 0 | -92,000 | |
| Plan 2e | Levee RB6 | 165,000 | 9,000 | 174,000 | 10,000 | 1,000 | 11,000 | 1,000 | 0.1 | -10,000 | |
| **Reach 11 Leetown Creek** | | | | | | | | | | | |
| Plan 1 | Evaluate reliability of the Red Rock Remedial Works levee (see Plan Formulation Section and Hydraulics Appendix). Evaluation reported adequate reliabilities, therefore no Leetown Creekway structural improvements were assessed. | | | | | | | | | | |

5-5/8% Discount Rate, 50-Year Evaluation Period

## 4. E. REACH 1 - BIRDLAND PARK EVALUATION

The Birdland Park area contains 170 acres of residential and commercial property located along the left descending bank of the Des Moines River north of the downtown area. This area includes the North High

School complex, Birdland City Park, and numerous commercial establishments. This levee was overtopped during the 1993 flood, causing extensive flood damages. This levee requires upgrading to meet current USACE flood protection levee standards. A comprehensive analysis of levee height and structure was conducted, along with street closures and other related structures (Figure 3.)

### 4.E.1. Existing Conditions (Birdland Park)

Based on the revised hydrologic and hydraulic modeling discussed in Volume 2, Appendix A, the updated 100-year flood profile of the Des Moines River at Birdland Park was determined to be essentially the same as the 1988 flood insurance study (FIS) report. The Birdland Park levee, constructed in the 1950s by the City, was overtopped during the 1993 flood event, causing extensive damage. The levee was constructed of miscellaneous fill and has been found to contain rubble and debris. Today, the top width and slopes are variable and do not meet minimum federal standards. In the years since construction, portions of the levee have become heavily overgrown with trees. Geotechnical analysis of the levee has determined that this levee is insufficient to provide reliable flood protection. The existing levee has the following estimated probabilities for failure, based on water surface elevation National Geodetic Vertical Datum (NGVD):

- 801.0 feet NGVD – Above the 100-year flood event - (95% probability of failure)
- 798.0 feet NGVD - Below the 50-year flood event - (50% probability of failure)
- 784.0 feet NGVD - Below the 5-year flood event - (0% probability of failure)

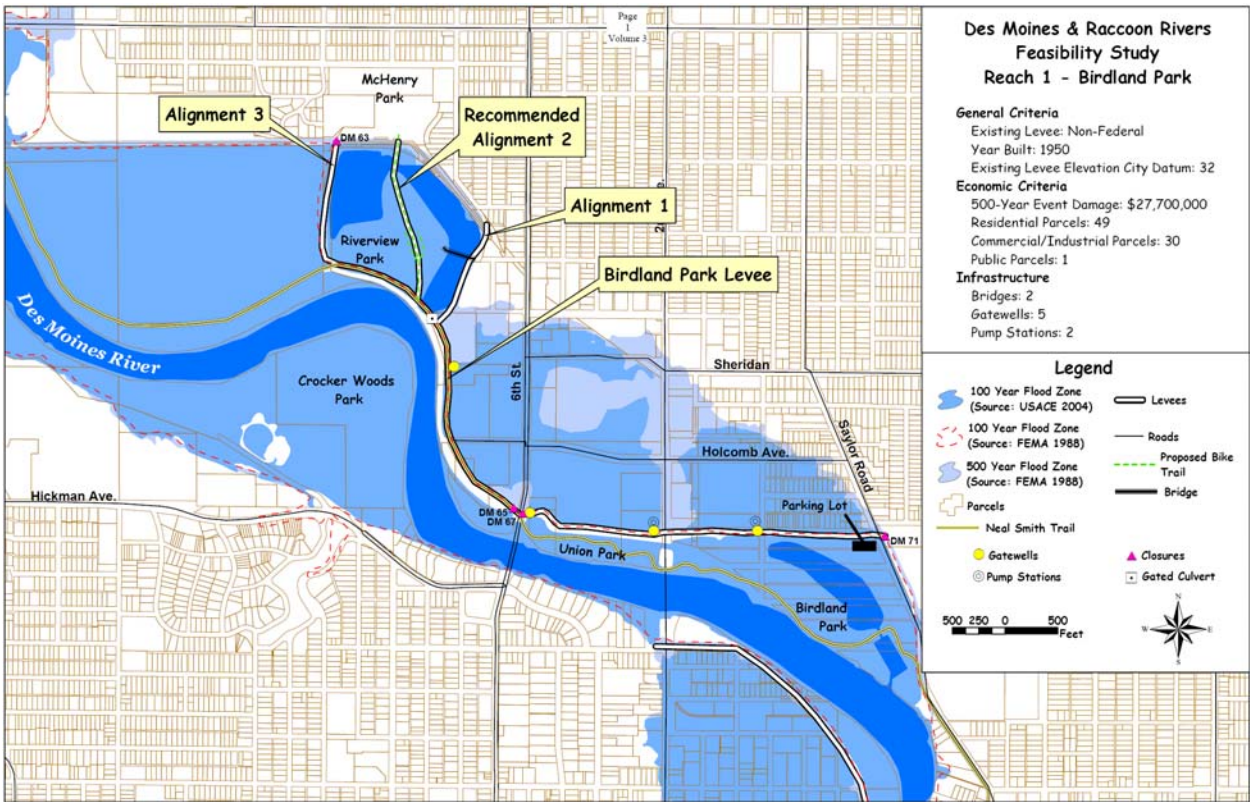


**Figure 3: Reach 1 Birdland Park Study Area**

The soils underlying the proposed levee through the Riverview Park include sand seams. The sand layers could contribute to under-seepage.

Storm water systems do not cross-over into Reach 3 Downtown East, making Reach 1 independent. Two pump stations, one built in the late 1960s, is next to Guthrie Avenue, and the other, constructed in the 1990s, is west of 2nd Avenue. Both pump stations are well maintained and provide adequate protection from interior flooding. The road closure opening at Saylor Road is over 150 feet wide and over 6 feet high, making it too large to be effectively closed with temporary earthen structures during flood events. FEMA's Flood Insurance Rate Maps (FIRMs) currently show the Birdland Park levee as providing 100-year flood protection; however, based on the findings for this study, the existing levee does not meet federal standards for providing 100-year flood protection, see Appendix C, Engineering.

The Birdland Levee is currently part of the City of Des Moines recreational trail system, the Neal Smith Trail. This trail runs beside and on the top of the levee, and is a segment of the longer Saylorville Trail (Figure 4). The Neal Smith Trail runs north from University Avenue to the City limits along the Des Moines River to Saylorville Lake, and then to Big Creek State Park. Trailheads are located at the Botanical Center's riverfront parking lot near the University Avenue Bridge and at a shopping center off Douglas Avenue. The existing recreational trail is on and alongside the levee at Birdland Park and is well used.

**Figure 4: Neal Smith Trail, Woody Vegetation on Levee**

Hazardous, toxic, or radioactive waste (HTRW) soil testing indicated the presence of arsenic, beryllium, and benzo(a)pyrene. Groundwater testing confirmed the presence of arsenic, beryllium, thallium, barium, boron, cadmium, chromium, lead, manganese, nickel, selenium, and vanadium. Contaminant concentrations were in excess of the Iowa Land Recycling Program statewide standards. HTRW

clearance has been obtained from the State of Iowa in a letter dated 7 February 2005 and is located in Appendix H.

The structural diversity of the existing large trees, shrubs, and herbaceous plants growing on the levee provide habitat for a variety of wildlife. A bottomland hardwood forest of varying widths and distances to the Des Moines River borders the riverward side of the levee.

The Kiwanis Club leases Riverview Park from the City, and has developed a Master Plan for replacing an abandoned amusement park with a more natural setting for public recreation. Possible recreational improvements are also proposed as part of the Greenbelt; however, planning for these improvements is currently inactive. Riverview Park has scattered large trees, although most of the island is mowed by the Kiwanis Club to maintain a park-like setting. A cattail marsh in the western end of the island sits on an abandoned asphalt parking lot, and a scrub-shrub and emergent wetland runs along the northern tip of the island increases the value of the area for wildlife and recreation. The large bottomland hardwood forest that runs along the levee continues along the western edge of Riverview Park and the adjacent large lagoons. The lagoons are fed by groundwater and storm water and do not have a surface water connection to the Des Moines River. Sediment is being carried into the lagoons in excess amounts due to erosion around the storm water culverts at the northern end of the lagoons. Local recreational fishermen utilize the lagoons. South of Riverview Park, the landward side of the existing levee is developed with mowed lawns and paved roads. The riverside of the existing levee is primarily vegetated with emergent wetland species, see Section 4.E.6.a) of this report for additional environmental information.

A cultural survey and record investigation recommended cultural resource management clearance for the entire Reach 1 study area.

It is likely that large flood events of the magnitude of the 1993 flood would not be successfully fought, and flood damage to the existing structures would exceed 50 percent of their value. Those structures would then need to be demolished or relocated from the floodplain, and reconstruction on that site would be allowed only if certain costly design features were included in the reconstruction design. As this progressively occurs over time, many existing neighborhoods would become vacant lots and/or degraded housing. It is also likely that future development of Birdland Park would occur on lands that are outside the floodplain, creating further problems in the older established neighborhoods. There would also be restrictions on the development of structures located in the floodplain, consistent with the National Flood Insurance Program. The ongoing cost of flood insurance and the spiral of negative impacts associated with the community located within the regulatory floodplain remaining susceptible to flooding are unacceptable to City officials.

### 4.E.2. Future without Project Conditions (Birdland Park)

The existing Neal Smith Trail, which is adjacent to and on top of the existing levee, would likely be broken apart in areas where the levee fails. Existing hazardous contamination would remain undisturbed until the levee failed, at which point it may be released into the environment. The North High School facilities would remain at risk to flood damage and extended school closures.

“No Action” means that no federal flood reduction project would be constructed. This alternative assumes that the community would continue to rely on the existing levee system, emergency flood fighting measures, and flood insurance to provide flood damage protection.

### 4.E.3. Problems and Opportunities (Birdland Park)

**Problem:** The existing levee has a high probability of failure due to instability of the levee embankment, putting nearly 200 homes and businesses at risk of flooding. Fifty-year-old trees and brush, unsuitable construction materials, and steep embankments which are difficult to mow to keep vegetation controlled

are the major sources of instability. Inability to adequately make road closures during floods also increases the potential for flood damage.

**Opportunities:** There is an opportunity to improve a portion of the Neal Smith Trail by widening it to improve safety and to accommodate increased recreational traffic. The City would like to connect McHenry and Riverview Parks with the Neal Smith Trail. With these improvements, it is estimated that a 75-100 additional people would use the trail daily. As earlier stated, residents of the Birdland Park community have requested that the City of Des Moines develop a hub connecting McHenry Park, Riverview Park and the Neal Smith Trail to provide a rest area and trail access.

### 4.E.4. Measures Eliminated From Further Analysis (Birdland Park)

Reconstructing the existing levee to protect against a 25-year or 50-year flood were eliminated because these heights would result in a levee that is lower than the existing levee, and would require removing earthen material from the site, which would result in a cost greater than flood damage reduction benefits.

### 4.E.5. Selecting and Combining Measures into Alternatives (Birdland Park)

Stanley Consultants, with the aid of study team members, investigated the reliability of the existing levee system by making soil borings. Based on the results of the study, the study team's conceptual plan was to:

- remove all woody vegetation from the levee and 15 feet outside the toe;
- dig an inspection trench 8-feet wide along the bottom of the levee to determine the types and locations of unsuitable construction materials in the levee;
- rebuild the levee and replace those materials with suitable core material. In the southern portion of the proposed levee rebuild, portions of the Neal Smith trail are on top of the levee and only 9-feet wide. The reconstructed levee would be widened to accommodate a 12-foot trail, and.
- Construct a seepage berm on the land side of the levee to ensure control of seepage in areas where the ground elevation is less than 32 feet city datum.

The Stanley team determined that there were three viable alternative alignments as shown in Figure 5 , varied environmental, real estate acquisition and cost impacts to the project. All alignments will be initially compared at the 500-year levee height. The following description of each alignment:

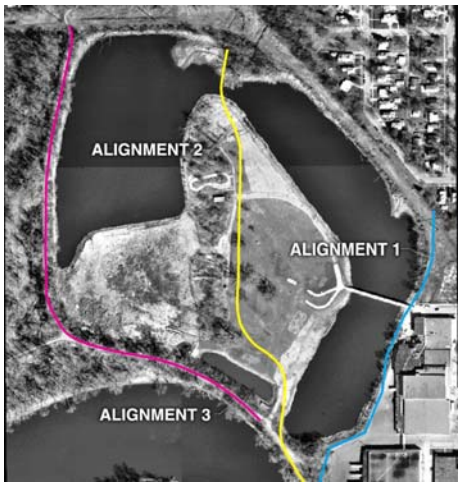


**Figure 5: Birdland Park Proposed Levee Alignments**

Alignment 1 hugs the easterly shore of the lagoon, tying off into the bluff at the nearest point beyond the commercial buildings and is constructed of both floodwall and levee. A floodwall is required to avoid affecting the existing businesses. The advantages of this alignment include minimizing impacts to wetlands/bottomland hardwood forest. However, real estate/land acquisition costs are the highest for this alignment because of the close proximity to commercial businesses.

Alignment 2 crosses Riverview Park and avoids the already-cramped access to the commercial buildings. It is an earthen levee and has 42" Reinforced Concrete Pipe (RCP) drainage pipe and gatewell to drain the eastern portion of Riverview Park Lagoon. A seepage berm would be constructed on the island, with any open water or wetlands filled in to insure proper operations. It also disturbs twice the amount of wetland acres as Alignment 1. A recreational feature would include a bicycle trail/hub connecting the existing Neal Smith Trail, to McHenry Park and Riverview Park. Landscaped overburdens with a pedestrian and bike trail down to Riverview Park with overlooks and resting areas would act as a hub to the two parks and Neal Smith Trail system (Figure 6).

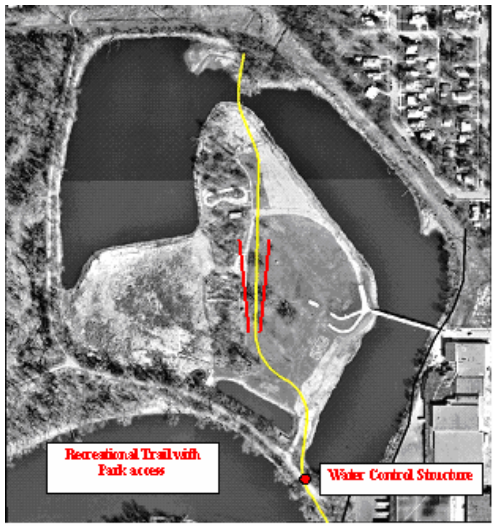


**Figure 6: Recreational Features at Riverview Park Associated with Alignment 2**

Alignment 3 follows the existing alignment and is an earthen levee with a seepage berm. A 42" RCP drainage pipe and gatewell drains storm water from the lagoon. In addition, this alignment would include a bicycle trail connecting the existing Neal Smith Trail to McHenry Park. Alignment 3 removes three times the amount of wetland/bottomland hardwood forest acres but avoids impacts to Riverview Park.

Each of these three alignments shares a common portion of proposed levee reconstruction, portions of which would accommodate the improved Neal Smith recreational trail. Along with other portions of the levee, the levee slopes would be truncated by retaining walls to avoid affecting existing parking lots and ball fields. A double-gated closure would be constructed at Saylor Road as part of the levee design. Following USACE regulations to account for the risk and uncertainty in a design, a detailed process was undertaken to determine the top of levee elevation relative to the design water surface elevation. A confidence interval was established around the various design parameters, and a quantitative analysis is performed to assure that the elevation at the top of the levee has a high probability of containing the design flood event. In addition, a 0.9 foot superiority elevation was added upstream to assure that any overtopping event occurs first at the downstream end of the project. Cost estimates were developed for three different levee heights (100-, 250- and 500-year) and were evaluated to see which optimized the economic benefits. Table 8 summarizes the features included in each of the three alternative alignments.

Following USACE regulations to account for the risk and uncertainty in a design, a detailed process was undertaken to determine the top of levee elevation relative to the design water surface elevation. A confidence interval was established around the various design parameters, and a quantitative analysis is performed to assure that the elevation at the top of the levee has a high probability of containing the design flood event. In addition, a 0.9 foot superiority elevation was added upstream to assure that any overtopping event occurs first at the downstream end of the project. Cost estimates were developed for three different levee heights (100-, 250- and 500-year) and were evaluated to see which optimized the economic benefits.

**Table 8: Summary of Flood Protection Alternatives**

**Alignment 1**

*Flood Protection Features:*

- Levee length: 7,000 ft; side slope is 3 to 1 with a 10' to 15' crown width
- Flood wall instead of levee along east portion Riverview Park Lagoon
- Closures at Saylor Road, 2nd Ave and 6th Ave
- Retaining wall to narrow levee footprint at Birdland Park's parking area
- Replace existing bike trail

*Recreation Features:*

- Widen Neal Smith bike trail to 10'

**Alignment 2**

*Flood Protection Features:*

- Levee length: 7,700 ft, side slope is 3 to 1 with a 10' to 15' crown width
- Seepage berm, land side of the levee 150' from toe of levee
- Closures at Saylor Road, 2nd Ave and 6th Ave
- Retaining wall to narrow levee footprint at Birdland Park's parking area
- Replace existing bike trail
- 42" RCP Drainage pipe and gatewell for Riverview Park Lagoon

*Recreation Features*

- Widen Neal Smith bike trail to 10'
- Bike trail on levee with access to Riverview Park and McHenry Park
- Over burden and landscaping

**Alignment 3**

*Flood Protection Features:*

- Levee length: 8,300 ft, side slope is 3 to 1 with a 10' to 15' crown width
- Seepage berm, land side of the levee 150' from toe of levee
- Closures at Saylor Road, 2nd Ave and 6th Ave
- Retaining wall to narrow levee footprint at Birdland Park's parking area
- Replace existing bike trail
- 42" RCP Drainage pipe and gatewell for Riverview Park Lagoon

*Recreation Features*

- Widen Neal Smith bike trail to 10'

#### a) Borrow Material

The Birdland levee project would require more than 100,000 cubic yards of compacted impermeable borrow. Searching for a suitable borrow site took a significant amount of time. The initial site proposed was a 50-acre area in the floodplain north of Euclid Avenue on the west side of the river, owned by USACE and managed by the Polk County Conservation District. The proposal was to develop topographic diversity to improve the existing wetlands found in the area. After coordination with local, state, and federal agencies, the District decided not to use the site. Using aerial photography, open agricultural fields that could possibly be used for borrow material were identified. None of these sites were selected because the suitable sites were private property and a long distance from the project. Finally, the City recommended using the excess material excavated from the I-235 project for borrow. The District geotechnical engineering section reviewed the boring logs for this material and determined the material suitable for the levee project. The City arranged to have the material stockpiled at the Harriet Street landfill area, approximately 5miles from the project site. Missman Stanley Phase IIA soils analysis has confirmed the presence of arsenic and beryllium in the stockpiled borrows material that is in excess of the Iowa State Land Recycling Program standards. Remediation may be required as coordinated with the Iowa State Land Recycling Program. Hazardous, toxic, or radioactive waste (HTRW) soil testing confirmed the presence of arsenic, beryllium in excess of the Iowa Land Recycling Program statewide standards. HTRW clearance has been obtained from the State of Iowa in a letter dated 7 February 2005 and is located in Appendix H.

In addition to the primary flood damage reduction features of the project, recreational features have been integrated into the project design at the request of the City. These recreational features include widening part of the Neal Smith recreational trail system on top of the proposed Birdland Park Levee and developing a trail on the proposed Alignment 2 levee from the Neal Smith Trail across Riverview Park to McHenry Park. A trail leading down off the levee crossing Riverview Park would be constructed on both sides of the levee, reconnecting two parts of Riverview Park that were divided by the original levee. Some recreational lookouts constructed on overburden added at the top of the levee are also proposed for this area for enhancing the park's use.

### 4.E.6. Screening of Alternatives (Birdland Park)

#### a) Environmental Impacts

An interagency team comprised of the District, USFWS, and Iowa Department of Natural Resources (Iowa DNR), evaluated the project area and conducted a habitat analysis to quantify the forested habitat impacts and develop appropriate mitigation measures to offset those impacts. Informal consultation between the USFWS and the District determined that a biological assessment would not be required for these species under the proposed project.

The habitat analysis of existing study area conditions, future conditions without the project, and the compensatory mitigation proposal used a modified version of the numerical habitat appraisal methodology, Expert Habitat Evaluation Technique (EXHEP). Impacts for all alternatives are shown in Table 9, with Alignment 2 showing a range of impacts depending upon final design.

Mitigation acreage may exceed the number of acres impacted depending on the habitat functions of the impacted area and the proposed mitigation site. The acreages shown in Table 9 reflect the most current plan. These acreages are different than those stated in the Fish and Wildlife Coordination Act Report as shown in Appendix H because the plans have changed slightly since the Coordination Act Report was prepared. Ongoing coordination has taken place with FWS regarding these plan changes to ensure they have had the opportunity to provide input as the District finalizes the proposed alignments.

Habitat analysis suggests that Alignment 3 would have the greatest impacts to upland and bottomland forest followed by Alignment 2. Alignment 1 would impact the least amount of possible threatened and endangered species habitat.

**Table 9: Comparison of Environmental Impacts at Birdland Park Levee**

| Alternatives | 100-year levee | | | | | 250-year levee | | | | | 500-year levee | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wetland [1] | Bottomland Forest [2] | Open Water | Upland Forest | Total Acres | Wetland | Bottomland Forest | Open Water | Upland Forest | Total Acres | Wetland | Bottomland Forest | Open Water | Upland Forest | Total Acres |
| **Alignment 1** | 0.2 | 0.2 | 0.1 | 1.4 | 1.9 | 0.3 | 0.2 | 0.1 | 1.4 | 2.0 | 0.5 | 0.2 | 0.1 | 1.4 | 2.2 |
| **Alignment 2** | 1.0 | 0.2 | 2.4 | 1.4 | 5 | 1.2 | 0.2 | 2.5 | 1.4 | 5.3 | 1.4 | 0.2 | 2.7 | 1.4 | 5.7 |
| **Align. 2 max.** | | | | | | | | | | | 2.3 | 0.2 | 3.8 | 1.4 | 7.7 |
| **Alignment 3** | 2.9 | 0.9 | 2.2 | 4.3 | 10.3 | 3.3 | 0.9 | 2.4 | 4.3 | 10.9 | 4.0 | 0.9 | 2.7 | 4.3 | 11.9 |
| **No Action** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

[1] Acreage refers to emergent wetlands impacted through permanent filling from levee placement
[2] Acreage refers to loss of bottomland forest within 15 feet of the proposed levee alignment

### b) Mitigation site in the Chichaqua Bottoms Greenbelt

"The Skunk River was straightened many years ago, but the river's old floodplain remains wet and easily flooded. For decades, various conservation partners have created and expanded the Chichaqua Greenbelt floodplain, setting it aside for a variety of wildlife and recreation purposes.

Chichaqua is an important resting and staging area for migrating waterfowl and is home to several rare and declining species. It's also home to many reptiles and amphibians, as well as ground-nesting birds like the bobolink. Other parts of the wildlife area contain native prairies, natural or restored wetlands, and trails. Recreational uses include hunting, trapping, native seed harvest, future native seeding, educational tours, hiking and camping" *Iowa Natural Heritage Foundation*

Although this mitigation site is not in the immediate vicinity of the impacts, this 85-acre of farmed land near Hubbell Road, owned by the City was chosen to replace habitat lost at the Birdland Park levee construction. Located within the larger Chichaqua Bottoms Greenbelt, which is approximately 7,000-acres of marshes, forests, prairies, and oxbows that is slowly being restored by a multi-agency effort led by the Polk County Conservation Board, this 20-acre mitigation site is adjacent to another mitigation effort that has installed monitoring wells and has over five-year of monitoring data. This data would be used to aid in designing the new habitat structure. As stated before, the Chichaqua mitigation site is currently used for row-crop agriculture, except for the portion already developed into a wetland (Figure 7). Loss of this marginal farmland would not have any significant impacts to agriculture business. The No Action alternative would allow continued agricultural use of the site for the immediate future. However, because the site was purchased for mitigation purposes, conversion of the entire site into wetlands would eventually take place. A summary of alternative mitigation plans are described in Table 10 Birdland Park Alternative Mitigation Incremental Cost Comparison.

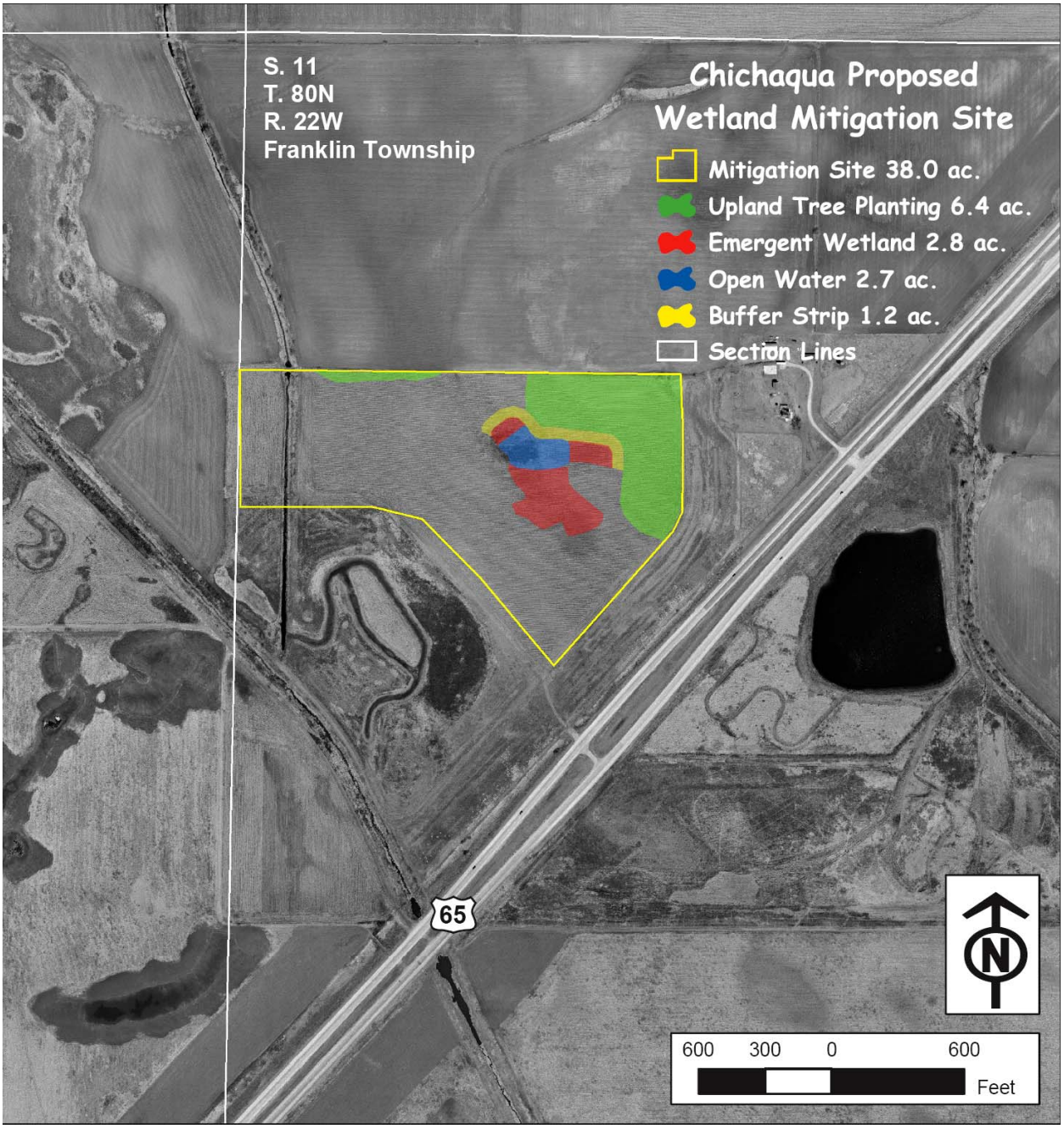


**Figure 7: Chichaqua Proposed Wetland Mitigation Site**

**Table 10 Birdland Park Alternative Mitigation Incremental Cost Comparison**

| Description of Mitigation Alternative | Cost |
|---|---|
| Mitigation avoidance would set back the levee into an urban setting along Alignment 1; condemnation would be required for the entire length of the levee affecting homes, schools and commercial buildings. | $1 million plus makes the project economically unbeneficial |
| Onsite mitigation would require condemnation of adjacent City Parks, (politically unacceptable) | N/A |
| Another offsite mitigation alternative is a city owned area in close proximity to the Des Moines River and soccer fields. The site is located on the hillside above Euclid Ave. Above the site lies high-density housing which may pollute the stormwater runoff supplying the site. Because of the urban setting, there is a high likelihood that pollutants would affect the wetland's function. The site would also require significant physical modification to provide structure, and top soils to replace the lost habitat functions. | $600,000 plus, a high construction cost and low ecological suitability of this site excludes it from further evaluation. |
| Offsite conversion of farmland in the Chichaqua Bottoms Greenbelt floodplain. | $300,000 (most cost effective plan) |

A cultural survey and record investigation documented one isolated archeological site of unknown prehistoric affiliation at the mitigation site and a recommendation was made to make it ineligible for inclusion to the National Register for Historic Properties. The State Historic Preservation Officer concurred with this recommendation. No hazardous contamination concerns were indicated from Phase 1 records search and site survey.

Overall, social and environmental impacts shown in Table 11 were weighted by the number of arrows. Arrows pointing up are positive, arrows pointing down negative. This table provided a summary of impacts for each alignment. Wetland and other environmental impacts were considered during the screening of alternative alignments. The level of environmental impacts and low net annual benefits caused Alignment 3 to be screened out early in the process. Alignment 1 has the least amount of environmental impacts, although it was determined to not be a practicable alternative due to its even lower net annual benefits.

**Table 11: Birdland Park Summary of Environmental Quality Account and Project Objectives**

| Impacts to | No Action | Alignment 1 | Alignment 2 | Alignment 3 |
|---|---|---|---|---|
| Social-Economic Build Levee | ↓↓↓↓ | ↑ | ↑ | ↑ |
| Wildlife Habitat | ↑ | ↓ | ↓↓ | ↓↓↓ |
| Kiwanis Club Aesthetics | ↑ | ↓ | ↓↓ | ↑ |
| Recreational Opportunities Trail to McHenry Park | ↑ | ↓ | ↑ | ↑ |
| Continuity of the Neal Smith Trail | ↓ | ↓ | ↑ | ↑ |

Note: categories that had variance across alternatives were chosen

Table 12 identifies construction costs for each of the alternative alignments, and shows how mitigation and Real Estate (LERRD) costs varied over the alignments. Alignment 2 incurs the lowest over-all construction costs. To simplify the comparison, only the 500-year levee height was evaluated. Each of the lower levee heights showed similar proportions among the three alignments.

**Table 12: Construction Cost Break-out for Alternative Alignments, Birdland Park**

| Alignments (500-year) | Construction | LERRD | Environmental Mitigation | Total for Comparison | Compared Difference |
|---|---|---|---|---|---|
| Alignment 1 | $5,674,000 | $870,000 | $60,000 | $6,604,000 | $1,637,000 |
| Alignment 2 | $4,172,000 | $655,000 | $140,000 | $4,967,000 | $0 |
| Alignment 3 | $5,185,000 | $520,000 | $350,000 | $6,055,000 | $1,088,000 |

These cost figures were preliminary estimates and were used in the initial screening process.

Alignment 2 is the recommended alternative because it has the highest net annual benefits. In addition, wetland and other environmental impacts would be avoided and minimized to the extent possible. A compensatory mitigation plan has also been developed to compensate for any unavoidable wetland and upland forest impacts associated with Alignment 2.

When it became evident that Alignment 2 would be the recommended plan, several coordination meetings were held with the Kiwanis Club to discuss impacts to their plans for Riverview Park, including alternate levee alignments on Riverview Park. Representatives of the Kiwanis Club identified the following planning limitations:

- save as many of the large trees on the island as possible
- minimize impacts to wetlands
- provide access to both sides of the levee with a trail system
- develop landscaped overburdens to naturalize the levee
- provide overlooks and minimize maintenance

In addition, the District identified the following constraint: An alignment on the eastern shore of the island would locate the seepage berm next to the lagoon. During flood events, inspection of the levee system would be difficult.

It was agreed that during plans and specification development, coordination with the Kiwanis Club and the Des Moines City Parks Department would be necessary to integrate local needs into the final design.

#### c) Value Engineering (VE)

USACE, St. Paul District conducted a value engineering study, which provided an objective look at the planning effort for the levee in an attempt to find additional cost-saving measures. The St. Paul District provided several recommendations that were incorporated into the design that helped to reduce project costs and environmental impacts. Following is a summary of these recommendations:

- Raise Saylor Road to eliminate a closure.
- Use a trapezoidal inspection trench with a two-foot bottom width, rather than an eight-foot bottom width, and reuse any suitable material from the trench.
- Use a slurry trench cut-off rather than a seepage berm at Riverview Park, which would significantly reduce the levee footprints (See Figure 8 and Figure 9)
- Replace riprap with articulated concrete mats.
- Use geotextile under the riprap.
- Dispose of unsuitable levee material on the outboard portion of the levee.

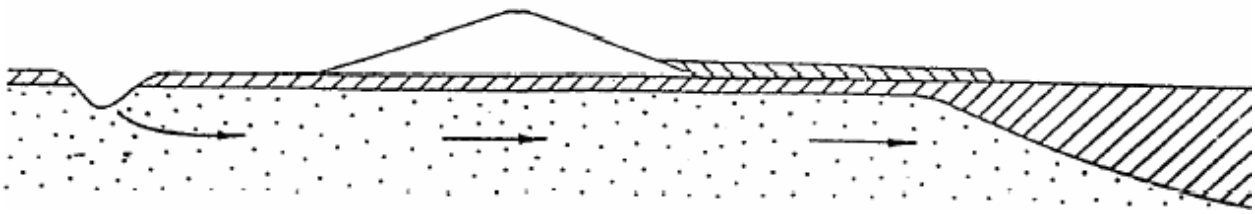

**Figure 8: Seepage Berm**

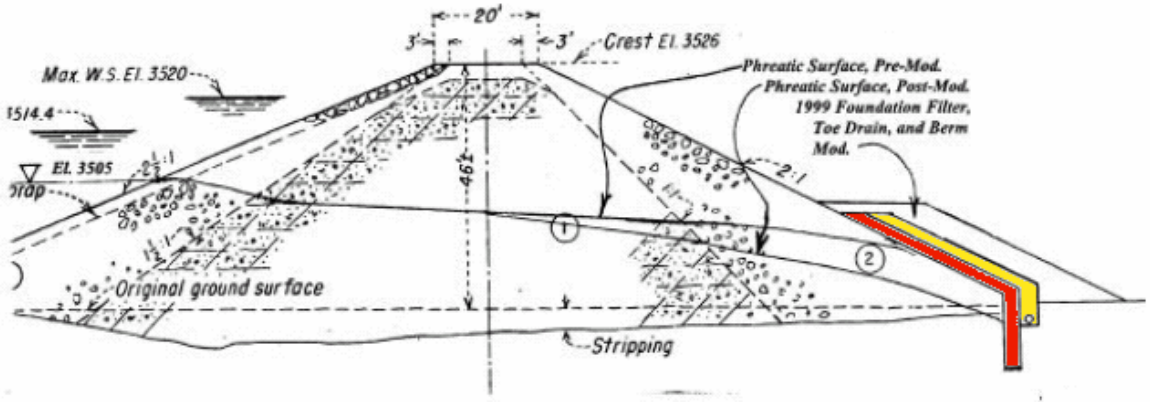


**Figure 9: Cut-off Trench**

### d) Economic Analysis

Specifically, designs and associated costs were prepared for levee plans at a range of levee heights. Levee heights were selected based on elevations that were approximately three feet higher than the following flood profiles:

100-year (1.0 percent) exceedance frequency;

250-year (0.4 percent) exceedance frequency; and

500-year (0.2 percent) exceedance frequency

The net benefits associated with each of these plans were compared to define the optimized design elevation. These evaluations determined that the 500-year level of flood protection was feasible, had the highest net benefits of the plans evaluated, and the optimization curve had not yet turned downward. At that point, an evaluation of possible plans that would provide a higher level of protection were evaluated and coordinated with the City. An evaluation of probable costs to increase the level of protection greater than the 500-year level showed that the cost of a larger project would increase substantially because the environmental and real estate costs were prohibitive for higher alternatives. Therefore, the study team determined that it would be unlikely that the incremental costs of such a plan would be offset by the associated residual benefits. In addition, it was found that from the local perspective, construction of a larger project would result in substantial adverse social impacts. Discussions with the City of Des Moines (Sponsor) regarding the possibility of implementing a higher level-of-protection revealed that there was no support for such a plan because taking additional structures and increasing local construction and

operations costs are not politically or socially acceptable. The details of the initial evaluations and findings of the plan with the highest Net Annual Benefits are summarized in Table 13. Since the costs and benefits of at least one plan providing greater flood damage reduction (i.e. a larger plan) than the recommended plan is not presented, the report would not adequately demonstrate that the recommended plan is the NED Plan. Therefore, in accordance with paragraph 4-3b(2)(a) of ER 1105-2-100, the recommended plan should not be labeled as the NED Plan and should be labeled and presented as the Locally Preferred Plan.

**Table 13: Birdland Park Alignment 2 Cost and Benefits (May 2004 price level)**

| Birdland Park | Top of Levee | Project Cost Estimate | Total First Costs | Annualized Annual First Costs | Annual O & M Costs | Total Annual Costs | Total Annual Benefits | Benefit Cost Ratio | Net Annual Benefits | Residual Annual Flood Damages |
|---|---|---|---|---|---|---|---|---|---|---|
| **Alignment 2** | | | | | | | | | | |
| 100 year | 803.3 | 3,618,000 | 3,961,000 | 238,000 | 14,000 | 252,000 | 255,000 | 1.01 | 3,000 | 181,000 |
| 250 year | 806.3 | 4,048,000 | 4,421,000 | 266,000 | 14,000 | 279,000 | 312,000 | 1.12 | 32,000 | 130,000 |
| 500 year | 809.5 | 4,984,000 | 5,421,000 | 326,000 | 14,000 | 340,000 | 437,000 | 1.29 | 97,000 | 11,000 |
| **Recreation Trail** | | 242,000 | 257,000 | 15,000 | 1,000 | 16,000 | 116,000 | 7.1 | 100,000 | N/A |

5-5/8% Discount Rate, 50-Year Evaluation Period

The recreational component of the project is also required to have a B/C ratio greater than 1. In Table 13, the cost estimates were calculated along with net annual benefits. The recreational features have a B/C ratio of 7.1, and therefore are included with the project.

### 4.E.7. Final Plan (Birdland Park)

The recommended and locally preferred plan is Alignment 2 at the 500-year level, including the recreational features. This plan would have a significant beneficial effect upon the local economy by allowing for future growth and improved public safety via improved flood protection. The plan also would improve recreational opportunities. The total fully-funded cost of the recommended multipurpose project is shown in Table 13. The combined flood damage reduction and recreation B/C ratio is 1.6. The City would serve as the Sponsor (the Sponsor) for the project.

The recommended plan for Reach 1 does not cause any increase in the 100-year regulatory flood profiles or increase ponding elevations for interior flooding. The existing levee defines the left floodway conveyance boundary for the Des Moines River and the interior drainage ponding characteristics. Reconstruction of the levee to a higher elevation would have minimal impacts on conveyance or storage of floodwaters for floods exceeding the 100-year flood. In addition, any increase in flood profiles that may occur would have negligible impact on properties not protected by the levee. USACE owns or has flood easements over most of the Des Moines River immediate floodplain upstream of 6$^{th}$ Avenue to facilitate high flows from Saylorville Reservoir. These lands are managed for floodplain, recreational and wildlife habitat uses, and is not available for future development. Because potential induced flood damages are negligible, mitigation measures are not necessary.

### 4.E.8. Plan Components Including Mitigation (Birdland Park)

The Birdland Park levee is approximately 7,700 feet in length. The crown width and levee height varies. The proposed levee would have a minimum crown width of 10 feet. A 15-foot crown width is required in places where a 10-foot recreation trail with adequate shoulders is constructed. Where the trail leaves the levee top construction of a 12-foot crown width would be maintained. A 12-foot wide top allows easier maintenance, inspection, and operation. The proposed side slopes are 3 feet horizontal to 1 foot vertical except along the river where riprap is proposed or where space limitations require a slightly steeper slope.

The proposed alignment follows the existing alignment until the levee reaches the upper end of the system near Riverview Park. At Riverview Park, the proposed alignment crosses the island creating a natural area to the west of the levee. A new gatewell and 42 inch RCP pipe would be constructed between the river and the lagoon to allow storm water to drain out of the lagoon. It would be closed during flooding. If necessary, the interior could be pumped out with a portable pump.

Existing stormwater pump stations are incorporated into the design. Gatewells and other crossing utilities are upgraded to meet Federal requirements. At the downstream end, a closure gate would be installed where Saylor Road crosses an opening in the levee. A retaining wall would prevent the levee from encroaching on the parking lot at the public park near Saylor Road. The existing Neal Smith multi-purpose recreation trail on the levee would be reconstructed as the levee is rebuilt. A new multi-purpose trail across the Riverview Park Island would connect McHenry Park with the existing Neal Smith Trail. The levee, which extends through Riverview Park, may contain landscaping and include an access trail over the levee.

The Chichaqua mitigation site would be excavated to an open water and wetland condition with bermed areas supporting upland trees and shrubs. Approximately 1.4 acres of upland forest, 0.2 acres of bottomland forest, 1.4 to 2.3 acres of emergent wetland, and 2.7 to 3.8 acres of open water would be impacted by the current alignment. The bottomland forest impacts include 0.6 acres of permanent filling through levee construction and 0.2 acres of permanent clearing of forested areas within 15 feet of the proposed levee alignment. These acreages would be finalized during plans and specifications. Approximately 6.4 acres of upland forest, 2.8 to 4.6 acres of emergent wetland, 1.2 acres of herbaceous upland buffer between the uplands and wetlands (this is an engineering feature that will reduce sedimentation runoff from the upland area into the wetland), and 2.7 to 3.8 acres of open water would be created at the Chichaqua mitigation site in the current plan. Approximately 0.4 acres of bottomland forest would be enhanced at the Central Place mitigation site for the Birdland bottomland forest impacts through planting of trees in an existing herbaceous wetland (see Figure W-1 in Volume 3). Complete details of the mitigation plan can be found in Appendix G, Section 1.

### 4.E.9. Design and Construction Considerations (Birdland Park)

Design and construction considerations vary for each levee system. See Appendix C, *Engineering Design* for a description of pertinent considerations.

An eight-foot wide inspection trench would insure unsuitable materials would be detected. Stanley consultants recommended rebuilding the riverside face of the levee. Materials stockpiled at the Harriet Street landfill appear to have suitable properties for rebuilding the core of the levee, however the Iowa State Land Recycling Program needs to determine the extent of remediation require before using this material. A major water line and power lines are located near the landside toe of the levee. A road closure would be designed to swing and lower into place. The design would eliminate the need for a brace. A seepage berm is sized so that enough landside load is establish for a minimum distance. A cutoff trench would sizably diminish the levee footprint. Please see section E *Design Considerations for Birdland Park* in Appendix C Volume 2.

## 4. F. REACH 2 - CENTRAL PLACE EVALUATION

The Central Place Business District is on the near north side of the City. This area was redeveloped as a commercial area in the 1970s and 1980s, and now is home to 109 commercial properties, 1 residential property, and 1 public property. The area is protected from flooding by a levee constructed by the City and is mapped in the National Flood Insurance Program as having 100-year flood protection. The levee was overtopped during the 1993 flood, causing extensive flood damages.

### 4.F.1. Existing Conditions (Central Place)

Based on the revised hydrologic and hydraulic modeling discussed in Volume 2 Appendix A, the 100-year flood profile of the Des Moines River at Central Place was determined to be essentially the same as the current flood insurance study (FIS) report.

Central Place is protected by a levee built by the City in 1950 that has been periodically upgraded. The levee generally consists of earth embankment except for 222 feet of concrete floodwall underneath University Avenue Bridge. The levee begins just north of 2nd Avenue, tying into high ground along the riverbank. It extends over a mile and a half along the river down to I-235. The levee upstream of University Avenue is 12 feet high, protecting approximately 200 acres of high value commercial property. From University Avenue to Interstate 235 (approximately 0.4 miles), the levee is integrated with the existing riverbank and protects West River Drive and a small park. The levee in this last portion of the reach is only a few feet high. The southern end blends into higher ground close to the Interstate.

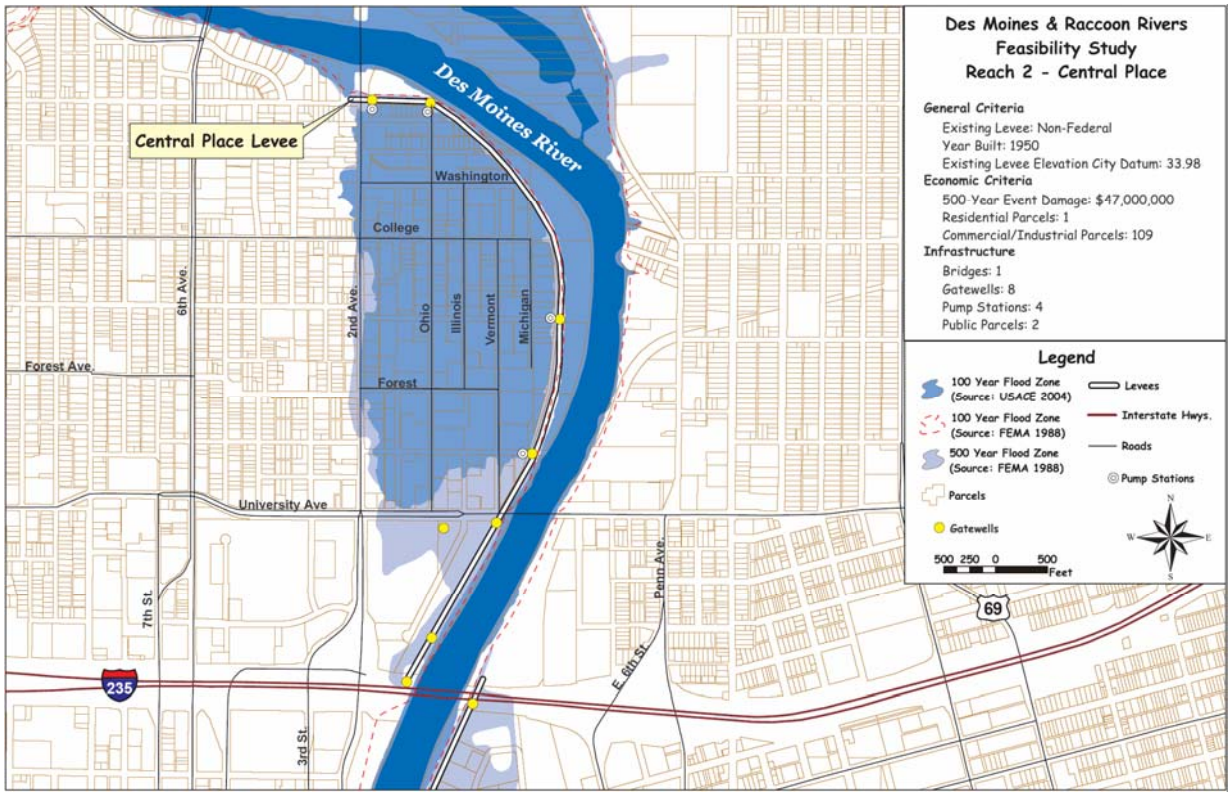


**Figure 10: Central Place Project Area**

The Central Place area is unique since it is lower than the normal river levels and, therefore, all runoff from the area must be pumped over the levee and into the river. All pump stations are in good shape, with new pumps and new pipe lining. All meet federal standards. The Central Place Business District is on the near north side of the City's central business district (Figure 10).

The levee is overgrown with trees on both slopes, extending from the crown beyond the toe on both sides (Figure 11). Animal holes and other debris in the levee have contributed to the following estimated probabilities of failure:

796.8 feet NGVD (Below the 50-year flood event) - 95% probability of failure

792.7 feet NGVD (Below the 5 to 10-year flood event) - 10% probability of failure

777.0 feet NGVD (Stream Bottom) - 0% probability of failure

The levee is currently used as an informal walking path and green space. The City has no plans to develop recreation features in the study area.

Hazardous, toxic, or radioactive waste (HTRW) soil testing confirmed the presence of arsenic, beryllium, and benzo(a)pyrene in excess of the Iowa Land Recycling Program statewide standards within the levee alignment and associated with the mitigation site at Central Place, however due to the very low concentrations the Iowa DNR has cleared the levee area and no remediation is required.

**Figure 11: Central Place Levee, Showing Woody Vegetation**

### 4.F.2. Future without Project Conditions (Central Place)

As with Birdland Park, it is highly unlikely that large a flood similar to the 1993 flood would be successfully fought and that resultant flood damage to the existing structures could exceed 50 percent of their value. Restrictions on the development of structures located in the floodplain would be required, consistent with the National Flood Insurance Program. The ongoing cost of flood insurance and the spiral of negative impacts associated with the community located within the regulatory floodplain remaining susceptible to flooding are unacceptable to City officials.

### 4.F.3. Problems and Opportunities (Central Place)

**Problem:** The existing levee has a high probability of failure due to instability of the levee embankment, putting at risk 111 primarily commercial properties.

**Opportunities:** Presently there are no recreational opportunities. The Central Place Levee system is currently not included in the City's long-range recreation development plans for future use of riverfront areas, which was initially thought during preliminary engineering design.

### 4.F.4. Measures Eliminated From Further Analysis (Central Place)

The following measures were eliminated form consideration:

- Pump station retention ponds were initially considered to increase storm water pumping efficiencies. The lack of available real estate, potential for hazardous contamination, and subsurface soil conditions caused this measure to be eliminated from further evaluation.
- Two lower levee heights (25-year and 50-year heights), were considered and eliminated, as the existing levee has enough material for a 250-year height and the cost to remove the excess material exceeded the economic benefits.

- As the downstream tie-off to high ground becomes very expensive and problematic for levees greater than 500-year elevations, higher levee elevations were also eliminated from further evaluation.

### 4.F.5. Selecting and Combining Measures into Alternatives (Central Place)

The study team developed conceptual plans for providing increased flood protection for the affected area, which, as in Birdland Park, was to reconstruct the existing levee at Central Place. The same levee alignment would be used, which is approximately 6,000 feet in length, and would have side slopes measuring between 3' to 4' horizontal to 1' vertical. A one-foot superiority elevation would be added upstream and existing pump stations utility crossings would be incorporated into the new design. The levee height would be optimized through incremental cost analysis. The same stockpile of material proposed for use in the Birdland Park levee plan would be utilized for Central Place levee construction.

### 4.F.6. Screening of Alternative Plans (Central Place)

**Environmental Impacts:** The same inter-agency team that evaluated the impacts of the Birdland levee also evaluated the environmental impacts of the Central Place levee using EXHEP. Approximately 1.2 acres of wetland bottomland forest and 3.2 acres of upland forest are impacted with the current levee alignment, a total of 4.4 acres The same 4.4 acres would be impacted at all levee heights considered. During final design all due consideration should be made to reduce the impact to the 1.2 acres of wetland bottomland forest by shifting the levee landward by up to 15 feet. The current levee design calls for a 15 ft top width to accommodate a recreational trail. Since it has been determined that there is not a need or desire by the City for a trail a 10 ft levee top width would be considered to lessen the impact to wetlands or create additional wetland which could mitigate for other project impacts. Again, informal consultation between the USFWS and the District determined that a biological assessment would not be required for the proposed project.

The same mitigation site proposed for the Birdland Park levee was selected for mitigating some of the impacts to the upland forest habitat (see Figure 12). The remaining upland forest mitigation would be located in an existing mowed upland area riverside of the northern portion of the Central Place levee. The bottomland forest mitigation would occur within the non-forested portion of the wetland located on the riverside of the levee. The only environmental and social impact involves the removal of trees and shrubs, which would decrease the aesthetic value of the view-shed.

**Value Engineering**: The VE study performed for the Birdland Park levee by the St. Paul District was incorporated into the analysis used for Central Place because of the similarities in design, construction, and conditions. Articulated concrete mat rather than stone protection along the Des Moines River would be considered. The St. Paul District also recommended that unsuitable material found in the levee and inspection trench areas be disposed of on-site rather than hauled off site. Organic material and trash would still be required to be hauled off-site; however, broken concrete and large rocks that cannot be used in the levee embankment could be placed outside of the levee template and covered so that is not unsightly. A 2-foot inspection trench would replace the current 8-foot inspection trench.

**Economic Analysis**: Following USACE regulations to account for the risk and uncertainty in a design, a detailed process was undertaken to determine the top of levee elevation relative to the design of water surface elevation. A confidence interval was established around the various design parameters, and a quantitative analysis was performed to assure that the top-of-levee has a high probability of containing the design flood event. In addition, upstream superiority elevation would be added to assure that any overtopping event occurs first at the downstream end of the project. With a B/C ratio of 3.34, as shown in Table 14, the recommended plan for Reach 2 is to reconstruct the levee to protect against a 500-year flood. Since the costs and benefits of at least one plan providing greater flood damage reduction (i.e. a

larger plan) than the recommended plan is not presented, the report does not adequately demonstrate that the recommended plan is the NED Plan.

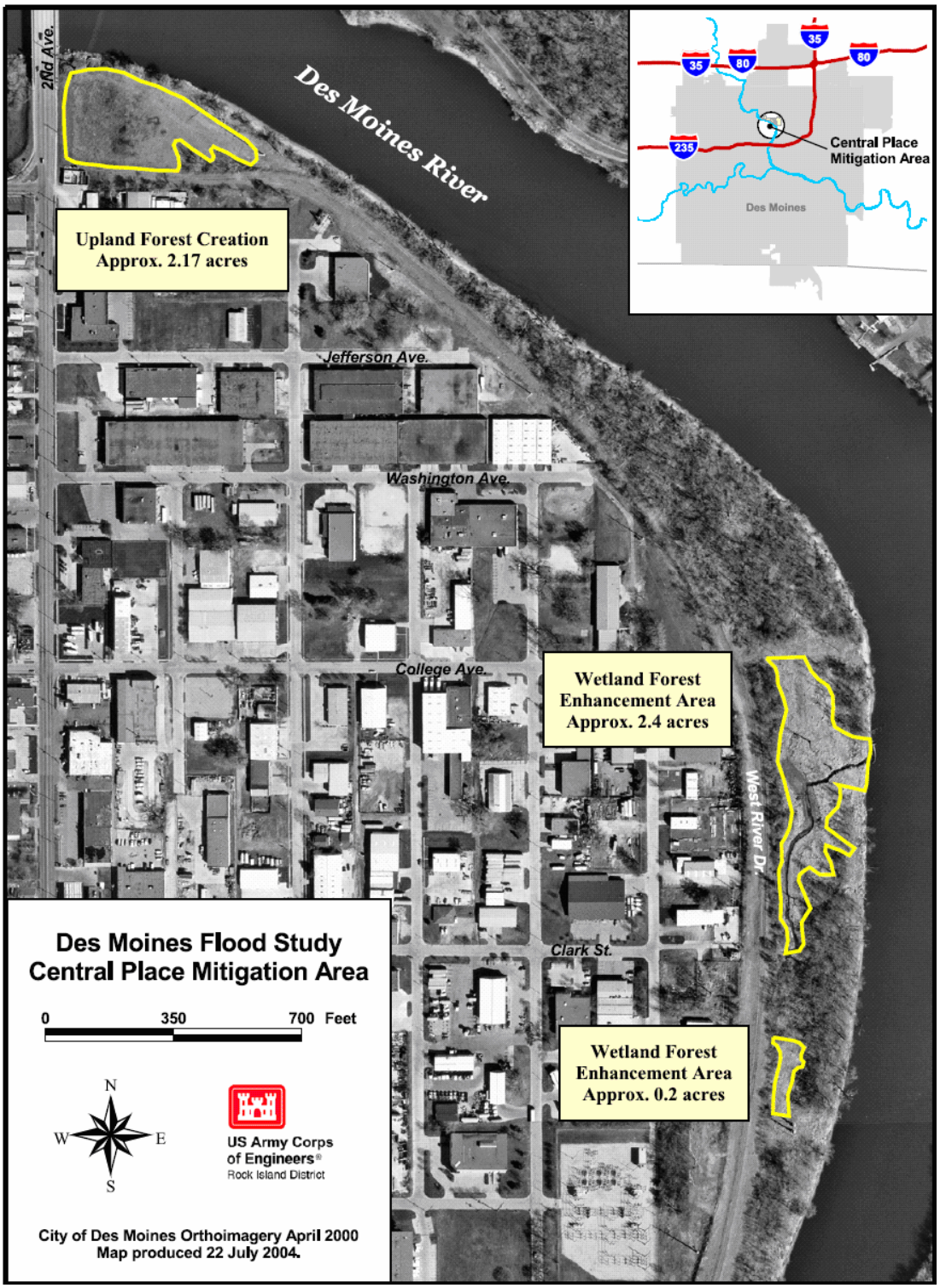


**Figure 12: Central Place Mitigation Site for Upland and Bottomland Forest**

**Table 14: Central Place Cost Benefit Evaluation (May 2004 price level)**

| Central Place | Top of Levee | Project Cost Estimate | Total First Costs | Annualized First Costs | Annual O & M Costs | Total Annual Costs | Total Annual Benefits | Benefit Cost Ratio | Net Annual Benefits | Residual Annual Flood Damages |
|---|---|---|---|---|---|---|---|---|---|---|
| **100 year** | 802.3 | 3,156,000 | 3,396,000 | 204,000 | 15,000 | 219,000 | 667,000 | 3.05 | 448,000 | 235,000 |
| **250 year** | 805.3 | 3,420,000 | 3,678,000 | 221,000 | 15,000 | 236,000 | 764,000 | 3.24 | 528,000 | 139,000 |
| **500 year** | 808.7 | 3,839,000 | 4,126,000 | 248,000 | 15,000 | 263,000 | 895,000 | 3.4 | 632,000 | 8,000 |

5-5/8% Discount Rate, 50-Year Evaluation Period

### 4.F.7. Final Plan (Central Place)

The recommended and locally preferred plan is to construct a levee to the 500-year protection level. This plan would have a significant beneficial effect upon the local economy by allowing for future growth and improved public safety with improved flood protection. The fully funded cost of the recommended plan is shown in Table 24. The B/C ratio is 3.4.

The recommended plan for Reach 2 does not cause any increase in the 100-year regulatory flood profiles or increase ponding elevations for interior flooding. The existing levee defines the right floodway boundary for the Des Moines River and the interior drainage ponding characteristics. Reconstruction of the levee to a higher elevation would have minimal impacts on conveyance or storage of flood waters for floods exceeding the 100-year flood. In addition, any increase in flood profiles would have negligible impact on properties not protected by the levee. The floodplain lands across the river and upstream of the Central Place levee are managed for floodplain, public recreational and wildlife habitat uses, and is not available for future development. Because potential induced flood damages are negligible, mitigation measures are not necessary.

### 4.F.8. Plan Components Including Mitigation (Central Place)

The proposed upgraded levee is approximately 5,900 feet in length. The proposed crown width is 12 feet. The alignment would follow the existing alignment and tie to the north side of the University Avenue Bridge embankment. Side slopes would be constructed with slopes equal to 3' horizontal and 1' vertical. Sufficient material exists on site to construct the proposed levee. Two new gatewells would be constructed, and three older pump stations would be upgraded to include new discharge pipes constructed over the levee. Trees and shrubs would be removed from the levee and 15 feet out from the levee toe. Mitigation for loss of habitat would be accomplished on site and at the Chichaqua site. Approximately 3.2 acres of upland forest would be impacted and 1.2 acres of bottomland forest would be impacted. Approximately 2.2 acres of upland forest would be created on-site and 3.8 acres of upland forest would be created at the Chichaqua site. Approximately 2.2 acres of bottomland forest would be enhanced on-site through planting of trees in an existing herbaceous wetland.

### 4.F.9. Design and Construction Considerations (Central Place)

Design and construction considerations vary for each levee system. See Appendix C, *Engineering Design* for a description of pertinent considerations.

Minimize impacts to wetland bottomland forest (all resources outward from the levee toe) by moving the levee landward so the needed 15 foot clear zone (free of trees and shrubs) is within the current levee footprint. The reduction of the levee top width should also be evaluated to determine the feasibility of reducing wetland impacts or creating additional wetland habitat. The embankment should not include abandoned utilities, debris, tree growth, animal burrows, or other items or deficiencies that could lead to failure of the embankment. An alternative to minimize costs is to remove and replace the riverside

portion of the levee. The horizontal thickness of the compacted layer is about 15 feet. This would provide sufficient room for compaction equipment and replace enough levee embankments to provide levee stability. The standard USACE inspection trench for this size levee is 6 feet deep and 8 to 10 feet wide.

## 4. G. REACH 3 - DOWNTOWN EAST EVALUATION

Reach 3 is the easterly levee bank of the Des Moines River from University Avenue downstream to the Sewage Treatment Plant and the beginning of the Red Rock Remedial Works levee (Figure 13). The levee has numerous roads, railroad closures, utility crossings, and storm water outfalls. The downtown portion is part of riverfront development program called Des Moines Recreational River and Greenbelt (Greenbelt).

### 4.G.1. Existing Conditions (Downtown East)

The protected area contains the central business core of the City with over 1,800 acres of highly urbanized commercial, retail, industrial, residential, and public facilities as shown in Volume 3, Figure 5. The Downtown East area is a fully-developed urban area containing 227 residential properties, 272 commercial or industrial properties, and 9 public properties.

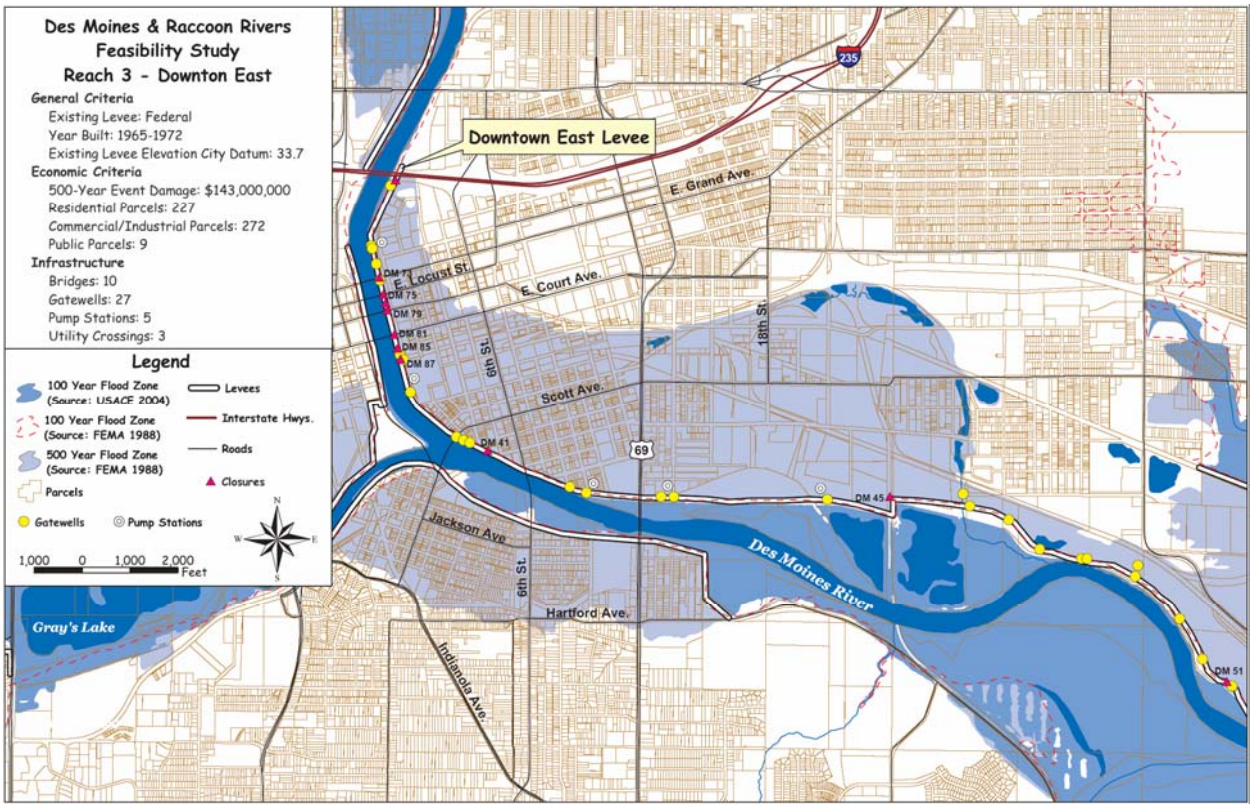


**Figure 13: Reach 3 Downtown East Study Area**

The existing levee system was designed to provide slightly more than 100-year flood protection. This system, designed in the 1960s, has numerous street and sewer closures that penetrate the line-of-protection at the design flood level. This situation causes the City to take multiple operational actions

during a flood event, including sandbagging, installing earthen closures, and placing and operating portable pumps. However, as demonstrated during the 1993 flood, floodwaters on both the Des Moines and Raccoon Rivers can rise rapidly, making the successful execution of these operations difficult.

A multi-use trail, the John Pat Dorrian Trail, is a segment of the longer Saylorville Trail. The John Pat Dorrian Trail runs from Hawthorne Park north to University Avenue along the Des Moines River for approximately 2.2 miles. Trailheads are located at Hawthorne Park, Botanical Center riverfront parking lot under the University Bridge, and several other points along the trail, including the Armory parking lot and City Hall.

Hazardous, toxic, or radioactive waste (HTRW) soil testing confirmed the presence of arsenic, beryllium, and benzo(a)pyrene. Groundwater testing indicated the presence of arsenic, beryllium, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene in excess of the Iowa Land Recycling Program statewide standards. HTRW clearance has been obtained from the State of Iowa in a letter dated 7 February 2005 and is located in Appendix H.

The Downtown East area is fully urbanized dominated by buildings, pavement, mowed grass, and scattered ornamental trees. The levee in this area is well maintained and regularly mowed. This reach is located within the Civic Center Historic District, which is a National Register of Historic Places multiple-property listing based on thematic areas of significance including architecture, community planning and development, and landscape architecture dating from 1892 to 1938. The historic places nomination includes seven contributing structures, six contributing buildings, and five noncontributing structures. Seven closure structures proposed for Reach 3 are located within the Civic Center Historic District including one adjacent to the Court Avenue Bridge, a contributing resource to the NRHP Civic Center Historic District nomination, and one adjacent to the Des Moines Union Railway Bridge, a noncontributing structure that has been determined individually eligible for inclusion on the NRHP.

### 4.G.2. Future without Project Conditions (Downtown East)

The Downtown East road and railroad closures would continue to be at risk during flood events. Demands for recreational facilities in the City have and would continue to increase. No substantial changes in environmental or cultural conditions should occur.

### 4.G.3. Problems and Opportunities (Downtown East)

**Problems:** The existing levee was over topped during the 1993 flood.

**Problems:** Flood fighting along Reach 3 requires construction of temporary closures during major flood events, including staging and installing clay embankment plugs or plastic sheeting and sand bag structures to repel the floodwaters. Nevertheless, as was the case in the 1993 flood, floodwaters rose rapidly, jeopardizing successful placement of these closures.

**Opportunities:** There are opportunities for recreational features as part of the City's Riverfront development; however, because of a special Greenbelt authorization for the City, recreational opportunities would be coordinated through that program. Flood damage reduction structures would be designed in cooperation with the Greenbelt projects.

### 4.G.4. Selecting and Combining Measures into Alternatives (Downtown East)

Two measures were considered to reduce flood damages, raising the existing levee and floodwalls from slightly over 100-year level to the 500-year level of protection, which is an estimated raise of 3 feet and redesigning existing closure structures to increase their constructability and reliability during flood fighting. Three alternative approaches were evaluated for redesigning the existing closures that are part of the levee system:

- One, permanently close existing openings that are no longer needed
- Two install gate structures to ensure quick and reliable closure
- Three, reduce the size of the opening and change the alignment to lower the height of the temporary closure and improve stability/reliability. (The change in alignment would also enable the streets to remain open longer during flood events)

Eleven closures were identified for modification or elimination and a simple risk-based analysis was performed. See Appendix C, Section 4e1 for details. Four of the closures were identified as being no longer needed and could be permanently closed. The existing closures at Simon Estes Amphitheater could be gated or stop logs used, and six other closures on different roads would benefit from having the opening width of each closure reduced. See Table 16 for closure description and proposed design. All alternative closure alternatives were coordinated with the riverfront redesign and reconstruction Greenbelt project authority and the City.

- Permanent Closure, DM 41 – R.R. Bridge
- Reduce Closure, DM 45-R.R. Bridge
- Permanent Closure, DM 51-Build-up, Gravel Rd. at downstream end of Des Moines wastewater treatment plant
- Reduce Closure, DM 73-Grand Ave
- Reduce Closure, DM 75-Locust St.
- Install gates at existing pedestrian walkway closures at Simon Estes Amphitheater feature
- Reduce Closure, DM 79-Walnut St.
- Reduce Closure, DM 81-Court Ave.
- Permanent Closure, DM 85-R.R. Bridge South of Court St.
- Reduce Closure, DM 87-R.R Bridge at Vine St
- Permanent Closure-Tie upper end of Levee into I-235 embankment

### 4.G.5. Screening of Alternatives (Downtown East)

A preliminary cost estimate for a levee raise to 500-year level was determined to have a low B/C ratio—less than 0.17—eliminating this measure from further analysis.

The study team had developed overall flood-fighting "reliability and risk" base matrix, analyzing the likelihood for closure failure, assuming all the closures in the city would need to be closed. These risk and uncertainty values were input into the FDA model, which computed the economic benefits. The only two effective alternatives ( Table 15) are the "No Action" alternative or to construct closure modifications. With a B/C ratio of 3.8, the recommended plan is to construct15 closure modifications.

An analysis of temporary structures was also made, results of which are in Appendix C, *Engineering Evaluation*. An environmental survey was conducted, which indicated that there would be no significant impacts. A cultural survey and coordination with the State Historical Society of Iowa were also conducted. No known historic sites exist in this study area (see Environmental and Cultural Inventories starting on 73).

**Table 15: Downtown East Closures and Levee Raise Cost Benefit Analysis (May 2004 price level)**

| Downtown East Leve | Project Cost Estimate | Total First Costs | Annualized First Costs | Annual O & M Costs | Total Annual Costs | Total Annual Benefits | Benefit Cost Ratio | Net Annual Benefits | Residual Annual Flood Damages |
|---|---|---|---|---|---|---|---|---|---|
| Closure Improvements | 642,000 | 679,000 | 41,000 | 0 | 41,000 | 156,000 | 3.8 | 115,000 | 252,000 |
| 500 year levee | 11,440,000 | 12,510,000 | 7,520,000 | 10,000 | 762,000 | 113,000 | 0.15 | -649,000 | |

### 4.G.6. Final Plan (Downtown East)

A major desire of the project partner, the City, was to maximize flood damage reduction at a reasonable cost. After review of the Feasibility Report, modification of 11 closures, which significantly reduces flood damage, is both the recommended and locally preferred plan. Four closures would be permanently closed. The Simon Estes Amphitheater closure would have gate structures installed, and six other road closures would have their opening widths reduced. A detailed description of these closures can be found in Appendix C, *Engineering Evaluation*.

Since the costs and benefits of at least one plan providing greater flood damage reduction (i.e. a larger plan) than the recommended plan is not presented, the report does not adequately demonstrate that the recommended plan is the NED Plan.

The recommended plan for Reach 3 does not cause an increase in flood profiles or increase ponding elevations for interior flooding. (Because there are no induced flood damages, mitigation measures are not necessary.)

### 4.G.7. Plan Components Including Mitigation (Downtown East)

The downtown levees and floodwalls are currently designed to protect for slightly over a 100-year flood event. Four closures would be made permanent and closures at several locations would be modified to reduce the opening size and increase system reliability as described below and shown on Plates D3-D12 in Volume 3:

**Table 16: Existing Closure Conditions and Proposed Correction, Downtown East**

| Closure Title Total of 11 Closures | Existing Open Width | Future Opening Width | Proposed Closure Design | Length Closure Material | Height Closure Material | Buried / Depth |
|---|---|---|---|---|---|---|
| **DM 41** - R.R. Bridge Permanent Closure | 50 ft | 0 ft | 12 ft' crown & 30 ft base levee | 70 ft | 3 ft | n/a |
| **DM 45** - R.R. Bridge – Reduce Closure | 45 ft | 20 ft | 12" concrete walls on either side of tracks | 25 ft | 3 ft | 5 ft |
| **DM 51** - Build-up Vandalia, Gravel Rd - Permanent Closure | 100 ft | 0 ft | 28 ft crown & 300 ft base levee | 120 ft | 8 ft | 6 ft |
| **DM 73**- Grand Ave. – Reduce Closure | 137 ft | 85 ft | 12" concrete walls on either side of road | 32 & 34 ft | 3 ft | 5 ft |
| **DM 75** - Locust St. – Reduce Closure, | 85 ft | 70 ft | 12" concrete walls on either side of road | 45 ft | 3 ft | 5 ft |
| **Simon Estes Amphitheater** – Gates at existing pedestrian Closure | 7 ft | 7 ft | Variety of gate or stop log closures | 7 ft | 4 ft | n/a |
| **DM 79** - Walnut St. – Reduce Closure | 150 ft | 85 ft | 12" concrete walls on either side of road | 100 ft | 3 ft | 5 ft |

| Closure Title Total of 11 Closures | Existing Open Width | Future Opening Width | Proposed Closure Design | Length Closure Material | Height Closure Material | Buried / Depth |
|---|---|---|---|---|---|---|
| **DM 81** – Court Ave. Reduce Closure | 165 ft | 100 ft | 12" concrete walls on either side of road | 35 & 25 ft | 3 ft | 5 ft |
| **DM 85** - R.R. Bridge South of Court St. - Permanent Closure, | 40 ft | 0 ft | 12 ft crown & 36 ft Base levee | 60 ft | 4 ft | n/a |
| **DM 87** – R.R. Bridge – Reduce Closure | 45 ft | 20 ft | 12" concrete walls on either side of tracks | 25 ft | 3 ft | 5 ft |
| **I-235 Embankment,** Tie upper end of Levee - Permanent Closure | 60 ft | 0 ft | 12 ft crown & 48 ft Base Levee | 80 ft | 6 ft | 6 ft |

Note: Because of the concurrent riverfront redesign and reconstruction Greenbelt project, detailed designs for closures would be performed in final design in conjunction with Greenbelt River front development design. No environmental mitigation is necessary.

### 4.G.8. Design and Construction Considerations (Downtown East)

Detail design for each of the closures would be completed during final design. Many of the closures must conform to new architectural concepts and designs for the Greenbelt River Front project, much of which has not been completed. Bridge tie-ins and location of flood wall extensions would be developed in conjunction with Greenbelt projects. See Volume 3, *Figures, Exhibits, and Plates.*

## 4. H. REACH 4 - DOWNTOWN WEST EVALUATION

This levee follows the westerly bank of the Des Moines River 1,000 feet downstream of I-235 to the confluence of the Raccoon River then along the northern bank of the Raccoon River past Fleur Drive, see Figure 14.

### 4.H.1. Existing Conditions (Downtown West)

The existing federal levee and floodwalls, constructed in the 1960s through the1970s, currently offers protection for slightly over a 100-year flood event. Three pump stations remove stormwater from behind the levee during flooding. Ten closures need to be closed during flooding. The levee is currently used as an informal walking path and green space. Hazardous, toxic, or radioactive waste (HTRW) soil testing confirmed the presence of arsenic, beryllium, and benzo(a)pyrene in excess of the Iowa Statewide Standard throughout the levee alignment. Groundwater analysis confirmed the presence of arsenic, cadmium, barium, thallium, beryllium, chromium, lead, manganese, molybdenum, nickel, selenium, vanadium, and zinc. Contaminant concentrations were in excess of the Iowa Land Recycling Program statewide standards. While Phase IIA assessments were conducted for much of this project area, the assessments did not include the west side of the Des Moines River between Center Street and Riverview Park, even though the Phase I ESA indicated environmental concerns. At the time the Phase IIA ESA was awarded (December 2003), the City of Des Moines was performing significant construction activities in this area that might have removed existing material to a depth of 20 feet.

HTRW clearance has been obtained from the State of Iowa in a letter dated 7 February 2005 and is located in Appendix H.

The Downtown West area is a fully urbanized area, which includes 182 commercial or industrial properties and 3 public properties. It is dominated by buildings, pavement, and mowed grass, with scattered ornamental trees. The levee in this area is well maintained and regularly mowed.

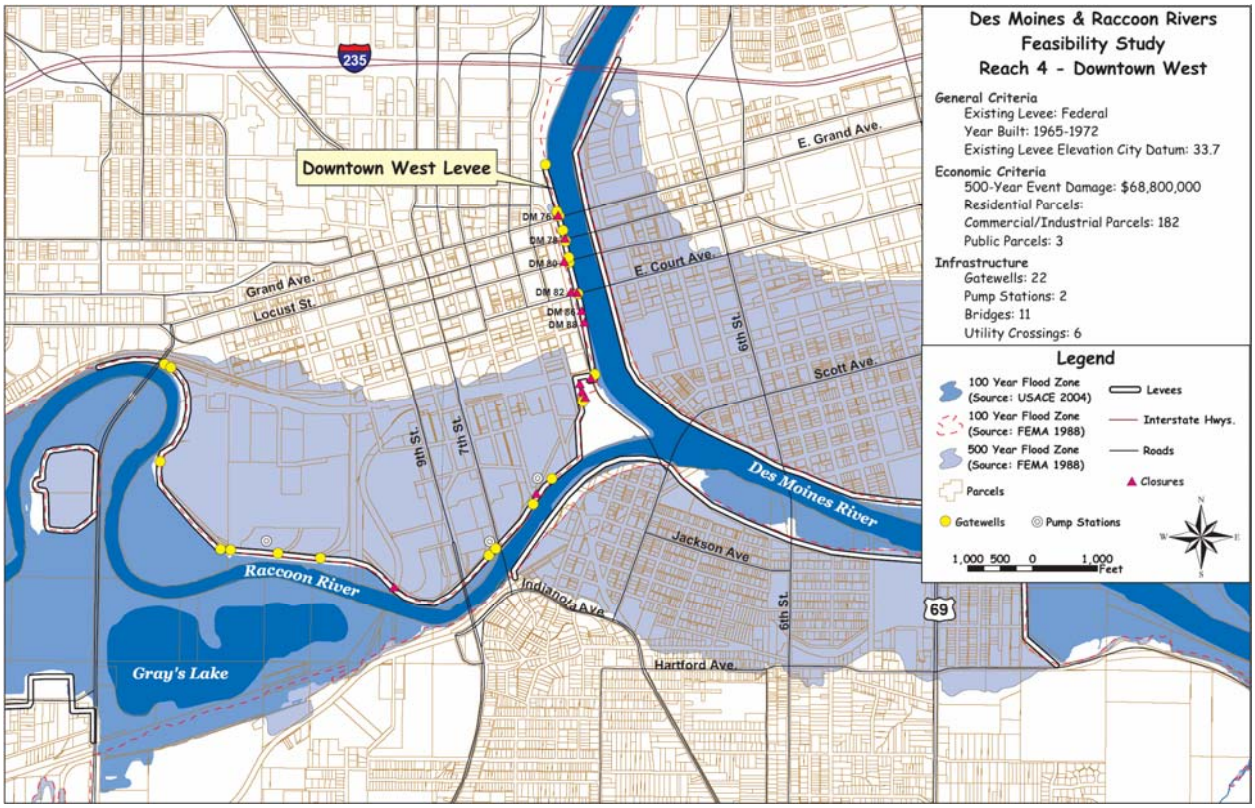


**Figure 14: Reach 4 Downtown West Study Area**

A portion of Reach 4 is located within the Civic Center Historic District and within the boundaries of National Register for Historic Properties (NRHP) eligible archeological site 13PK61, sees Environmental and Cultural Inventories starting on page 72. Four closure structures are proposed within the site boundaries of archeological site 13PK61. Site 13PK61, Fort Des Moines No. 2, is a multi-component prehistoric and historic archeological site. Numerous investigations have evaluated portions of the site and it was formally included in the NRHP in 2000.

### 4.H.2. Future without Project Conditions (Downtown West)

The Downtown West road and railroad closures would continue to be at risk during flood events. Demands for recreational facilities in the City have and would continue to increase. No substantial changes in environmental or cultural conditions would occur.

### 4.H.3. Problems and Opportunities (Downtown West)

**Problems:** Flood fighting along Reach 4 requires construction of temporary closures during major flood events. These structures have failed in the past causing serous flood damages.

**Opportunities:** As in Reach 3 the Greenbelt, riverfront development would implement any recreational opportunities.

### 4.H.4. Selecting and Combining Measures into Alternatives (Downtown West)

Two measures were considered to reduce flood damages, raising the existing levee and floodwalls from slightly over 100 year level to the 500-year level of protection, which is an estimated raise of 3 feet. In addition, existing closures were redesigned to increase their constructability and reliability. Three

alternative approaches were evaluated for redesigning the existing closures that are part of the levee system:

- Permanently close existing openings that are no longer needed
- Install gate structures to ensure quick and reliable closure
- Reduce the size of the opening and change the alignment to lower the height of the temporary closure and improve stability/reliability. (The change in alignment would also enable the streets to remain open longer during flood events)

Six closures were identified for modification and a simple risk based analysis was performed, see Appendix C, Section 4e1 for details. One closure was no longer needed and could be permanently closed. Five more would benefit from having the width of temporary closures reduced, see Table 18 for closure description and proposed design. All alternative closure alternatives were coordinated with the riverfront redesign and reconstruction Greenbelt project authority and the City.

- Reduce Closure, DM 76-Grand Ave.
- Reduce Closure, DM 78-Locust St.
- Reduce Closure, DM 80-Walnut St.
- Reduce Closure, DM 82-Court Ave.
- Permanent Closure, DM 86-R.R
- Reduce Closure, DM 88-R.R.

### 4.H.5. Screening of Alternatives (Downtown West)

A preliminary cost estimate for a levee raise to 500-year level was determined to have a low B/C ratio less than 0.29 eliminating this measure from further analysis.

As in Reach 3 the study team applied the same flood-fighting reliability and risk base matrix, and input these into the FDA model, which computed the economic benefits. If the closures received the recommended modifications, the time to make closures would decrease, for detailed analysis. See Engineering Appendix C Volume II.

An environmental survey was conducted, which indicated that there would be no significant impacts. Consultation with the State Historical Society of Iowa concluded that the actions described in the final plan would have "no adverse effects" on the archeological site 13PK61, the Civic Center Historic District, or on the Des Moines Union Railway Bridge (see Environmental and Cultural Inventories starting on page 72).

The only two effective alternatives (see Table 17) are the No Action and to construct closures modifications. A detailed incremental cost analysis was not performed due to the small project cost. With a B/C ratio of 4.5, the recommended plan is to construct 6 closure modifications.

**Table 17: Downtown West Closures and Levee Raise Cost Benefit Analysis (May 2004 price level)**

| Downtown West Levee | Project Cost Estimate | Total First Costs | Annualized First Costs | Annual O & M Costs | Total Annual Costs | Total Annual Benefits | Benefit Cost Ratio | Net Annual Benefits | Residual Annual Flood Damages |
|---|---|---|---|---|---|---|---|---|---|
| Closure Improvements | 260,000 | 275,000 | 17,000 | 0 | 17,000 | 74,000 | 4.5 | 57,000 | 252,000 |
| 500 year levee | 4,943,000 | 5,472,000 | 329,000 | 10,000 | 339,000 | 97,000 | 0.29 | -241,000 | |

5-5/8% Discount Rate, 50-Year Evaluation Period

### 4.H.6. Final Plan (Downtown West)

A major desire of the project partner, the City, was to maximize flood damage reduction at a reasonable cost. After review of the Feasibility Report, the recommended and locally preferred plan is to modify six closures, to reduce flood damages. One closure would be made permanent, while five other closures would be reduced in opening width. A detailed description of these closures can be found the Engineering Appendix C Volume II.

Since the costs and benefits of at least one plan providing greater flood damage reduction (i.e. a larger plan) than the recommended plan is not presented, the report does not adequately demonstrate that the recommended plan is the NED Plan.

The recommended plan for Reach 4 does not cause an increase in flood profiles or increase ponding elevations for interior flooding. Because there are no induced flood damages, mitigation measures are not necessary

### 4.H.7. Plan Components Including Mitigation (Downtown West)

One closure would be made permanent; and five closures would be improved to reduce the opening size and increased system reliability as described below and shown on Plates D15-D22 in Volume 3:

### 4.H.8. Design and Construction Considerations (Downtown West)

Design and construction considerations vary for each levee system. See Appendix C, Engineering Design for a description of pertinent considerations, see Table 18.

**Table 18: Existing Closure Conditions and Proposed Correction, Downtown West**

| Closure Title Total of 6 Closures | Existing Open Width | Future Open Width | Proposed Closure Design | Length Closure Materials | Height Closure Materials | Buried/Depth |
|---|---|---|---|---|---|---|
| DM 76- Grand Ave Reduce Closure | 120 ft | 80 ft | 12 in Concrete | 100 ft | 3 ft | 5 ft |
| DM 78- Locust St. Reduce Closure | 100 ft | 70 ft | 12 in Concrete | 100 ft | 3 ft | 5 ft |
| DM 80- Walnut St. Reduce Closure | 135 ft | 0 | 12 in Concrete | 80 ft | 4 ft | n/a |
| DM 82- Court Ave. Reduce Closure | 165 ft | 100 ft | 12 in Concrete | 80 ft | 3 ft | 5 ft |
| DM 86-R.R Permanent Closure | 140 ft | 0 | 12 ft Crown & 36 ft Base | 80 ft | 4 ft | n/a |
| DM 88- R. R. Reduce Closure | 80 ft | 20 ft | 12 ft Crown & 30 ft Base | 30 ft | 3 ft | n/a |

No environmental mitigation is necessary.

## 4. I. REACH 5 – DOWNTOWN SOUTH EVALUATION

Downtown South Reach is on the southerly bank of the Raccoon River (see Figure 15: Reach 5 Downtown South Study Area). The levee starts downstream of SW 7th Street and continues along the Des Moines River to Hartford Avenue.

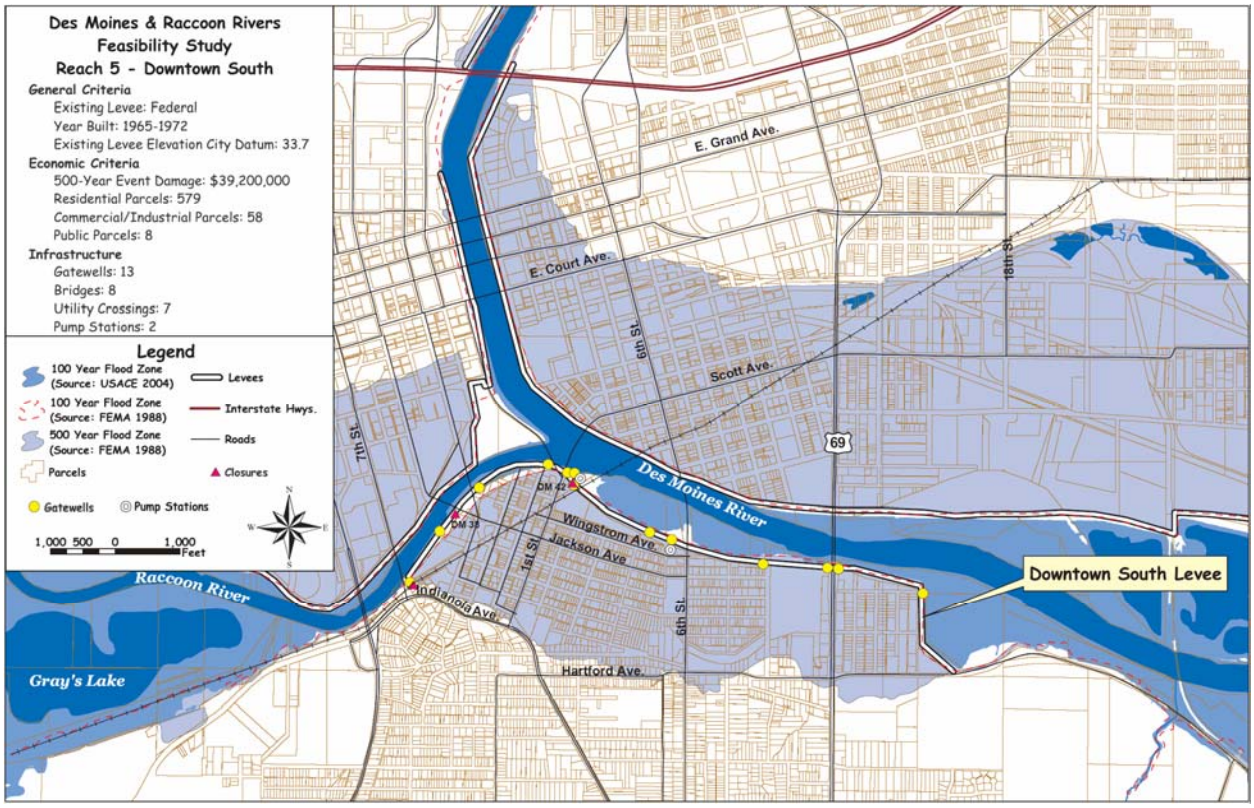


**Figure 15: Reach 5 Downtown South Study Area**

### 4.I.1. Existing Conditions (Downtown South)

Reach 5 is protected by a federal levee providing slightly over a 100-year flood protection. The levee consists of grass covered earthen embankments, floodwalls and closures at 1st Street, Scott Avenue, SE 6th Street, and SE 14th Street. Three pump stations remove storm water during flooding.

Kruidenier Trail is a multi-use recreational trail. The trail at Gray's Lake Park, 2100 Fleur Drive, is located within the park and is within 2,000 feet of the levee. It is known among the City's trails for the 1500-foot bridge that allows the trail to encircle the lake for approximately 2.0 miles. All parking lots located within the park provide beginning and ending points for this circular trail. This trail is 2,000 feet from the levee.

The HTRW Phase I Environmental Site Assessment found no recognized environmental conditions for this location. As a result, no further investigations were conducted.

The Downtown South area is a fully developed urban area, including 579 residential properties, 58 commercial or industrial properties, and 8 public properties. It is dominated by buildings, pavement and mowed grass, with scattered ornamental trees. The levee in this area is well maintained and regularly mowed. A portion of Reach 5 is located within the Civic Center Historic District along with one of the closures.

### 4.I.2. Future without Project Conditions (Downtown South)

The Downtown South road and railroad closures would continue to be at risk during flood events. Demands for recreational facilities in the City have and would continue to increase. No substantial changes in environmental or cultural conditions should occur.

### 4.I.3. Problems and Opportunities (Downtown South)

**Problems:** Flood fighting along Reach 5 requires construction of temporary closures during major flood events. These structures have failed in the past causing serous flood damage.

**Opportunities:** As in Reach 3 the "Greenbelt riverfront development would implement any recreational opportunities.

### 4.I.4. Selecting and Combining Measures into Alternatives (Downtown South)

Two measures were considered to reduce flood damages, raising the existing levee and floodwalls from slightly over 100 year level to the 500-year level of protection, which is an estimated raise of 3 feet. In addition, existing closures were redesigned to increase their constructability and reliability. Three alternative approaches were evaluated for redesigning the existing closures that are part of the levee system:

- Permanently close existing openings that are no longer needed
- Install gate structures to ensure quick and reliable closure
- Reduce the size of the opening and change the alignment to lower the height of the temporary closure and improve stability/reliability. (The change in alignment would also enable the streets to remain open longer during flood events)

Two closures were identified for modification and a simple risk based analysis was performed see (Appendix C, Section 4e1) for details. Both closure are no longer needed and could be permanently closed, see Table 20 for closure description and proposed design). All alternative closure alternatives were coordinated with the riverfront redesign and reconstruction Greenbelt project authority and the City.

- Permanent Closure, DM 36 R.R. W. 7$^{th}$ Street
- Permanent Closure, DM 42-S.E. 1$^{st}$ St. & Riverview Dr.

### 4.I.5. Screening of Alternatives (Downtown South)

A preliminary cost estimate for a levee raise to 500-year level was determined to have a low B/C ratio less than 0.07 eliminating this measure from further analysis.

As in Reach 3, the study team applied the same flood-fighting reliability and risk base matrix and input these into the FDA model, which computed the economic benefits. If the closures received the recommended modifications, the time to make closures would decrease (for detailed analysis see Engineering Appendix C Volume II).

An environmental survey was conducted, which indicated that there would be no significant impacts. A cultural survey was also conducted, which determined that there were no known cultural resources (see Environmental and Cultural Inventories starting on page 73).

The only two effective alternatives (see Table 19) are the No Action and to construct closures modifications. A detailed incremental cost analysis was not performed due to the small project cost. With a B/C ratio of 15.3, the recommended plan is to construct 2 closure modifications.

**Table 19: Downtown South Closures and Levee Raise Cost Benefit Analysis (May 2004 price level)**

| Downtown South Levee | Project Cost Estimate | Total First Costs | Annualized First Costs | Annual O & M Costs | Total Annual Costs | Total Annual Benefits | Benefit Cost Ratio | Net Annual Benefits | Residual Annual Flood Damages |
|---|---|---|---|---|---|---|---|---|---|
| Closure Improvements | 31,000 | 33,000 | 2,000 | 0 | 2,000 | 30,000 | 15.3 | 28,000 | 46,000 |
| 500 year levee | 6,175,000 | 6,752,000 | 406,000 | 10,000 | 416,000 | 29,000 | 0.07 | -388,000 | |

5-5/8% Discount Rate, 50-Year Evaluation Period

### 4.I.6. Final Plan (Downtown South)

A major desire of the project partner, the City, was to maximize flood damage reduction at a reasonable cost. After review of the Feasibility Report, both the recommended locally preferred plan is to modify two closures, both of which would be permanently closed. A detailed description of these closures can be found in Volume 2, Appendix C: *Engineering Design*.

Since the costs and benefits of at least one plan providing greater flood damage reduction (i.e. a larger plan) than the recommended plan is not presented, the report does not adequately demonstrate that the recommended plan is the NED Plan.

The recommended plan for Reach 5 does not cause an increase in flood profiles or increase ponding elevations for interior flooding. Because there are no induced flood damages, mitigation measures are not necessary.

### 4.I.7. Plan Components Including Mitigation (Downtown South)

Two closures would be made permanent at the following locations listed below and shown on Plates D24-D27 in Volume 3:

### 4.I.8. Design and Construction Considerations (Downtown South)

Design and construction considerations vary for each levee system. See Appendix C, *Engineering Design* for a description of pertinent considerations; also see a summary description of the closures in Table 20.

**Table 20: Existing Closure Conditions and Proposed Correction, Downtown South**

| Closure Title Total of 2 Closures | Existing Open Width | Future Open Width | Proposed Closure Design | Length Closure Material | Height Closure Material | Buried / Depth |
|---|---|---|---|---|---|---|
| DM 36-R.R. S.W. 7th St. Permanent Closure | 60 | 0 | 12' Crown & 42' Base | 40 ft | 6 ft | 6 ft |
| DM 42 - S.E. 1st St. & Riverside Dr. Permanent Closure | 70 | 0 | 12' Crown & 36' Base | 45 ft | 5 ft | 6 ft |

No environmental mitigation is necessary.

## 4. J. REACH 6 – RACCOON RIVER SECTION 205 LEVEE EVALUATION

This existing federal levee was built under the authority of Section 205 of the 1948 Flood Control Act. The levee was completed in 2000 and is located along the south bank of the Raccoon River from SW 30th Street downstream to the railroad closure west of Fleur Drive, approximately three miles upstream of the confluence with the Des Moines River (Figure 16). The Federal levee was constructed by reconstructing an existing non-federal levee.

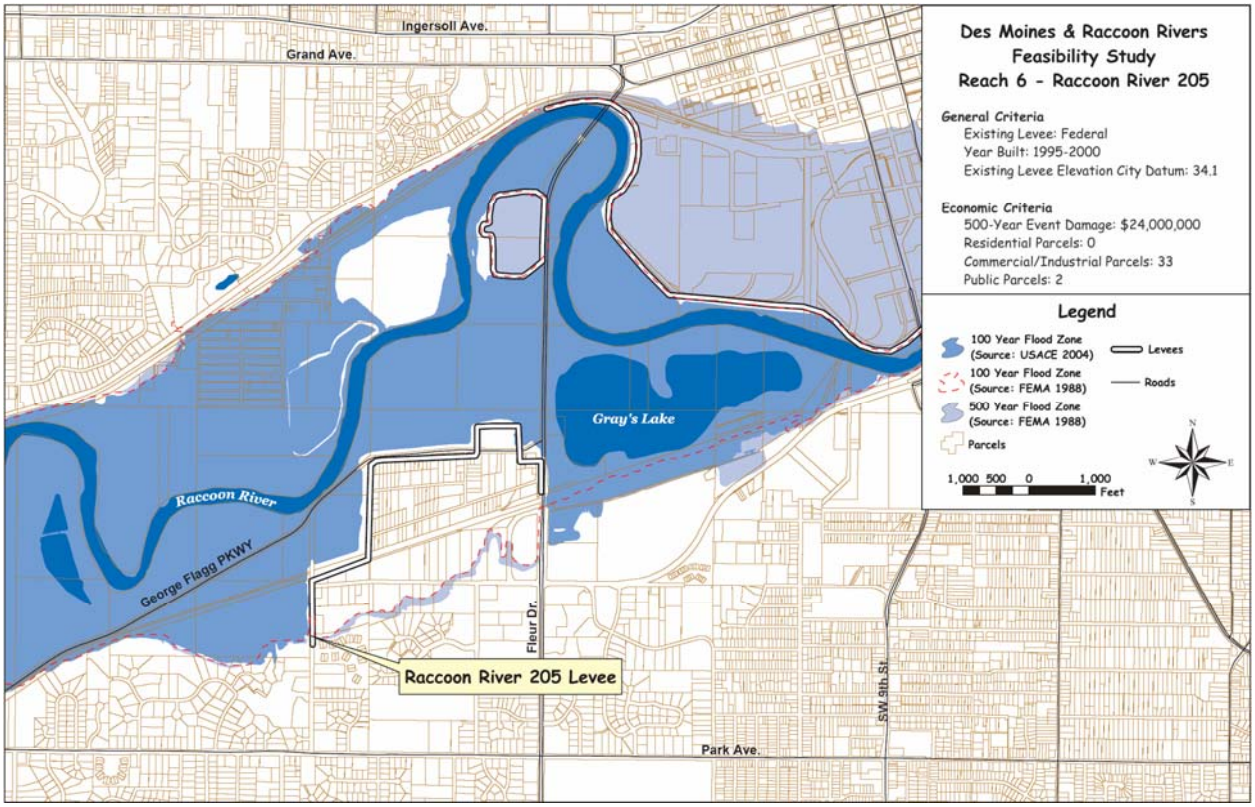


**Figure 16: Reach 6 Raccoon River 205 Study Area**

During the 1993 flood, the levee in this reach was overtopped and the area suffered extensive flood damages. The new federal levee was designed to provide a more than 100-year level of protection. As a result of the hydrologic and hydraulic analyses completed in Phase 1 of the study, it was determined that the estimated flood profiles have increased approximately one foot since the time the existing levee was designed. Despite this increase, the levee is in very good condition and is now estimated to provide slightly more than 100-year level of flood protection. The existing levee provides flood protection to 130 acres of moderately developed urban land. Behind the levee are 33 commercial and light industrial properties, a few older residential homes, and two public properties.

There are no recreation facilities on or adjacent to the levee and there appears to be little demand for such facilities. The City has developed an extensive trail system at Gray's Lake, just east of this area, which is used intensively, and plans are underway to connect the Gray's Lake facilities with the Riverwalk recreation facilities proposed for downtown Des Moines. The City has no plans to develop recreation features along or adjacent to the levee.

The Phase I Environmental Site Assessment found no recognized environmental conditions for this location. As a result, no further investigations were conducted.

There is little apparent growth in this area, and no demand for recreational facilities on the levee is anticipated. No substantial changes in environmental or cultural conditions are expected.

Non-structural measures were eliminated from consideration because structures in this reach are protected by the existing levee. It is not necessary or economically feasible to relocate, raise, or floodproof the structures.

Channel conveyance in the Raccoon River is severely limited by bridges and other structures in the floodplain, and modification of the channel to increase conveyance is not economically feasible. An

alternative to raise the height of the existing levee was conceptually developed but was determined to be not economically feasible. Based on this evaluation, there are no economically feasible flood damage reduction alternatives that can be applied to Reach 6, Raccoon River Section 205 Levee. The "No Action" alternative was selected for this reach.

## 4. K. REACH 7 – DES MOINES WATER WORKS LEVEE EVALUATION

The Des Moines Water Works (DMWW) is a publicly owned incorporated utility providing drinking water to more than 300,000 people in the Des Moines, Iowa, metropolitan area. The utility was established as a private company in 1871 and was purchased by the City in 1919. It is the largest water utility in Iowa, and is among the largest 100 utilities in the country. The main treatment plant is located in the Raccoon River floodplain along Fleur Drive (Figure 17).

The Des Moines Water Works is protected from flooding by a ring levee surrounding the plant. The treatment plant flooded during the Great Flood of 1993, causing most of the metropolitan area to be without drinking water for nearly two weeks and resulting in millions of dollars of damages to the facility. Following the disastrous flood, the Des Moines Water Works improved the levee by substantially increasing the height of the levee and installing additional closure structures.

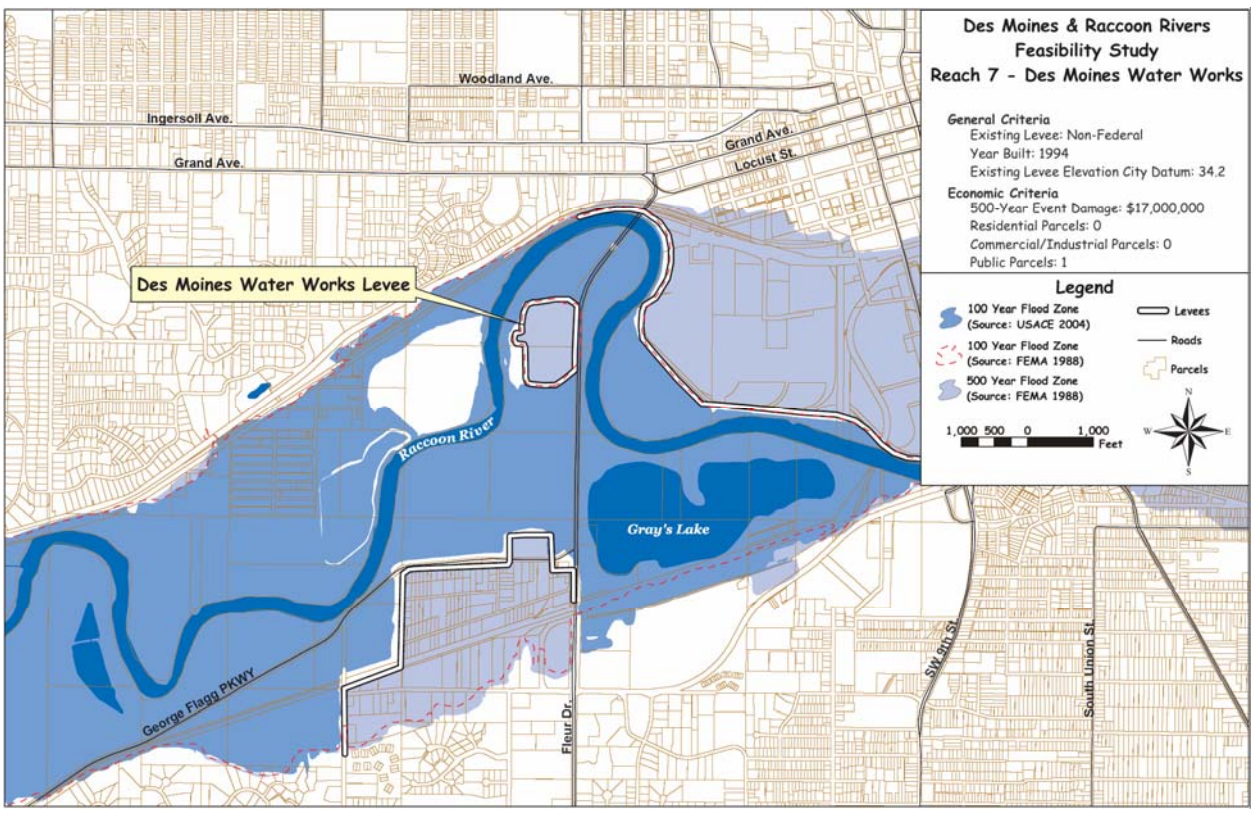


**Figure 17: Reach 7 Des Moines Water Works Study Area**

As a result of the hydrologic and hydraulic analyses completed in Phase 1 of the study, it was determined that the estimated flood profiles have increased approximately one foot since the time the existing levee was designed. Despite this increase, the levee is believed to be in good condition and provides a high level of flood protection. Currently, the top of the improved levee is about one foot higher than any of the existing Des Moines levee systems, giving it the capability to withstand a slightly more than a 250-year

flood event. During the course of this study, the design team did not evaluate the structural integrity of the system to withstand significant flood events.

The Des Moines Water Works did determine that areas within the ring levee get soft and saturated during a major flood. This can be caused by under-seepage that results from pervious layers of earth material. Another cause could be utility penetrations that allow piping or seepage along the utility. To evaluate structural integrity of the levee and its foundation, a series of soil borings, utility search, and other construction records are required. A follow-on assessment and analysis of the system could then be undertaken. It is recommended the City pursue this type of engineering analysis by requesting a USACE PL 84-99 eligibility inspection. If the levee meets minimum requirements, it can be allowed into the PL 84-99 program and receive annual inspections, flood fighting assistance, and repair due to flood damages. The inspection report would include an analysis of the system and identify any potential deficiencies.

The Des Moines Water Works is located inside Waterworks Park and adjacent to extensive recreation facilities located at Gray's Lake. There are no recreation facilities on the levee and none would be allowed or appropriate due to operational and security considerations.

The Phase I Environmental Site Assessment found no recognized environmental conditions for this location. As a result, no further investigations were conducted.

Because the existing levee provides a high and reliable level of protection, it is expected that future flood damages would be limited. No substantial changes in environmental or cultural conditions are expected.

Non-structural measures were eliminated from consideration, because structures in this reach are protected by the existing levee. It is not necessary or economically feasible to relocate, raise, or flood proof the structures. Channel conveyance in the Raccoon River is severely limited by bridges and other structures in the floodplain, and modification of the channel to increase conveyance is not economically feasible. Raising the height of the existing levee was determined to be not economically feasible. Based on this evaluation, there are no economically feasible flood damage reduction alternatives that can be applied to Reach 7, Des Moines Water Works Levee. The "No Action" alternative was selected for this reach.

## 4. L. REACH 8 – WEST DES MOINES LEVEE EVALUATION

The West Des Moines–Des Moines Local Flood Protection Project levee system provides protection to the west bank floodplain areas of Walnut Creek and north bank floodplain areas of the Raccoon River upstream of Walnut Creek, as shown on Plate 9, Volume 3 and in Figure 18 below. This system, which protects 900 acres of commercial, residential, and industrial properties in the Cities of Des Moines and West Des Moines, was completed in 1999. Reach 8 contains 904 residential parcels, 227 commercial or industrial properties, and 11 public properties. This area experienced extensive flooding in 1993. The levee system is composed of earthen levees, floodwalls, gated storm sewer outlets, pump stations, ponding areas, and road and railroad closures structures. In the fall of 1993, construction began on the first of four stages of the levee system, with completion in 1999. The overall levee system now provides slightly more than 100-year protection from Raccoon River and Walnut Creek flooding and would have protected the area during the 1993 flood.

Even though the revised modeling (Volume 2, Appendix A), shows the 100-year flood profile of the Raccoon River along the West Des Moines levee as two feet higher than the 1988 Flood Insurance Study (FIS), the levee still provides slightly more than 100-year level of protection.

The levee includes a recreation trail on the levee top, with extensive recreation features protected by the project. Demand for recreational facilities on the levee is strong and is expected to continue to increase. No substantial changes in environmental or cultural conditions are expected.

The Phase I Environmental Site Assessment found no recognized environmental conditions for this location. As a result, no further investigations were conducted. A wetland was identified along the southern edge of the existing levee, although wetland delineation was not performed to determine the boundaries and potential impacts. No cultural resources were investigated as part of this study.

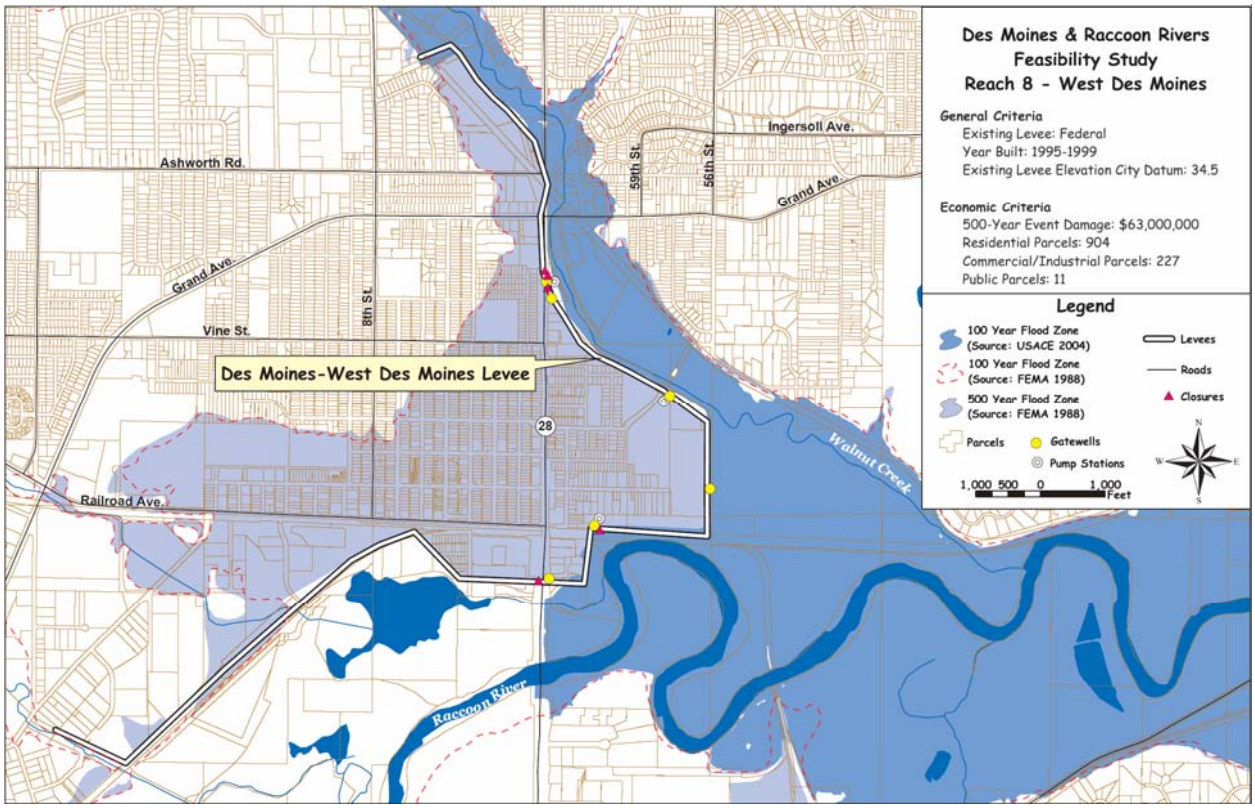


**Figure 18: Reach 8 West Des Moines Study Area**

Non-structural measures were eliminated from consideration, because structures in this reach are protected by the existing levee. It is not necessary or economically feasible to relocate, raise, or flood proof the structures. Channel conveyance in the Raccoon River is severely limited by bridges and other structures in the floodplain, and modification of the channel to increase conveyance is not economically feasible. An alternative to raise the height of the existing levee was conceptually developed, but was determined to be not economically feasible. Based on this evaluation, there are no economically feasible flood damage reduction alternatives that can be applied to Reach 8. The "No Action" alternative was selected as the final plan.

## 4. M. REACH 9 - WALNUT CREEK EVALUATION

Walnut Creek is a tributary to the Raccoon River and is subject to flooding as water levels increase on the Raccoon River. The westerly side of the creek is protected by the West Des Moines levee system, leaving the easterly side susceptible.

### 4.M.1. Existing Conditions (Walnut Creek)

Walnut Creek flows through a rapidly developing 84-square-mile watershed located west of the City in the western suburbs and Dallas County. The creek has experienced flash flooding on numerous

occasions, including 1973, 1986, 1990, 1993, 1997, and 1998. The recently completed Corps of Engineers' West Des Moines – Des Moines Local Flood Protection Project provides comprehensive flood protection to the developed western right bank floodplain areas near the creek's confluence with the Raccoon River. The study area of concern is the unprotected developed floodplain area located on the east bank of the creek near Grand Avenue in the City (Figure 19). The 100-year floodplain in this area from 64th and Center Streets downstream to North Valley Drive contains several residences and businesses that have experienced frequent flooding. The existing ALERT flood warning system provides advance warning to the City and allows residents some additional time to prepare.

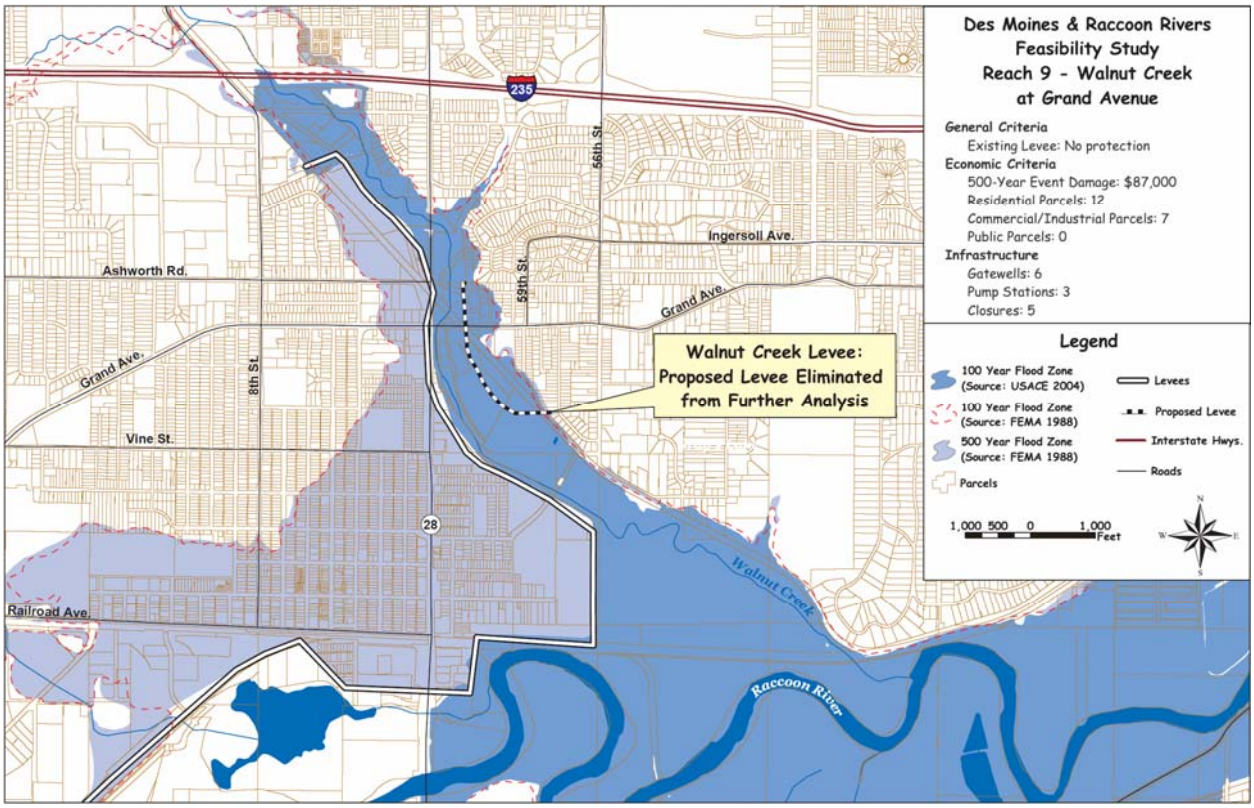


**Figure 19: Reach 9 Walnut Creek Study Area**

There are no recreation facilities near Reach 9. A multi-use recreation trail, the Bill Riley Trail, is proposed to run along Walnut Creek to Water Works Park terminating at the Great Western Trail on the south side of the Raccoon River. The Phase I Environmental Site Assessment found no recognized environmental conditions for this location. As a result, no further investigations were conducted.

Portions of the Reach 9 area are forested, and wetlands were found to be scattered within that area. No wetland delineation was performed to determine acreages of potential impacts. No cultural resources were investigated.

### 4.M.2. Future without Project Conditions (Walnut Creek)

Continued urbanization in the Walnut Creek watershed would moderately increase the discharge-frequency values, and flood damages are likely to increase. Structures would continue to be damaged by flash flooding, and further development of affected properties is unlikely. Because the flood profiles used for regulatory purposes have been developed based on complete development of the watershed, additional flood-prone development within the floodplain is unlikely.

### 4.M.3. Problems and Opportunities (Walnut Creek)

**Problem:** Approximately 12 homes and 7 businesses are located within the floodplain along Walnut Creek in the Reach 9 study area. Some of these structures are subject to frequent flooding from flash floods, although the depth of the flooding has typically been relatively shallow.

**Opportunity:** There is an opportunity to develop a recreation trail along Walnut Creek as part of the City's trail master plan.

### 4.M.4. Selecting and Combining Measures into Alternatives (Walnut Creek)

A levee alignment along the eastern bank of Walnut Creek was selected for evaluation, as discussed in Section VIII of Appendix C and shown on drawings WC-1 to WC-10 in Volume 3. No other levee alternatives were found to be feasible. The levee was designed at the same height as the existing levee and floodwall system on the western bank of Walnut Creek. Levee alternatives higher or lower than the levee on the western bank were considered unlikely to be either cost effective or acceptable to the community.

The proposed alignment begins at the southern end of Reach 9 by tying the levee into high ground behind residences on the west side of 58th Street north of Terrace Drive and continues northward until terminating at high ground behind residences on the north side of Walnut Hill Avenue. This proposal includes approximately 1,620 feet of levee, 780 feet of concrete floodwall, 2,150 feet of relocated sanitary sewer, 140 feet of relocated storm sewer, gate closure structures and gatewells. Real estate concerns may necessitate increasing the overall length of floodwall southward from station 11 + 78. This would result in a corresponding decrease in the length of the levee. If necessary, the increased use of floodwall would result in an increase in the project cost.

The proposed alignment requires the partial closure of 62nd Street between Grand Avenue and Walnut Hill Avenue. This closure would include approximately 200 feet of roadway at the north end of the block. Access from Grand Avenue to existing businesses on both sides of 62nd Street would be maintained via 62nd Street, while access for residences on Walnut Hill Avenue would be maintained via 61st Avenue.

### 4.M.5. Screening of Alternative (Walnut Creek)

As indicated in Table 21, the estimated cost of the levee alternative is $2,481,000. The estimated total annual costs exceed the total annual benefits resulting in a benefit/cost ratio well below one, therefore indicating that a federal project is not economically feasible. No further alternatives were evaluated. See Appendix B, *Economic Analysis* of the main report for more information about economic evaluation of the alternative.

**Table 21: Walnut Creek Cost Benefit Evaluation (May 2004 price level)**

| Reach 9<br>Walnut Creek | Project Cost Estimate | Total First Costs | Annualized First Costs | Annual O & M Costs | Total Annual Costs | Total Annual Benefits | Benefit Cost Ratio | Net Annual Benefits |
|---|---|---|---|---|---|---|---|---|
| 100 year levee | 2,481,000 | 2,624,000 | 158,000 | 0 | 158,000 | 50,000 | 0.32 | -11,000 |

5-5/8% Discount Rate, 50-Year Evaluation Period

### 4.M.6. Final Plan (Walnut Creek)

The "No Action" alternative was selected. There are no economically beneficial flood damage reduction measures that can be implemented for Reach 9.

## 4. N. REACH 10 - FOURMILE CREEK EVALUATION

Fourmile Creek is a 121-square-mile watershed that starts in southern Boone County and drains much of north-central Polk County north of Des Moines, including the communities of Alleman, Ankeny, Altoona, and Pleasant Hill, see Figure 20. The basin is about 28 miles long and 4 miles wide. The stream flows south through the eastern part of Des Moines to its confluence with the Des Moines River. The Fourmile Creek floodplain contains over 225 structures including houses, mobile homes, and businesses that are dispersed at several locations along the stream.

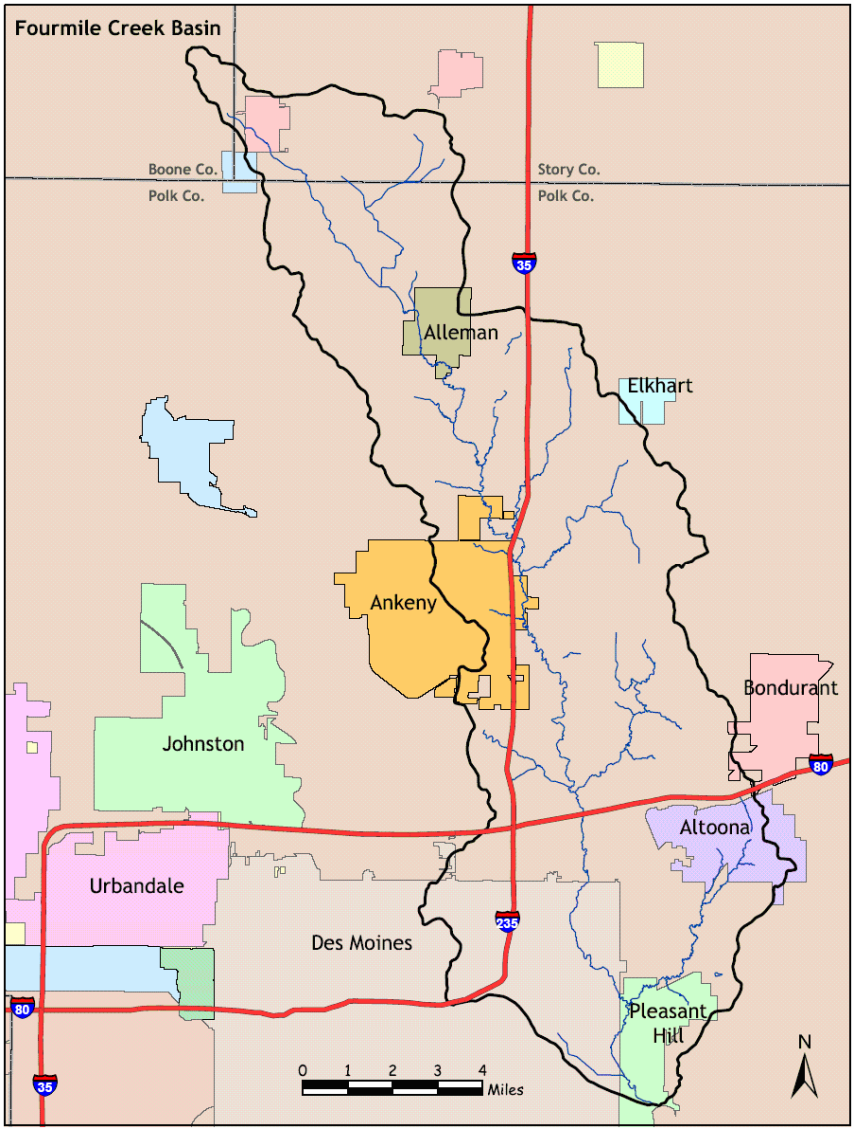


**Figure 20: Fourmile Creek Watershed**

The USACE completed a flood damage reduction study on Fourmile Creek in May 1975. This report looked at alternatives for providing flood protection along the creek, including upstream reservoirs and several levee alignments, however no justifiable economic alternatives were found. The data, findings and conclusions of the May 1975 study were reevaluated by the study team based upon Fourmile Creek flood profiles from Phase I of this study, current topography mapping, and current housing/business development information.

### 4.N.1. Existing Conditions (Fourmile Creek)

Fourmile Creek has a heavy growth of trees and brush along most of the creek channel. Some portions of the channel have been straightened between Scott Avenue and the Des Moines River and between Easton Boulevard and Hubbell Avenue. A map of the Fourmile Creek floodplain along Reach 10 is shown on Figure 21. The channel averages 40 to 50 feet wide and 5 to 7 feet in depth.

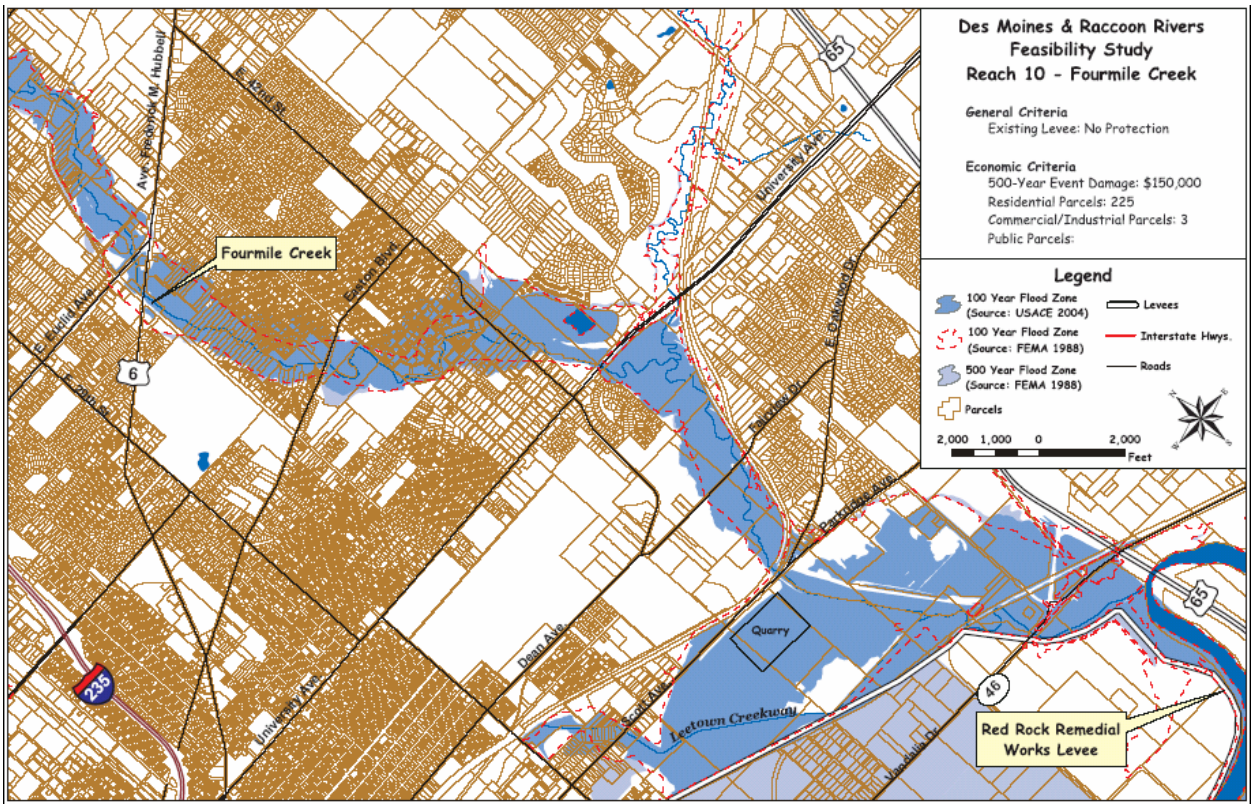


**Figure 21: Reach 10 Fourmile Creek Study Area**

Many of the areas along Fourmile Creek were developed prior to the era of regulated flood plain development. This development has occurred on both sides of the creek, resulting in a large number of structures that have been subject to repeated flooding. The most intensive area of development is from East Aurora Avenue downstream to East University Avenue. The area has experienced frequent flash flooding, with flood damages occurring on at least twelve occasions since 1947. The most recent flooding on May 23, 2004 was only slightly lower than the record flood crest on June 18, 1998. The 2004 flood was determined to be less than a 4 percent annual chance (25-year) flood event, but caused an estimated $500,000 in damages. Due to the severe flooding, Polk County was declared a federal disaster area in June 2004.

Flood discharge-frequency values for Fourmile Creek were determined using hydrologic models of the watershed as discussed in Appendix A, Volume 2. Because the drainage area for Fourmile Creek is small enough to be impacted by urbanization, both the existing conditions and future conditions were modeled. The future conditions discharges were prepared based on guidance from Federal Emergency Management Agency (FEMA) and were estimated based on year 2020 growth projections from the communities in the watershed. This analysis found that the projected development in the watershed could increase future flood discharges by about 12 to 13 percent as shown in Table 22.

**Table 22: Comparison of Fourmile Creek Discharges**

| Year | Exceedance Probability | Existing CFS | Future CFS | % Increase |
|---|---|---|---|---|
| 2 | 0.5 | 2,330 | 2,780 | 19% |
| 5 | 0.2 | 3,820 | 4,470 | 17% |
| 10 | 0.1 | 4,870 | 5,640 | 16% |
| 25 | 0.04 | 6,230 | 7,140 | 15% |
| 50 | 0.02 | 7,260 | 8,260 | 14% |
| 100 | 0.01 | 8,290 | 9,380 | 13% |
| 250 | 0.004 | 9,650 | 10,850 | 12% |
| 500 | 0.002 | 10,700 | 12,000 | 12% |

Because the existing conditions discharges are higher than those used in the July 1988 Flood Insurance Study, the estimated 1 percent annual chance (100-year) flood profile increased up to three feet. The largest increases are downstream of Euclid Avenue to Easton Boulevard. The updated flood profiles are shown on Plates A12 to A16 in Volume 3. Flood inundation maps of the Fourmile Creek floodplain were prepared based on the existing conditions flood profiles.

There are no structural flood protection facilities to protect properties along Fourmile Creek, except along the lower portion near the confluence with the Des Moines River. The Red Rock Remedial Works Levee was constructed along the west bank to prevent flooding of commercial and industrial properties in this area.

The flash flooding nature of Fourmile Creek allows for very little response time to flooding events. The City's ALERT flood-warning system increases the warning time to allow additional time to evacuate people from the flood area. However, the flashy nature of the stream does not allow adequate response time to protect property, resulting in repeated property damage from flooding.

Flood damage along Fourmile Creek is caused by overbank flooding. Over 1,200 acres would be inundated by the 1 percent annual chance (100-year) flood. Approximately 225 residences, 135 of which are mobile homes in two parks, and three businesses are contained in the Fourmile Creek floodplain. The mobile home park just south of Hubbell Avenue is particularly at risk of severe flooding.

In some cases, it is impractical to protect structures from flooding; removal of the structures from the floodplain is the best alternative. The City has an ongoing floodplain property buyout program to purchase frequently damaged structures in unprotected areas. This program has been very successfully in reducing flood damage by the removal of many of the most flood-prone structures.

The City has undertaken an effort, in cooperation with FEMA, to relocate residents and remove several flood-prone structures from the floodplain in the Williams Street area. Because some residents have elected to remain in their homes, some portions of the floodplain are a patchwork of scattered homes and vacant properties. Properties that are part of the buy-out program are being reformed into green space or small parks. Buyouts of the mobile home parks have not been performed since mobile home parks are considered commercial properties and the funds used for the FEMA buyout program are prioritized for residential properties.

The Gay Lea Wilson Trail is a multi-use trail currently connecting east Des Moines with Pleasant Hill and Altoona. From a hub off University Avenue, at the Copper Creek shopping center in Pleasant Hill, one segment runs northeast for about four miles to Altoona, a second segment runs south for about two miles to Scott Avenue and a third segment runs northwest into Des Moines terminating at Easton Boulevard. The length of the third segment is approximately 1.5 miles with an asphalt surface and a width of 10 feet. Trailheads are located at Easton Boulevard at Fourmile Creek and the parking lot at E 42nd Street and

Washington Avenue. A map of the City's recreational trail facilities is shown on Plate 12 in Volume 3. The trails are frequently used, and use is steadily increasing.

The Phase I Environmental Site Assessment found no recognized environmental conditions for this location. As a result, no further investigations were conducted.

A site visit to the Fourmile Creek area did not result in the identification of any sensitive environmental resources that would have been impacted, although no detailed analysis was prepared. No cultural resources were investigated.

### 4.N.2. Future without Project Conditions (Fourmile Creek)

Urbanization would continue to moderately increase the discharge-frequency relationships in the Fourmile Creek drainage. Structures would continue to be damaged by flooding, and further development of affected properties is unlikely. Additional buyouts and relocations of homes from the floodplain are likely. The recreational opportunities would likely improve as additional green space becomes available and as demand for recreational opportunities continues to grow.

### 4.N.3. Problems and Opportunities (Fourmile Creek)

**Problem**: Properties along Fourmile Creek are subject to frequent flooding from flash flood events. Flood damages are not confined to a concentrated area, but are scattered along the length of the stream.

**Opportunities**: As structures are removed from the Fourmile Creek floodplain, there is an opportunity for increased recreational use and green space. Construction of levees would provide opportunities for increased trail development along Fourmile Creek.

### 4.N.4. Selecting and Combining Measures into Alternatives (Fourmile Creek)

During the 1975 feasibility study, levees to protect selected areas along the stream were evaluated and found to be not feasible. The study team updated some of these levee alignments to reflect existing conditions and reevaluated the levees. Four of the alignments evaluated in the 1975 study (Levees RB-1, RB-2, LB-1, and LB-3), were eliminated because they severely encroached into the floodway, causing the 1 percent annual chance (100-year) flood profile to rise more than one foot and unacceptably impacting adjacent properties. Three of the four levee alignments eliminated, RB-1, RB-2 and LB-1, would provide protection to very few structures; however LB-3 would provide protection to a flood-prone mobile home park containing approximately 105 units, just south of Hubbell Avenue. The alignment of LB-3 would, however, encroaches into the floodway and would require the removal of all the mobile home units adjacent to Fourmile Creek. The locations of these levee alignments are shown on Drawings FMC1 to FMC11 in Volume 3. Six levee alignment alternatives, as described below, were evaluated:

LB-2, E. 38th Street to Fourmile Drive, left bank, LB-2, 2,250 ft levee

LB-4, Douglas Street to E. 38th Street, left bank, 7,000 ft levee

RB-3, E. 33rd St. to E. 35$^{th}$ St. north of Easton Avenue, right bank, 3,900 ft levee

RB-4, Hubbell Avenue at E. 32nd Court, right bank, 800 ft levee

RB-5, E. Euclid Avenue at E. 33$^{rd}$ Street, right bank, 1,000 ft levee

RB-6, Colfax Avenue at Shawnee Avenue, right bank, 2,250 ft levee

Because a levee to protect the mobile home (MH) park south of Hubbell Avenue was not feasible, a buyout of the park was evaluated. Buyouts of selected high-risk homes in the Fourmile Creek floodplain were also considered. Preliminary evaluation indicated that costs to remove these structures from the floodplain would far exceed the estimated flood damage reduction benefits; therefore, this alternative was

not selected for further consideration. A buyout of the mobile home park was determined to be the flood damage reduction alternative most likely to be feasible for this area.

### 4.N.5. Screening of Alternatives (Fourmile Creek)

A summary of the estimated costs and benefits for each of the alternatives is shown in Table 23. As shown in this table, the estimated annual costs are much greater than the annual benefits and the benefit cost ratios for each alternative are substantially less than one. Based on this analysis, all the alternatives were eliminated from further consideration. Detailed information about the economic analysis is included in Appendix B.

### 4.N.6. Final Plan (Fourmile Creek)

The "No Action" alternative was selected. There are no economically feasible flood damage reduction alternatives for Reach 10, Fourmile Creek. Continued buyouts of flood prone structures in the floodplain by the City are likely to continue and would help to reduce future flood damages.

**Table 23: Fourmile Creek Economic Evaluation Summary (May 04 price level) [1]**

| Alternatives | Project Cost Est. | Annualized First Costs | Annual O & M Costs | Total Annual Costs | Total Annual Benefits | Benefit Cost Ratio | Net Annual Benefits |
|---|---|---|---|---|---|---|---|
| **Reach LB-2** | 3,790,000 | 241,000 | 3,100 | 244,000 | 13,000 | 0.06 | -230,000 |
| **Reach LB-4** | 2,690,000 | 171,000 | 3,000 | 174,000 | 12,000 | 0.07 | -162,000 |
| **Reach RB-3** | 571,000 | 36,000 | 1,000 | 37,000 | 1,000 | 0.03 | -36,000 |
| **Reach RB-4 & 5** | 1,420,000 | 90,000 | 2,000 | 92,000 | 0 | 0.00 | -92.000 |
| **Reach RB-6** | 165,000 | 10,000 | 1,000 | 11,000 | 1,000 | 0.10 | -10,000 |
| **MH Park Buyout** | 2,150,000 | 147,000 | 0 | 147,000 | 47,000 | 0.32 | -99,000 |
| **No Action** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

[1] 5-5/8% Discount Rate, 50-year Evaluation Period

## 4. O. REACH 11 – LEETOWN CREEKWAY EVALUATION

Leetown Creekway (formerly known as 7th Ward Ditch) is within a 9-square-mile drainage area on the east side of the City, which drains into Fourmile Creek south of Scott Avenue. The Reach 11 area is shown on Plate 11 14, Volume 3 and below, in Figure 22.

### 4.O.1. Existing Conditions (Leetown Creekway)

Since the 1980s, the City has constructed several storm water detention basins to reduce flood flows, as well as channel and storm sewer improvements to improve the capacity of the system. Downstream of Easton Boulevard, Leetown Creekway flows through a storm sewer system that goes under the western edge of the Iowa State Fairgrounds.

The storm sewer emerges just past East 30th Street and Dean Avenue and combines with other storm sewers into an open channel. The channel flows approximately 2 miles across low-lying properties to its confluence with Fourmile Creek. This area is in the Fourmile Creek floodplain and experiences poor drainage and frequent flooding.

Despite the numerous improvements to the storm sewer system, homes and businesses near the southwest corner of the fairgrounds (E. 30th Street and Dean Avenue) continue to experience frequent flooding from

water backing up through the storm sewer system. Homes and businesses along the stream down to Scott Avenue also experience flooding.

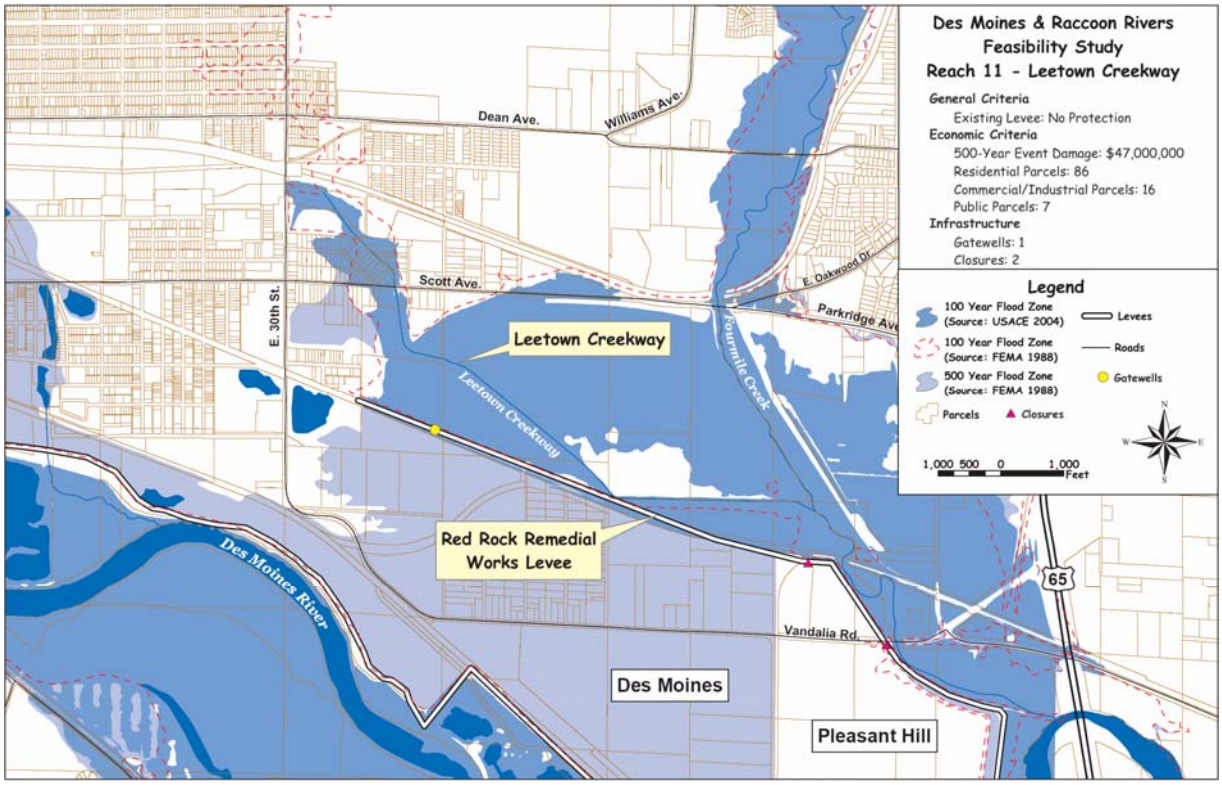


**Figure 22: Reach 11 Leetown Creekway Study Area**

There is no structural flood protection along Leetown Creekway. A floodplain buyout program has existed since the late 1990s and several structures near the intersection of 30th Street and Dean Avenue have been purchased and removed. The Red Rock Remedial Works Levee was constructed along the lower portion of Leetown Creekway and Fourmile Creek to prevent flooding of commercial and industrial properties in this area from Lake Red Rock. No recreation facilities were identified or are planned for the Leetown Creekway area..

The Phase I Environmental Site Assessment found no recognized environmental conditions for this location. As a result, no further investigations were conducted.

No environmental or cultural resources were investigated; however a database search revealed one cultural resource site within 100 yards of the study area.

Leetown Creekway area has 86 residential properties, 16 commercial or industrial properties and 7 public properties within the 500-year floodplain. Many structures within the 100-year floodplain that had been subject to frequent flooding have been removed.

### 4.O.2. Future without Project Conditions (Leetown Creekway)

Urbanization would likely increase in the upper portions of the watershed and possibly causing increased flood discharges. Structures would continue to be damaged by flooding and further development of affected properties is unlikely.

### 4.O.3. Problems and Opportunities (Leetown Creekway)

**Problem:** The low-lying areas near East 30th Street contain single-family residences that experience frequent flooding caused by a combination of inadequate storm-sewer capacity, inadequate channel capacity, and backwater from flooding in Fourmile Creek. Flooding caused by inadequate storm sewer capacity must be addressed locally, rather than as part of a Federal project.

**Opportunities:** There are no opportunities to improve recreation as part of a Federal project, due to the existing urban land uses.

### 4.O.4. Measures Eliminated From Further Analysis (Leetown Creekway)

Levees along Leetown Creekway were eliminated from consideration. Flood-prone structures in this area are located very close to the stream and there is inadequate room to construct a levee. A floodwall could be constructed in some areas, but the cost would be prohibitive for the relatively small number of structures that could be protected.

### 4.O.5. Selecting and Combining Measures into Alternatives (Leetown Creekway)

An alternative was initially developed for providing flood protection in the Leetown Creekway area by preventing Fourmile Creek floodwaters from backing up into the Leetown Creekway floodplain. This would reduce the flood stages in Leetown Creekway and, to a lesser extent, increase the capacity of the storm sewer systems draining into Leetown Creekway.

A levee would be constructed from the Red Rock Remedial Works Levee to high ground on the north side of Leetown Creekway along Scott Avenue. Storm water in Leetown Creekway would be diverted into a local quarry when Fourmile Creek was flooding that would in turn be pumped over the levee into Fourmile Creek. The plan would require the City to acquire flood easements to allow the City to store stormwater in the quarry.

It was initially believed that this alternative would also provide increased flood protection for commercial and industrial structures protected by the Red Rock Remedial Works Levee. When it was discovered that this alternative would not increase the level of protection for the Red Rock Remedial Works area, it was eliminated from further consideration due to its high cost and relatively low level of flood damages that could be prevented. The Red Rock Remedial Works Levee provides a high and reliable level of protection to the structures within its protected area.

### 4.O.6. Final Plan (Leetown Creekway)

The “No Action” alternative was selected. There are no economically feasible flood damage reduction measures, which could be implemented for Reach-11, Leetown Creekway. Continued buyouts of flood prone structures in the floodplain by the City are likely to continue and would help to reduce future flood damages.

# 5. DESCRIPTION OF RECOMMENDED PLAN

As discussed in Section 4, alternatives were evaluated for each reach resulting in the identification of a recommended plan for each reach. These recommended plans for each reach have been combined into a single recommended plan for a project as described below:

# 5. A. PLAN COMPONENTS

## 5.A.1. Reach 1, Birdland Park

**Project Levee Features**

- Reconstruct 7,700 feet of levee to 500-year level side slope is 3 to 1 with a 10' to 15' crown width.
- Closures at Saylor Road, (hinged steel gate)
- Retaining wall at Birdland Park's parking area (440 ft long)
- 42" RCP drainage pipe and gatewell for Riverview Park Lagoon
- Several utilities would be relocated
- Reconstruct existing asphalt bike trail on levee (10 ft wide 2,900 Ft long)

**Project Recreational Features**

- Construct a multipurpose recreational trail from the Neal Smith Trail to Riverview and McHenry Parks (12 ft wide 2,200 ft long)
- Landscaping on the section of levee crossing Riverview Park.

**Unavoidable Environmental Impacts and Mitigation Plan**

- Between 1.4 to 2.3 acres of emergent wetlands would be impacted. Mitigation at Chichaqua would be between 2.8 to 4.6 acres of emergent wetlands restored.
- Approximately 0.2 acres of bottomland forest would be impacted. Mitigation at the Central Place Riverside of levee would be 0.4 acres.
- Between 2.7 to 3.8 acres of open water would be impacted. Mitigation at the Chichaqua site would be between 2.7 to 3.8 acres of open water.
- Approximately 1.4 acres of upland forest would be impacted. Mitigation at Chichaqua will be 2.6 acres of upland forest.

### a) Real Estate Estimates

| | Birdland Park Reach | Acres | Acres |
|---|---|---|---|
| Non-Creditable | Existing Levee Right of Way | 26.47 | |
| | Sub Totals | → | 26.47 |
| Creditable | Temporary Work Areas Easement | 3.22 | |
| Creditable | Temporary Borrow Area Easement | 2 | |
| Creditable | Fee Mitigation | 17.38 | |
| Creditable | Fee (Additional Right-of-way) | 0.5 | |
| | Sub Totals | → | 23.1 |
| | Total acres needed for the project | | 49.57 |

## 5.A.2. Reach 2, Central Place

**Project Features**

- Reconstruct approximately 5,900 feet of levee to 500-year level
- Construct outlet pipes and gatewells from 3 existing pump stations

**Unavoidable Environmental Impacts and Mitigation Plan**

- Approximately 1.2 acres of bottomland forest would be impacted. Mitigation would be 2.2 acres onsite, riverside of the levee.
- Approximately 3.2 acres of upland forest would be impacted. Mitigation would be 2.2 acres at Central Place riverside of the levee and 3.8 acres at Chichaqua.

**Real Estate Estimates**

- Fee Mitigation (15.09 acres)
- Flood Protection Levee Easement (0.1 acres)
- Temporary Borrow Area Easement (0.5 acres)

### 5.A.3. Reach 3, Downtown East Closures

**Project Features**

- Four permanent closures; DM 41, DM 51, DM 85 and I-235 Embankment
- Six reduced closures widths; DM 45, DM 73, DM 75, DM 79, DM 81, and DM 87
- Install gates at existing pedestrian walkway closures at Simon Estes Amphitheater

**Real Estate Estimates**

- All lands are part of the existing right of way and are not creditable.

### 5.A.4. Reach 4, Downtown West Closures

**Project Features**

- One permanent closure DM86
- Five reduced closures width; DM 76, DM 78, DM 80, DM 82, and DM 88

**Real Estate Estimates**

- All lands are part of the existing right of way and are not creditable.

### 5.A.5. Reach 5, Downtown South Closures

**Project Features**

- Two permanent closures DM 36, and DM 42

**Real Estate Estimates**

- All lands are part of the existing right of way and are not creditable.

## 5. B. FINAL BENEFITS AND COSTS

A detailed cost estimate, referred to as a baseline or MCACES cost estimate, was prepared based on May 2004 price levels in order to accurately define the project costs. See Appendix D for the Cost Engineering breakouts prepared for the cost of implementing the recommended plan. These cost estimates have been indexed to October 2005 price levels in accordance with Engineer Manual 1110-2-1304. The total cost of the recommended multipurpose project, presented in October 2005 dollars, is $10,491,000 as shown in Table 24. A summary of project costs and benefits is shown in Table 25. It is important to note that the cost estimate will increase when the project is implemented due to higher

construction costs in the future. Accordingly, the recommended plan costs have been inflated to arrive at a "fully funded" construction cost estimate of $10,924,000 as shown in Table 24.

The net annual benefits for the project are $1,137,000. To reduce project costs where possible and to minimize the social effects wherever practical, designs will be refined during plans and specification in coordination with the landowners and the City Officials. After additional topography and soils data is available, the Study Team would work closely with the affected landowners and the City Officials to minimize the social effects and reduce overall/net project costs.

**Table 24: MCACES Summary of Cost Estimates for the Recommended Plan (Oct 2005 Price Level)**

| | Project Cost Est. (without inflation) Flood Damage Reduction | Project Cost Est. (without inflation) Recreation | Fully Funded Est. (incl. inflation) Flood Damage Reduction | Fully Funded Est. (incl. inflation) Recreation |
|---|---|---|---|---|
| **Birdland Park 500-year Levee Reconstruction** | | | | |
| Lands and Damages | 655,000 | | 655,000 | |
| Relocations | 123,000 | | 131,000 | |
| Levees and Floodwalls | 3,557,000 | | 3,745,000 | |
| Planning, Engineering, Design | 554,000 | | 546,000 | |
| Construction Management | 332,000 | | 349,000 | |
| Sub Total | 5,221,000 | | 5,426,000 | |
| **Birdland Park Recreation Multi-purpose Trail** | | | | |
| Recreational Facilities | | 204,000 | | 216,000 |
| Planning, Engineering, Design | | 31,000 | | 31,000 |
| Construction Management | | 19,000 | | 19,000 |
| Sub Total | | 254,000 | | 266,000 |
| **Central Place 500-Year Levee Reconstruction** | | | | |
| Lands and Damages | 164,000 | | 164,000 | |
| Levees and Floodwalls | 2,127,000 | | 2,239,000 | |
| Pump Stations | 989,000 | | 1,050,000 | |
| Planning, Engineering, Design | 470,000 | | 464,000 | |
| Construction Management | 282,000 | | 296,000 | |
| Sub Total | 4,032,000 | | 4,213,000 | |
| **Downtown East Levee Closures Improvements** | | | | |
| Lands and Damages | 9,000 | | 9,000 | |
| Levees and Floodwalls | 470,000 | | 495,000 | |
| Planning, Engineering, Design | 141,000 | | 140,000 | |
| Construction Management | 58,000 | | 59,000 | |
| Sub Totals | 678,000 | | 703,000 | |
| **Downtown West Levee Closures Improvements** | | | | |
| Lands and Damages | 9,000 | | 9,000 | |
| Levees and Floodwalls | 187,000 | | 196,000 | |
| Plans and Engineering Design | 56,000 | | 55,000 | |
| Construction Management | 22,000 | | 24,000 | |
| Sub Totals | 274,000 | | 284,000 | |
| **Downtown South levee Closures Improvements** | | | | |
| Lands and Damages | 8,000 | | 8,000 | |
| Levees and Floodwalls | 17,000 | | 17,000 | |
| Plans and Engineering Design | 5,000 | | 5,000 | |
| Construction Management | 2,000 | | 2,000 | |
| Sub Totals | 32,000 | | 32,000 | |
| FDR and Recration Totals | 10,237,000 | 254,000 | 10,658,000 | 266,000 |
| **Recommended Plan Total** | **10,491,000** | | **10,924,000** | |

**Table 25: Summary of Cost and Benefits for all the Project Components (Oct 2005 Price Level)**

| | Project Cost Estimate | Interest During Const. | Total First Costs | Annualized First Costs | Annual O & M Costs | Total Annual Costs | Total Annual Benefits | Benefit Cost Ratio | Net Annual Benefits | Residual Annual Flood Damages |
|---|---|---|---|---|---|---|---|---|---|---|
| Birdland Park 500 year Levee | 5,221,000 | 416,000 | 5,637,000 | 315,000 | 14,000 | 329,000 | 458,000 | 1.4 | 129,000 | 11,000 |
| Central Place 500 year Levee | 4,032,000 | 273,000 | 4,305,000 | 240,000 | 15,000 | 255,000 | 938,000 | 3.7 | 683,000 | 8,000 |
| Downtown East Closure Improvements | 678,000 | 35,000 | 713,000 | 40,000 | 0 | 40,000 | 163,000 | 4.1 | 123,000 | 264,000 |
| Downtown West Closure Improvements | 274,000 | 14,000 | 288,000 | 16,000 | 0 | 16,000 | 77,000 | 4.8 | 61,000 | 167,000 |
| Downtown South Closure Improvements | 32,000 | 2,000 | 34,000 | 2,000 | 0 | 2,000 | 31,000 | 16.5 | 29,000 | 48,000 |
| Flood Damage Reduction Totals | 10,237,000 | 740,000 | 10,977,000 | 613,000 | 29,000 | 642,000 | 1,667,000 | 2.6 | 1,025,000 | 498,000 |
| Birdland Park Recreation Trail | 254,000 | 15,000 | 269,000 | 15,000 | 1,000 | 16,000 | 127,000 | 7.9 | 111,000 | N/A |
| Totals | 10,491,000 | 755,000 | 11,246,000 | 628,000 | 30,000 | 658,000 | 1,794,000 | 2.7 | 1,136,000 | 498,000 |

5-1/8% Discount Rate, 50-Year Evaluation Period

**Table 26: Deleted**

## 5. C. OPERATION AND MAINTENANCE

The City of Des Moines will operate and maintain the project in accordance with the procedures and schedules set forth in an Operation and Maintenance manual that the USACE would prepare and provide. The total estimated annual cost of operation and maintenance for the Recommended Plan is $30,000, which includes both flood control and recreation features. Maintenance would consist of annual inspections of and repairs to the project permanent levees, interior drainage facilities, and recreation facilities. Operation would include the operation of pumping stations and gates and the servicing of all project structures, including landscaping.

Levees would be kept free of brush and tree growth and be mowed several times a year. Rodent holes and other embankment damage would be filled and repaired as needed. See Appendix C for additional information on required operation and maintenance activities.

## 5. D. PLAN ACCOMPLISHMENTS

Based on public, interagency, and local Sponsor inputs and District evaluations, the social and economic effects of the recommended plan would be positive. Levels of protection for Birdland Park and Central Place would increase from 50-year to as much as 500-year. Improved design for closures would significantly reduce the risk of not completing a closure or having a closure fail, which has been the case in recent flood events. The environmental effects of the recommended plan would be negative due to the filling of wetlands and open water and clearing of upland and wetland forests. Compensatory mitigation is proposed to offset the environmental impacts. Recreational opportunities would be met by improving the existing trail network between parks and natural areas. By far, the most important effect of implementation of the recommended plan would be that hundreds of homes, businesses, and public structures would be reliably protected from future floods. It is important to note that the economic analysis done as part of this study claims only national economic benefits from flood damage reduction and recreation. The residual damages for the modified project in average annual dollars and as a percentage of the without-project average annual flood damages can be found in the chart below.

| | Without Project Average Annual Flood Damages | Flood Damage Reduction Annual Benefits | Residual Annual Damages | % Damages Reduced |
|---|---|---|---|---|
| **Birdland Park** | 418,500 | 407,300 | 11,200 | 97% |
| **Central Place** | 897,100 | 888,800 | 8,300 | 99% |
| **Downtown East** | 427,000 | 163,300 | 263,700 | 38% |
| **Downtown West** | 243,900 | 76,700 | 167,200 | 31% |
| **Downtown South** | 79,400 | 31,300 | 48,100 | 39% |
| Oct 05 prices, 5-1/8% discount Rate, 50-year evaluation period | | | | |

The recommended project would provide many long-term local and regional economic benefits that are not incorporated into the economic benefits attributed to the recommended plan, but which are very real and important to the community and its residents. These include improved community cohesion, preserved and improved property values and local tax base, enhanced recreation opportunities, improved public health and safety, and enhanced community growth and development opportunities.

An Environmental Assessment has been prepared to assess the impacts of the recommended project and obtain public and interagency comments. The Environmental Assessment is integrated in this document. Any change to project plan formulations that may affect environmental and social acceptability would be fully re-coordinated with the public, other agencies and the local Sponsor during the development of final plans and specifications.

## 5. E. SUMMARY OF ECONOMIC, SOCIAL AND ENVIRONMENTAL EFFECTS

In reviewing the planning objectives developed for the Des Moines and Raccoon Rivers Feasibility Study outline earlier in this report, all objectives were met in formulation of the recommended plan. Problem areas were identified and an array of potential alternatives, both structural and nonstructural, that would alleviate out-of-bank flooding problems within the study area were developed and evaluated. As the recommended plan was identified, coordination with the City took place throughout the study, taking into account the City's goals and input,

### 5.E.1. National Economic Development (NED)

A plan was formulated which contributes to National Economic Development (NED); i.e. the benefits of the project exceed the project costs. Since the costs and benefits of at least one plan providing greater flood damage reduction (i.e. a larger plan) than the recommended plan is not presented, the report would not adequately demonstrate that the recommended plan is the NED Plan. Therefore, in accordance with

paragraph 4-3b (2)(a) of ER 1105-2-100, the recommended plan should not be labeled as the NED Plan and should be labeled and presented as the recommended and is also the locally preferred plan.

### 5.E.2. Regional Economic Development (RED)

Regional Economic Development (RED) impacts are expected to be minimal due to FEMA certified flood protection currently in place in project areas. The Recommended Plan for flood damage reduction provides benefits too many areas of the flood threatened community along the Des Moines and Raccoon Rivers.

### 5.E.3. Other Social Effects (OSE)

Other Social Effects (OSE) addresses concerns in areas where there are potential risks to health, and community cohesion. These risks would continue under the "No Action Plan." The Recommended plan for flood damage reduction reduces the risk for flood-related loss of health issues and other community cohesion concerns. Neither Regional Economic Development nor social effects were significant areas of concern or controversy during the planning and public involvement process.

### 5.E.4. Environmental

The following Table 27 summarizes effects on the environment from actions of the proposed plan.

**Table 27: Summary of Environmental Effects**

| Types of Resources | Regulatory Authorities | Measurement of Effects |
|---|---|---|
| Air quality | Clean Air Act, as amended (42 U.S.C. 165h-7, | No significant effect |
| Areas of particular concern within the coastal zone | Coastal Zone Management Act of 1972, as amended | Not present in planning area |
| Endangered and threatened species critical habitat | Endangered Species Act of 1973, as amended (16 U.S.C. 1531, et seq.) | No significant impacts anticipated |
| Fish and wildlife | Fish and Wildlife Coordination Act (16 U.S.C. 661, et seq.) | No significant effect |
| Floodplains | Executive Order 11988, Flood Plain Management | No significant effect |
| Historic and cultural properties | National Historic Preservation Act of 1966 as amended (16 U.S.C. 470, et seq.) | No significant effect |
| Prime and unique farmland | CEQ Memorandum of Aug. 11, 1980; Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act | No significant effect |
| Water quality | Clean Water Act of 1977, as amended (33 U.S.C. 1251, et seq.) | No significant effect |
| Wetlands | Executive Order 11990, Protection of Wetlands, Clean Water Act of 1977, as amended (43 U.S.C. 1857h-7, et seq.) | No significant effect |
| Wild and scenic rivers | Wild and Scenic Rivers Act, as amended (16 U.S.C. 1271, et seq.) | Not present in planning area |

# 6. INVENTORY, ANALYSIS, AND STUDY FINDINGS

This inventory and analysis also serves as the existing condition, affected environment and environmental impact analysis in the project area.

## 6. A. HYDROLOGY AND HYDRAULICS

### 6.A.1. Floodplain Features and Assumptions

**Table 28: Stream/Floodplain Features**

| Feature | Des Moines | Raccoon | Fourmile | Walnut |
|---|---|---|---|---|
| Stream length | 79,000 feet | 45,000 feet | 43,637 feet | 16,600 feet |
| Number of cross sections | 142 | 83 | 85 | 42 |
| Number of bridges | 20 | 13 | 12 | 5 |
| Channel "n"-value | .020-.035 | .022-.030 | .038-.0475 | .032-.035 |
| Overbank "n"-value | .020-.135 | .060-.130 | .040-.140 | .068-.137 |

### 6.A.2. Project Impacts

Each proposed alternatives involve raising existing levees and care was taken not to move riverward of the existing levees. Therefore, there are no induced water level increases due to any levee raises or improvements. In fact, the proposed project changes involve making the side slopes of the alternative levees gentler. The net affects of this change would be to increase the cross-sectional area.

The storage behind Birdland Park and Central Place is not large enough to reduce discharges on the Des Moines River. Raising these levees would not create water surface increases due to the reduction in storage volume. During the 1993 Flood, failure of the levees did not result in any noticeable reduction of the flood water levels in the river channel.

## 6. B. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE MATERIAL

### 6.B.1. Background

Phase I and Phase IIA Hazardous, Toxic, and Radioactive Waste (HTRW) Environmental Site Assessments for the Des Moines and Raccoon Rivers Flood Damage Reduction Feasibility Study were conducted under contract for the District. Details associated with these reports are summarized in Appendix E.

### 6.B.2. Conclusions

The HTRW assessments revealed recognized environmental conditions in the following locations: Birdland Park, Central Place (including the local mitigation site), Downtown West, and Downtown East project areas, and the stockpiled material at the Harriet Street Landfill. These conditions were confirmed via Phase IIA sampling, revealing metals and polycyclic aromatic hydrocarbons (PAH) concentrations in excess of the Iowa State Land Recycling Program Standards.

Due to ongoing construction activities at the Downtown West Levee project area, between Center Street and Riverview Park,, no Phase IIA ESA was conducted at this time. However, the Phase I ESA did identify recognized environmental conditions at this location.

This assessment has revealed no evidence of recognized environmental conditions, such as hazardous substances, HTRW, or other regulated contaminants, in connection with the Walnut Creek project area, the Downtown South project area, Leetown Creekway (the 7th Ward Ditch) project area, the Fourmile Creek project area, and the wetland mitigation site.

### 6.B.3. Recommendations

No further investigation, such as a Phase II ESA, is warranted at Walnut Creek, Downtown South, 7th Ward Ditch, or Fourmile Creek. However, further investigation is warranted at the Downtown West Levee project area, between Center Street and Riverview Park.

The contaminants on the property are not an issue. ER 1165-2-132, *Water Resources Policies and Authorities - Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects*, requires coordination with the appropriate stage agency when a non-federal sponsor acquires land that is not contaminant-free. In Iowa, obtaining a No Further Remedial Action Planned (NFRAP) certificate from the Land Recycling Program administered by the Iowa DNR is typically the state process used by landowners. The non-federal-sponsor contacted the Iowa DNR regarding obtaining a NFRAP certificate for this property. The Iowa DNR informed the sponsor (see Appendix E-G-1 of Volume 2) that due to the low level of contaminants, it would not be appropriate to even enter the state Land Recycling Program, which ultimately issues the NFRAP certificate. The non-federal sponsor (City of Des Moines) received a letter from Iowa DNR stating that due to the very low concentrations (slightly elevated heavy metal concentrations were generally within the background levels in the State of Iowa), no further investigation of the site would be required.

All costs related to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulated material will be the sponsor's responsibility in accordance with ER 1165-2-132. Measures will be taken during construction to ensure worker safety if exposed to contaminated material.

## 6. C. ENVIRONMENTAL, CULTURAL, AND SOCIAL RESOURCES

### 6.C.1. Alternatives

During Plan Formulation, the following steps were used to develop final plans for flood damage reduction for each reach: 1) identify problems and opportunities; 2) identify planning constraints; 3) identify structural and non-structural flood damage reduction measures, evaluate for effectiveness, and combine effective measures for each reach into alternatives; 4) screen the alternatives against NED, to determine which alternatives for each reach would have the greatest net benefits and a B/C ratio greater than 1.0; and 5) select the final plan for each reach. More detailed information on plan formulation is described in section 4A.

#### a) Reach 1. Birdland Levee

The existing levee has a high probability of failure due to instability of the levee embankment. Fifty-year old trees and brush, unsuitable construction materials, and steep embankments which are difficult to mow are the major sources of instability. Inability to adequately make road closures during floods increases the potential for flood damage.

There is an opportunity to enhance a portion of the Neal Smith Trail by widening it to improve safety. The City would also like to construct short spurs from the trail to existing ball fields adjacent to the levee. Also, the City wants to construct some rest areas and lookout points along the trail on the levee near Riverview Park to increase enjoyment of the Trail.

The "No Action" alternative means that no Federal flood reduction project would be constructed. This alternative assumes that the community would continue to rely on the existing levee system, emergency flood fighting measures, and flood insurance to provide flood damage protection.

As shown in Figure 5, three alignments were considered.

- Alignment 1 is constructed of both floodwall and levee. The floodwall is required to avoid impacting the existing businesses.
- Alignment 2 traverses over Riverview Park and is an earthen levee with a seepage berm and gated culvert.
- Alignment 3 follows the existing alignment and is an earthen levee with a seepage berm and gated culvert to drain storm water.

In addition, one recreational alternative was developed which is dependent on the construction of Alignment 2. A bike trail would be built from the existing Neal Smith Trail and continue on the levee to McHenry Park and up the hill. Landscaped overburdens with a pedestrian and bike trail down to Riverview Park would be constructed. Overlooks and resting areas could also be part of the bike and pedestrian trail.

Constructing a 25-year or 50-year levee would result in a levee that is lower than the existing levee and would require removing earthen material from the site, which would result in cost greater than flood damage reduction benefits. Therefore, the 25-year and 50-year levees were removed from further consideration.

A major desire of the City is to maximize flood damage reduction at a reasonable cost. After review of the Feasibility Report, Alignment 2 is the Recommended Plan for flood damage reduction. Alignment 2 has not yet been formally selected by the City for implementation.

#### b) Reach 2. Central Place Levee

The Central Place levee was constructed over a period using different construction methods. Field observations and soil borings indicated that a high variety of fill materials was used with less than optimal compaction, extensive embedded debris, and tree root growth, which could lead to failure during a flood event.

At this time, the City does not plan to extend their bike trail system into this area; therefore, there are limited opportunities for recreation other than maintaining the green space between the levee and the river.

The "No Action" alternative means that flood protection would continue to diminish as trees continue to compromise the levee. Upland and bottomland forests would continue to become more structurally diverse on and adjacent to the existing levee. The existing reed canarygrass areas within the bottomland forest would likely remain for the foreseeable future since it is very difficult for trees or shrubs to seed themselves in areas fully vegetated with reed canarygrass.

The primary alternatives under consideration involve reconstruction of the existing levee to provide improved flood protection to the 500-year level from 2$^{nd}$ Avenue to I-235. The only viable measure to reduce flood damage along Reach 2 is reconstructing the levee; constructing new gatewells, and improving pump station discharge pipes at three elevations, 100-year, 250-year and 500-year.

Two lower levee heights, 25-year and 50-year, were considered and eliminated as the existing levee has enough material for a 250-year height, and the cost to remove the excess material exceeded the economic benefits.

A major desire of the City is to maximize flood damage reduction at a reasonable cost. After review of the Feasibility Report, Alignment 2 is the Recommended Plan for flood damage reduction. Alignment 2 has not yet been formally selected by the City for implementation.

**c) Reach 3 – Downtown East Levee**

Currently, flood fighting along Reach 3 requires construction of temporary closures during major flood events, consisting of staging and installing clay embankment plugs, or plastic sheeting and sand bag wall structures to repel the floodwaters. Nevertheless, as was the case in the 1993 flood, floodwaters rose rapidly, jeopardizing successful placement of these closures. The proposed closure improvements decrease the time to construct and would decrease the manpower.

The "No Action" alternative means that the Downtown East road and railroad closures would continue to be at risk during flood events. Demands for recreational facilities in the City have and would continue to increase. No substantial changes in environmental or cultural conditions should occur.

A major desire of the City is to maximize flood damage reduction at a reasonable cost. After review of the Feasibility Report, the Recommended Plan for flood damage reduction does reduce damages significantly with modification to 11 closures. Four permanent closures would be constructed, along with six narrowed closures and four gate closures within the amphitheater. Flood damage reduction measures must work cooperatively with the proposed Riverwalk facilities.

**d) Reach 4: Downtown West Levee**

The existing levee and floodwall system provides flood protection for slightly more than 100-year flood events. Flood fighting requires construction of temporary closures for flood events above the 10-year stage, consisting of installing clay embankment plugs or plastic sheeting and sand bag wall structures to repel floodwaters. In the 1993 flood event, floodwaters rose quickly, jeopardizing successful placement of these temporary closures. The proposed closure improvements decrease the time to construct and would decrease the manpower.

The "No Action" alternative means that the Downtown West road and railroad closures would continue to be at risk during flood events. Demands for recreational facilities in the City have and would continue to increase. Flood damage reduction measures must work cooperatively with the proposed River walk facilities.

The only alternative that would increase overall closure reliability with possible benefit/cost ratio greater than one is to permanently close four selected openings in the levee, narrow four more openings to decrease the size of the "temporary closure" structures, and build one gate closure required to increase overall closure reliability. Flood damage measures must work cooperatively with the proposed Des Moines Riverwalk facilities.

**e) Reach 5: Downtown South Levee**

The existing levee and floodwall system provides flood protection for events for slightly more than 100-year flood events. Flood fighting along Reach 5 requires construction of temporary closures during flood events in excess of the 100-year frequency. The closures consist of staging and installing clay embankment plugs or plastic sheeting and sand bag wall structures to repel the floodwaters. However, as was the case in the 1993 flood, floodwaters rose rapidly, jeopardizing successful placement of these closures. The proposed closure improvements decrease the time to construct and would decrease the manpower.

The "No Action" Alternative means that the Downtown South road and railroad closures would continue to be at risk during flood events. Demands for recreational facilities in the City have and would continue to increase. Flood damage measures must work cooperatively with the proposed Des Moines Riverwalk facilities

The only alternative with a possible benefit/cost ratio greater than one is to permanently close two selected openings in the levee to improve overall closure reliability.

#### f) Reaches 6 through 11

Reaches 6 through 11 have no federal interest because of B/C ratios below 1.0 and are therefore not included in this alternatives analysis.

### 6.C.2. Affected Environment

#### a) Reach 1: Birdland Park Levee

The Birdland Park area contains 170 acres of residential and commercial property. This area includes the North High School complex, Birdland City Park, and Riverview Park, in addition to numerous commercial establishments. The area is mapped in the National Flood Insurance Program as having 100-year flood protection by an existing levee constructed by the City in the 1950s. This levee was overtopped during the 1993 flood, causing extensive flood damage.

The levee was constructed of miscellaneous fill and has been found to contain rubble and debris. Today the top width and slopes are variable and do not meet minimum federal standards. In the years since construction, portions of the levee have become heavily overgrown with trees.

The structural diversity of the existing large trees, shrubs, and herbaceous plants growing on the levee provides habitat for a variety of animal and bird species. A bottomland hardwood forest of varying widths and distances to the Des Moines River borders the riverward side of the levee.

The Birdland Levee is part of and existing City' recreational trail system, the Neal Smith Trail, which runs beside and on the top of the levee, is a segment of the longer Saylorville Trail, all of which is highly used by recreationists.

In the spring of 2004, Phase IIA hazardous, toxic, and radioactive waste (HTRW) sampling revealed metals and polycyclic aromatic hydrocarbons (PAH) in low concentrations; however, these concentrations are in excess of the Iowa State Land Recycling Program Standards, however due to the very low concentrations the Iowa DNR has cleared the levee area and no remediation is required.

The Kiwanis Club leases Riverview Park from the City, and has developed a Master Plan for replacing the abandoned amusement park with a more natural setting for public recreation. The island has scattered large trees. A cattail marsh in the western end of the island and a scrub-shrub and emergent wetland along the northern and southern tips of the island increase the value of the area for wildlife and recreation. The large lagoons at the site are fed by groundwater and storm water and do not have a surface water connection to the Des Moines River.

#### b) Reach 2: Central Place Levee

The Central Place Business District is on the near north side of the City and now is home to numerous commercial properties. The area is protected from flooding by an earthen levee (with 222 feet of concrete floodwall underneath the University Avenue Bridge) constructed by the City in 1950. It is mapped in the National Flood Insurance Program as having 100-year flood protection. The levee was overtopped during the 1993 flood, causing extensive flood damages. Following the 1993 flood, the City undertook several measures to improve the level of protection provided by the levee; however, the levee still requires upgrading to meet the current USACE flood protection standards.

The Central Place area is unique since it is lower than the normal river levels and therefore, all runoff from the area must be pumped. The interior areas are presently serviced by four large stormwater pump stations, which were constructed by the City in the 1970s and upgraded in 1975. The City constructed a

new pump station at 2nd Avenue in 1997 that consists of three submersible pumps with a total capacity of 120,000 GPM.

The levee is overgrown with trees on both slopes extending out from the crown past the toe on both sides, which provides structural habitat diversity for various birds and small mammals. Animal holes and debris in the levee have contributed to the increased estimated probabilities of failure. The river side of the levee consists of bottomland hardwood forest scattered with open wetland herbaceous meadows dominated by the invasive species reed canarygrass *(Phalaris arundinacea*). An upland forest borders the southern portion of the levee. The levee is currently used as an informal walking path and green space.

In the spring of 2004, Phase IIA hazardous, toxic, and radioactive waste (HTRW) sampling revealed metals and polycyclic aromatic hydrocarbons (PAH) in low concentrations; however, these concentrations are in excess of the Iowa State Land Recycling Program Standards, however due to the very low concentrations the Iowa DNR has cleared the levee area and no remediation is required.

Upland forest, emergent wetland, and open water creation would occur at the Chichaqua site, an 85-acre parcel currently owned by the City, as mitigation for most of the project impacts. This mitigation site is located within the larger Chichaqua Bottomlands Greenbelt, an approximately 7,000-acre area of marshes, forests, prairies, and oxbows being restored by a multi-agency effort led by the Polk County Conservation Board. The Chichaqua site itself was purchased by the City in order to utilize it for future mitigation projects as needed. One mitigation effort has already taken place in a 20-acre portion of the site, and that effort included the use of monitoring wells over the five-year monitoring period. Those monitoring well results would be analyzed during creation of plans and specifications to determine the appropriate depths of excavation needed to reach the water table. The Chichaqua mitigation site is currently used for row-crop agriculture, except for the area already developed into a wetland mitigation site. The "No Action" alternative would result in continued agricultural use of the site.

The bottomland forest mitigation for this project would occur within the existing wetland meadows riverward of the levee at Central Place. The meadows are currently dominated by the invasive species reed canarygrass (*Phalaris arundinacea*). This species is thought to have invaded the area after a large flood such as the flood of 1993, which killed many of the trees riverward of the levee. Dead tree trunks are scattered through some of the wet meadow areas. Mast-producing trees and fruiting shrubs would be planted within the wet meadows. The "No Action" alternative would likely result in most of the existing reed canarygrass area remaining a monoculture of that species, since most species cannot become established in the thick mass of dead reed canarygrass on the ground surface of these areas. Reed canarygrass monocultures are used by some birds for resting areas, although few birds nest in these areas, and very few species use them as a food source. Some of the upland forest mitigation would also occur riverward of the Central Place levee, in an existing mowed upland area in the northern end of Central Place. Mast-producing trees and fruiting shrubs would be planted within this area.

#### c) Reach 3: Downtown East Levee

The Southeast 6th to Southeast 14th Streets area along the north and east side of the Des Moines River, the core of Des Moines' central business district, is protected by a flood levee. This 0.5-mile stretch of the northern left floodplain was initially constructed by the City, and was incorporated into the federal levee system constructed in the late 1960s (the Des Moines Local Flood Protection Project Stage I). During the 1993 flood, this section of levee experienced severe erosion.

The levee system contains three major reaches of levee protecting both the right and left banks of the Des Moines and Raccoon Rivers and the area between the confluences of the two rivers. The protected areas contain over 1,800 acres of highly urbanized commercial, retail, industrial, residential, and public facilities at the central business core of the City.

This system, designed in the 1960s, has numerous street and sewer closures that penetrate the line-of-protection at the design flood level, requiring additional actions such as sandbagging, installing earthen closures, and placing and operating portable pumps. However, as demonstrated during the 1993 flood, floodwaters on both the Des Moines and Raccoon Rivers can rise rapidly, making the successful execution of these operations difficult.

A multi-use trail, John Pat Dorrian Trail, is a segment of the longer Saylorville Trail.

In the spring of 2004, Phase IIA hazardous, toxic, and radioactive waste (HTRW) sampling revealed metals and polycyclic aromatic hydrocarbons (PAH) in low concentrations; however, these concentrations are in excess of the Iowa State Land Recycling Program Standards, however due to the very low concentrations the Iowa DNR has cleared the levee area and no remediation is required

The Downtown East area is fully urbanized, dominated by buildings, pavement, mowed grass, and ornamental trees.

#### d) Reach 4: Downtown West Levee

This levee follows the westerly bank of the Des Moines River a thousand feet downstream of I-235 to the confluence of the Raccoon River then along the northern bank of the Raccoon River past Fleur Drive.

The floodwalls and levees built by the federal government in the 1960s and 1970s currently offer slightly more than 100-year flood event. Three pump stations remove stormwater from behind the levee during flooding. Ten closures need to be closed during flooding.

The levee is currently used as an informal walking path and green space.

In the spring of 2004, Phase IIA hazardous, toxic, and radioactive waste (HTRW) sampling revealed metals and polycyclic aromatic hydrocarbons (PAH) in low concentrations; however, these concentrations are in excess of the Iowa State Land Recycling Program Standards, however due to the very low concentrations the Iowa DNR has cleared the levee area and no remediation is required. The Downtown West area is urbanized, dominated by buildings, pavement, and mowed grass, with scattered ornamental trees. The levee in this area is well maintained and regularly mowed.

#### e) Reach 5: Downtown South Levee

Downtown South Reach is on the southerly bank of the Raccoon River, starting downstream of SW 7th Street and continuing along the Des Moines River to Hartford Avenue.

Reach 5 is protected by a federal levee against a 200-year flood event. The levee consists of grass covered earthen embankments, floodwalls and closures at 1st Street, Scott Avenue, SE 6th Street, and SE 14th Street. Three pump stations remove storm water during flooding.

Kruidenier Trail is a 2-mile multi-use recreational trail located at Gray's Lake Park; it is unique among the City’s trails for the 1,500-foot bridge that allows the trail to encircle the lake. This trail is 2,000 feet from the levee.

The Phase I ESA found no recognized environmental conditions for this location.

The Downtown South area is highly urbanized and is dominated with buildings, pavement and mowed grass, with scattered ornamental trees. The levee in this area is well maintained and regularly mowed.

### 6.C.3. Environmental Impacts of the Preferred Alternative

#### a) Reach 1: Birdland Levee

The proposed levee reconstruction would impact emergent, scrub-shrub, and bottomland forest on the Kiwanis Riverview Park and the lagoon at the southern end of the levee reach by the placement of the

levee and would impact bottomland forest due to the need to clear and grub the area within 15 feet of the levee to prevent tree damage to the reconstructed levee. In addition, the existing levee is forested with upland tree species which would be removed during the levee reconstruction effort. The existing upland forests have structural diversity such as snags, canopy cover, understory, and downed logs, which is available habitat for a variety of species. The reconstructed levees would be kept mowed preventing regrowth of forest habitat on-site. Compensatory mitigation for project environmental impacts would occur as described in Section 1 of Appendix G.

**Table 29: Birdland Park Alignment 2 Environmental Quality Account**

| Negative Impacts to: | No Action | 100-year levee | 250-year levee | 500-year levee |
|---|---|---|---|---|
| Acres of Wetland Impact[1] | 0 | 1.0 | 1.2 | 1.4 - 2.3 |
| Acres of Bottomland Forest Impact[2] | 0 | 0.2 | 0.2 | 0.2 |
| Acres of Open Water Impact | 0 | 2.4 | 2.5 | 2.7 - 3.8 |
| Acres of Upland Forest Habitat Impact | 0 | 1.4 | 1.4 | 1.4 |
| Aesthetics | No | Yes | Yes | Yes |
| Cultural | No | No | No | No |
| Social-Economic | Yes | Yes | No | No |

[1]Acreage refers to emergent wetlands impacted through permanent filling from levee placement
[2]Acreage refers to bottomland forest within 15 feet of the base of the proposed levee alignment

### b) Reach 2: Central Place

The construction of the 500-year levee would involve the removal of the existing levee and replacement with a levee within the same footprint. The upland forest habitat on the existing levee would be impacted and the replacement levee would be kept mowed preventing regrowth of the forested community during the period of analysis. A bottomland forest community is present from the Des Moines River to the base of the existing levee. To prevent damage to the reconstructed levee, the bottomland forest would be removed within 15 feet of the levee toe during construction. That area would be maintained by mowing through the period of analysis. Compensatory mitigation would occur for project environmental impacts as described in Section 1 of Appendix G.

**Table 30: Central Place Environmental Quality Account**

| Impacts Types | No Action | 100-year levee | 250-year levee | 500-year levee |
|---|---|---|---|---|
| Acres of Wetland Impact | 0 | 0 | 0 | 0 |
| Acres of Bottomland Forest Impact | 0 | 1.2 | 1.2 | 1.2 |
| Acres of Open Water Impact | 0 | 0 | 0 | 0 |
| Acres of Upland Forest Habitat Impact | 0 | 3.2 | 3.2 | 3.2 |
| Endangered Species Habitat Impact (y/n-type) | No | No | No | No |
| Negative Aesthetics | No | Yes | Yes | Yes |
| Negative Cultural | No | No | No | No |
| Negative Social-Economic | Yes | Yes | No | No |

### c) Reach 3: Downtown East Levee

No adverse environmental impacts, as shown in Table 31, would occur from construction of these closure modifications, as they are located within an urbanized environment.

**Table 31: Downtown East Closures Environmental Quality Account**

| Impact Types | No Action | Closure Modifications |
|---|---|---|
| Acres of Wetland Impact | 0 | 0 |
| Acres of Bottomland Forest Impact | 0 | 0 |
| Acres of Open Water Impact | 0 | 0 |
| Acres of Upland Forest Habitat Impact | 0 | 0 |
| Endangered Species Habitat Impact (y/n-type) | No | No |
| Negative Aesthetics | No | No |
| Negative Cultural | No | No |
| Negative Social-Economic | Yes | No |

### d) Reach 4: Downtown West Levee

No adverse environmental impacts, as shown in Table 33, would occur from construction of these closure modifications. All closure structures involved are located within an urbanized environment.

**Table 32: Downtown West Closures Environmental Quality Account**

| Impact Types | No Action | Closure Modification |
|---|---|---|
| Acres of Wetland Impact | 0 | 0 |
| Acres of Bottomland Forest Impact | 0 | 0 |
| Acres of Open Water Impact | 0 | 0 |
| Acres of Upland Forest Habitat Impact | 0 | 0 |
| Endangered Species Habitat Impact (y/n-type) | No | 0 |
| Negative Aesthetics | No | No |
| Negative Cultural | No | No |
| Negative Social-Economic | Yes | No |

### 6.C.4. Reach 5: Downtown South Levee

No adverse environmental impacts, as shown in Table 33, would occur from construction of these closure modifications. The closure-structures involved are located within an urbanized environment.

**Table 33: Downtown South Closures Environmental Quality Account**

| Impact Types | No action | Closures |
|---|---|---|
| Acres of Wetland Impact | 0 | 0 |
| Acres of Bottomland Forest Impact | 0 | 0 |
| Acres of Open Water Impact | 0 | 0 |
| Acres of Upland Forest Habitat Impact | 0 | 0 |
| Endangered Species Habitat Impact (y/n-type) | No | 0 |
| Negative Aesthetics and Cultural | No | No |
| Negative Social-Economic | Yes | No |

### 6.C.5. Cumulative Impacts

The permanent impacts expected as a result of this project are the emergent wetland, open water, bottomland and upland forest impacts at the Birdland and Central Place levees. In addition, wetlands would be excavated and upland forest habitat would be created at the Chichaqua mitigation site; and, upland and bottomland forest habitat would be created at the Central Place mitigation area (Table 34).

**Table 34: Total Wetland Impacts and Mitigation**

| Habitat Types | Birdland Park Impacted Acres | Chichaqua [1] Mitigated Acres | Central Place Impacted Acres | Riverside of Levee [2] Mitigated Acres |
|---|---|---|---|---|
| **Emergent Wetlands** | 1.4 to 2.3 | 2.8 to 4.6 | 0 | 0 |
| **Open water** | 2.7 to 3.8 | 2.7 to 3.8 | 0 | 0 |
| **Bottomland forest** | 0.2 | 0 | 1.2 | 2.6 [3] |
| **Upland forest** | 1.4 | 6.4 [4] | 3.2 | 2.2 |
| **Herbaceous buffer** | 0 | 1.2 | 0 | 0 |
| **Total Acres Impacted** | 10.1 to 12.1 | | | |
| **Total Acres of Mitigation** | 17.9 to 20.8 | | | |

[1] Chicaqua proposed wetland mitigation site, see Figure 8.
[2] Mitigtion site is riverside of the levee at Central Place, see Figure 13.
[3] 2.2. acres for Central Place & 0.4 acres for Birdland Park
[4] 2.6 Birdland Park & 3.8 Central Place

The levees to be reconstructed at Birdland and Central Place were originally built in the 1950s by the City. They currently do not meet federal standards and are not expected to be able to withstand a heavy flood. The downtown closure structures would create permanent closures where now temporary earthen closures are often used. The preferred alternative project at Birdland, Central Place, and Downtown would not create new levee reaches. Currently the existing levees do provide some protection for the City, although during large floods, such as the Flood of 1993, the levees fail. This project would strengthen and potentially raise the levees so that in future floods, the levees would be less likely to fail.

Much of the City is located within the floodplain of the Des Moines and Raccoon Rivers. There were likely many upland and bottomland forests and emergent wetlands in the area prior to European settlement. The existing bottomland forest adjacent to the Central Place levee is a remnant of the previously existing larger bottomland forest community. The forest would be mowed out to 15' riverward of the reconstructed levee in order to prevent damage to the levee. This would eliminate many large and small trees and shrubs. Mitigation would occur within that bottomland forest by planting mast trees in an area currently dominated by reed canarygrass. Reed canarygrass has minimal wildlife habitat value, so the mast trees are expected to adequately compensate for the loss of forested habitat.

Wetlands would be impacted at Birdland through creation of a new levee alignment at the northern end and a widening of the levee at the southern end. The wetlands to be impacted are adjacent to lagoons that are historic oxbows of the Des Moines River. These wetlands are also likely remnants of larger wetland complexes that had existed within the Des Moines area prior to European settlement. These wetland impacts would be mitigated through creation of wetlands at a mitigation site outside of the City. This would further reduce the overall wetland habitat remaining within the City.

The upland forests to be impacted by the levee construction at Birdland and Central Place have developed on the existing levees and were likely not originally found in that area, since it was likely too wet to support an upland forest community. The upland forest would be mitigated through planting of trees and shrubs at Central Place and the Chichaqua mitigation site.

The cumulative natural resource impacts associated with the downtown closure structures are expected to be minimal since they are located in already highly developed areas and would only make permanent portions of what is currently done on an as-needed basis during flood events.

The northern end of the Birdland levee is proposed to go through the center of the Kiwanis Riverview Park. This island was proposed by the Kiwanis to be a passive and active recreation area for the residents of Des Moines. Most of the open areas within the City have been developed for industrial, commercial, or residential buildings and roads, so there would be a cumulative loss of the contiguous parkland at the island by the construction of the levee through the middle of the island. Rather than one large open area, there would be a much smaller open area on the eastern end of the island and a small forested and emergent wetland area on the western end of the island. No new levee reaches are known to be proposed along the Des Moines River during the reasonably foreseeable future. In addition, since the current levee is only being modified and no new levee construction is proposed, except for a new section at the northern end of the Birdland reach, the construction of this project is not expected to cumulatively exceed any known biological or social thresholds.

There are no induced stage affects in the study area. See section 6.A.2 page 72 for discussion.

### 6.C.6. Endangered Species

Of the four species listed by the USFWS as potential threatened and endangered species located near the project area (bald eagle, Indiana bat, western prairie fringed orchid, and prairie bush clover), only the bald eagle and Indiana bat have suitable habitat within areas to be impacted by this project. However, as mentioned, informal consultation between the USFWS and the District determined that a biological assessment would not be required for these species under the proposed project. The presence of suitable Indiana bat habitat within the upland and wetland forests to be cleared would be evaluated prior to the completion of plans and specifications to allow for ongoing coordination with the US Fish and Wildlife Service. See Figure 23, *Endangered Species Clearance Flowchart* for a description of the process if endangered species are encountered.

### 6.C.7. Historic Properties

The District queried the most current version of the District Archeological Site and Survey Geographic Information Systems (GIS) databases (current as of April 2004) and determined that there is one previously recorded archeological site within the project area. Reaches 1, 2, and 5 have not been surveyed previously and there are no previously recorded sites within the levee construction, closure construction, and/or wetland mitigation areas. Portions of Reaches 3 and 4 have been surveyed and one archeological site, 13PK61, is located in Reach 4 and adjacent to a proposed railroad bridge closure structure.

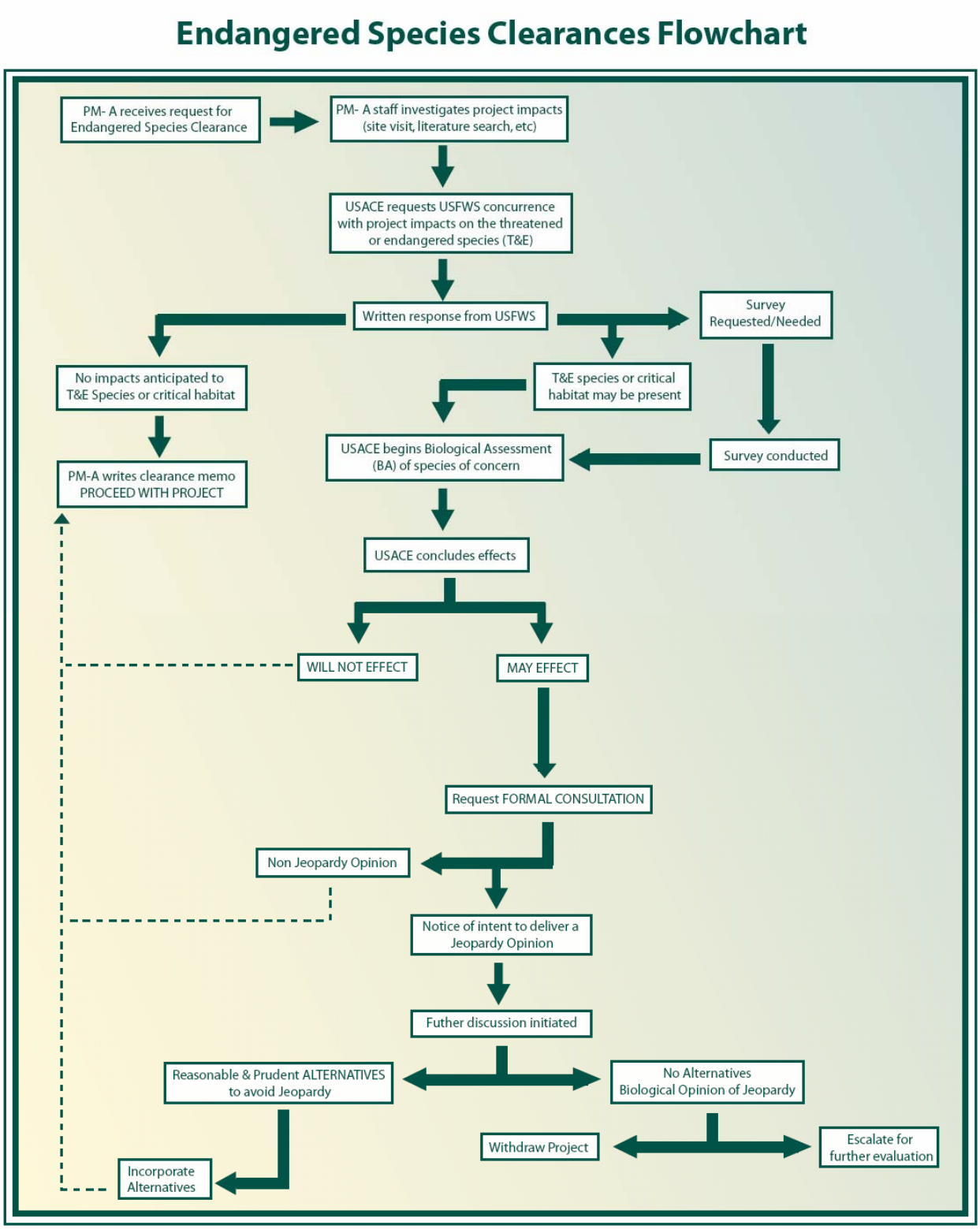


**Figure 23: Endangered Species Clearance Flowchart**

Of the 31 closure structures that are proposed, eight closures in Reach 3, seven closures in Reach 4, and one closure in Reach 5 are located within the Civic Center Historic District. Two closures are adjacent to the Court Avenue Bridge, a contributing resource to the NRHP Civic Center Historic District nomination and two closures are proposed for the Des Moines Union Railway Bridge, a structure that is individually eligible for inclusion on the NRHP. Finally, four closures in Reach 4 are located within the recorded boundaries of NRHP eligible archeological site 13PK61. Site 13PK61, Fort Des Moines No. 2, is a multi-component prehistoric and historic archeological site. Numerous investigations have evaluated portions of the site and it was formally determined eligible for inclusion on the National Register of Historic Places (NRHP) in 2000.

The District determined that the proposed closures would have "No Effect" on historic properties because of the minimal impact of the work. Ground disturbance associated with all closure construction would be limited to previously disturbed ground associated with the existing facilities including levees, flood walls, roads, and bridges. In addition, the minimal impact of the closures would not alter the defining characteristics of the known historic properties including the Civic Center Historic District, its contributing resources, or the individually significant Des Moines Union Railway Bridge. Work associated with the closures within the boundaries of site 13PK61 is limited to ground disturbed by bridge and levee construction and consequently will have No Effect on the site.

The District determined that ground disturbance associated with work proposed at Reaches 1 and 2, and with wetland mitigation would require archeological evaluation and deep geomorphological assessment in order to assess the effects to archeological cultural resources. The District contracted with Great Lakes Archaeological Research Center (GLARC) under contract W912EK-04-D-0001 to conduct the work. The investigation documented one archeological isolated find of unknown prehistoric affiliation and recommended that the cultural resource be determined ineligible for inclusion to the NRHP. The GLARC investigation recommended cultural resource management clearance for Reaches 1, 2, and the wetland mitigation areas. The District concurred with that recommendation and provided the report with a determination of "No Historic Properties Effected" to the SHSI by letter dated May 26, 2004. The SHSI concurred with the District determination by letter dated June 17, 2004 (R&C#: 000377008).

An additional consultation letter dated July 21, 2004 was mailed to the SHSI, relevant federally-recognized tribes, and the interested public that fully addressed the undertaking's potential effects on historic properties and particularly tribal concerns about properties that may be of religious and cultural significance (36CFR800.4 (a)(3-4)). The District determined that the preferred alternative would have No Effect on historic properties. The SHSI concurred with the District determination by letter dated August 9, 2004 (R&C#: 000377008). The SHSI concurred with the "No Effect" determination as it pertained to Reach 1, Reach 2, and those project features located outside of known historic district and individual historic property boundaries. The SHSI recommended a "No Adverse Effect" determination for those project features within known historic property boundaries in Reaches 3, 4, and 5. The Otoe-Missouria Tribe notified the District by letter dated August 26, 2004 that they had no knowledge of properties within the project "Area of Potential Effect" but that they would like to be notified in the event of inadvertent discoveries during project construction. No additional historic properties or concerns were identified as a result of the consultation. It is the opinion of the District that this undertaking is in full compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties."

While the District is assured that no significant historic properties would be affected by the preferred alternative; if any undocumented historic properties are identified or encountered during the undertaking, the District will discontinue project activities and resume coordination with the consulting parties to identify the significance of the historic property and determine any potential effects.

### 6.C.8. Environmental Impacts of Nonpreferred Alternatives

#### a) Reach 1: Birdland Levee

In the "No Action" alternative, the environmental resources would remain intact for the foreseeable future. The 100- and 250-year flood heights for Alignment 2 would involve less wetland and open water impacts since the levee footprints would be smaller. These non-preferred alternatives involve the same levee alignment, so no additional wetland or open water areas would be impacted by these alternatives. Alignment 1 would have minimal environmental impacts since most of the levee and floodwall would be located in an existing developed upland. Alignment 3 would have substantially greater environmental impacts since it is located in an area with bottomland forest, emergent wetlands, and open water surrounding much of the levee length.

#### b) Reach 2: Central Place Levee

The "No Action" alternative would not involve any environmental impacts. The upland and bottomland forests would continue to grow, with the trees becoming taller and the structure becoming more diverse. The existing reed canarygrass areas within the bottomland forest would likely remain for the foreseeable future since it is very difficult for trees or shrubs to seed themselves into areas fully vegetated with reed canarygrass. The mitigation effort associated with the preferred alternative would involve the planting of hard mast tree species within the reed canarygrass areas to eventually shade it out and provide additional wildlife habitat value, so that would not be done under the "No action" alternative. The 100-year and 250-year levee alternatives would have the same impacts as the preferred alternative since the levee footprint would remain the same for those alternatives.

#### c) Reach 3: Downtown East Levee

No foreseeable adverse environmental impacts would result from the "No Action" alternative. No other non-preferred alternatives were considered for this reach.

#### d) Reach 4: Downtown West Levee

No foreseeable adverse environmental impacts would result from the "No Action" alternative. No other non-preferred alternatives were considered for this reach.

#### e) Reach 5: Downtown South Levee

No foreseeable adverse environmental impacts would result from the "No Action" alternative. No other non-preferred alternatives were considered for this reach.

### 6.C.9. Probable Adverse Environmental Impacts which Cannot Be Avoided

The Birdland Levee would impact approximately 1.4-2.3 acres of emergent wetlands located within the footprint of the new levee and adjacent seepage berm and depression fill. The new levee section in the northern portion of the Birdland reach would also impact approximately 2.7-3.8 acres of open water in the lagoons surrounding the Kiwanis Riverview Park. In addition, approximately 0.2 acres of bottomland forest and 1.4 acres of upland forest habitat would be lost during construction of the Birdland levee.

Approximately 1.2 acres of bottomland forest adjacent to the reconstructed Central Place levee and approximately 3.2 acres of upland forest habitat that currently exists along the un-maintained levee slopes would be lost during construction.

The mitigation plan for the upland forest, bottomland forest, emergent wetland, and open water impacts associated with the Birdland and Central Place levees is described in Section 1 of Appendix G.

The Downtown closure structures are not expected to result in any wetland, open water, or forest impacts since they are primarily located in heavily developed areas.

### 6.C.10. Compliance with Environmental Quality Statutes

**Table 35: Environmental Law Compliance and Applicability Required for Recommended Plan**

| Federal Environmental Protection Statutes and Requirements | Applicability/Compliance |
|---|---|
| Archaeological and Historic Preservation Act, 16 U.S.C. 469, et seq. | Full compliance |
| Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq. | Full compliance |
| Clean Water Act, Sections 404 and 401 | Full compliance |
| Coastal Zone Management Act of 1972, as amended | Not applicable |
| Endangered Species Act of 1973, as amended, 16 U.S.C. 1531, et seq. | Full compliance |
| Environmental Effects Abroad of Major Federal Actions (E.O. 12114) | Not applicable |
| Estuary Protection Act, 16 U.S.C. 1221, et seq. | Not applicable |
| Farmland Protection Policy Act. 7 U.S.C. 4201, et seq. | Full compliance |
| Federal Water Project Recreation Act, 16 U.S.C. 460-1(12), et seq. | Full compliance |
| Fish and Wildlife Coordination Act, 16 U.S.C. 661, et seq. | Full compliance |
| Flood Plain Management (E. O. 11988) | Full compliance |
| Land and Water Conservation Fund Act, 16 U.S.C. 460/-460/-11, et seq. | Not applicable |
| Marine Protection Research and Sanctuary Act, 33 U.S.C. 1401, et seq. | Not applicable |
| National Economic Development (NED) Plan | Full compliance |
| National Environmental Policy Act, 42 U.S.C. 4321, et seq. | Full compliance |
| National Historic Preservation Act, 16 U.S.C. 470a, et seq. | Full compliance |
| Protection of Wetlands (E. O. 11990) | Full compliance |
| Rivers and Harbors Act, 33 U.S.C. 403, et seq. | Full compliance |
| Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq. | Not applicable |
| Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq. | Full compliance |

Full compliance - Having met all requirements of the statute for the current stage of planning (either preauthorization or post authorization).
Not applicable - No requirements for the statute required; compliance for the current stage of planning.

#### a) Archaeological and Historic Preservation Act

The project is in compliance with this act.

#### b) Clean Air Act, as amended

No aspect of the proposed project, neither short-term nor long-term, has been identified that would result in violations to air quality standards. The environment would not be exposed to contaminants/pollutants in such quantities and of such duration as may be or tend to be injurious to human, plant, or animal life, or property, or which unreasonably interferes with the comfortable enjoyment of life, or property, or the conduct of business.

**c) Clean Water Act (Sections 401 and 404), as amended.**

A Section 404(b)(1) Evaluation was prepared and is attached to this report as Appendix I. Certification under Section 401 of this Act from the State of Iowa would be obtained before project construction. Due to the unavoidable impacts to approximately 1.4 to 2.3 acres of emergent wetlands at the Birdland and Central Place reaches and 2.7-3.8 acres of open water impacts at the Birdland reach, compensatory mitigation would be provided. See Section 1 of Appendix G for the compensatory mitigation plan.

**d) Endangered Species Act of 1973, as amended.**

The proposed project has the potential to impact two species listed or proposed for listing under the Federal Endangered Species Act, the bald eagle and the Indiana bat. Informal consultation between the USFWS and the District determined that a biological assessment would not be required for these species under the proposed project. Project plans have been and will continue to be coordinated with the USFWS and the Iowa DNR. No State-listed threatened or endangered species are known to be present in the project area. The District's coordination letter and resource agency responses appear in Appendix H.

**e) Farmland Protection Policy Act of 1981,**

The Chichaqua mitigation site is currently being farmed. This will cease when mitigation construction is initiated, and is not expected to resume, since the site is proposed to be managed as a natural area in perpetuity. The NRCS Soil Scientist in Polk County indicated that a Farmland Conversion Impact Rating analysis is not necessary for this project since most of the mitigation is being performed on hydric soils and creation of wetlands on hydric soils is consistent with the direction of various NRCS programs for agricultural settings. In addition, the mitigation effort will not permanent alter the landscape in such a way that farming would not be possible again at the site in the future. The phone log documenting the conversation between the District biologist and the NRCS Soil Scientist is located in Appendix H.

**f) Federal Water Project Recreational Act,**

This Act requires that recreation opportunities be considered during the investigation and planning of any Federal navigation or other water resource project. The City is interested in creating an Americans with Disabilities Act (ADA) compliant bike trail on the proposed reconstructed Birdland levee. This would provide additional recreation opportunities for local residents and visitors to Des Moines.

**g) Fish and Wildlife Coordination Act,**

Project plans have been coordinated with the USFWS and the Iowa DNR. The District's coordination letter and resource agency responses appear in Appendix H.

**h) Flood Plain Management, (Executive Order 11988).**

This executive order requires federal agencies to evaluate and consider alternatives to avoid adverse effects and incompatible development in the floodplain. This project involves the protection of developments already existing within the floodplain and this project alone is not expected to increase incompatible development within the floodplain.

**i) National Environmental Policy Act, of 1969, as amended.**

The compilation of this integrated EA and the signing of the Finding of No Significant Impact fulfill NEPA compliance.

**j) National Historic Preservation Act of 1966, as amended (NHPA).**

The District consulted with the SHSI, relevant federally-recognized tribes, and the interested public regarding this undertaking's potential effects on historic properties and particularly tribal concerns about properties that may be of religious and cultural significance (36CFR800.4(a)(3-4)). The SHSI concurred with the District's determination of "No Effect" by letter dated July 21, 2004 (R&C#: 000377008). No

additional historic properties or concerns were identified as a result of that consultation. It is the opinion of the District that this undertaking is in full compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties."

#### k) Protection of Wetlands, (Executive Order 11990)

This executive order states that each federal agency shall avoid undertaking new construction located in wetlands unless there is no practicable alternative to such construction, and the proposed action includes all practicable measures to minimize harm to wetlands. As previously discussed, approximately 1.4 to 2.3 acres of emergent wetlands, 2.7-3.8 acres of open water, and 1.4 acres of bottomland forest would be impacted as a result of this project. These wetland and water impacts have been minimized to the extent possible. The wetland impacts at the Birdland reach were evaluated for each of the three alignments, and Alignment 2 was selected in part due to its lesser degree of wetland impacts than would occur at Alignment 3. Alignment 1 was not considered to be practicable due to a closer benefit/cost ratio. The Central Place reach wetland impacts are due to leveling and maintenance of the existing bottomland forest area up to 15 feet riverward of the levee. That area will remain as a wetland, but will be mowed, so the functions and values of the wetland will be greatly reduced. Each of the wetland impacts will be mitigated to replace lost wetland functions and values.

#### l) Rivers and Harbors Act

The proposed plan would not place any permanent obstruction across navigable water nor would it place obstructions to navigation outside established federal lines.

#### m) Wild and Scenic Rivers Act of 1968, as amended

The Des Moines and Raccoon Rivers are not listed in the National Rivers Inventory (NRI). The NRI is used to identify rivers that may be designated by Congress to be Component Rivers in the National Wild and Scenic Rivers System.

### 6.C.11. Relationship between Short-Term Use and Long-Term Productivity

When the levees at Birdland and Central Place and the closure structures in the downtown reaches are constructed, they will be utilized during each high water event over the period of analysis. This includes flooding events in both the short-term and the long term. The long-term productivity of the project is expected to outweigh any short-term resource uses such as borrow site excavation, use of fuel during construction, and labor.

### 6.C.12. Any Irreversible or Irretrievable Commitments of Resources if Project is Implemented

Approximately 17,300 cubic yards of borrow material would be used to construct the Birdland levee and approximately 132,740 cubic yards of borrow would be used to construct the Central Place levee. The Downtown closure structures would require a minimal amount of borrow material since those are mainly small earthen embankments or floodwalls. Much of the required borrow material has been gathered by the City from various construction projects and stockpiled for use by this project. That soil can be reasonably thought to be irretrievable once the levees are constructed. The cost of this project also represents an irretrievable commitment of funds once the project is constructed. The compensatory mitigation sites are proposed to be preserved in perpetuity. This would result in an irreversible commitment of the land to be used for mitigation. The fuel consumed, manpower expended, and the commitment of construction materials and equipment is considered irretrievable.

### 6.C.13. Socioeconomic Impacts of the Preferred Alternative

#### a) Community and Regional Growth

No significant impacts to the growth of the community or region would be realized because of the proposed levee and closure improvements.

#### b) Community Cohesion

The proposed project would be expected to somewhat enhance community cohesion by further reducing the threat of flooding and securing the economic viability of businesses located in the floodplain. The project would involve rebuilding the existing levee to meet current USACE design standards and rebuilding selected road and bridge closures to improve the reliability of positive closure during a flood event. Minimal resultant impacts to residential, industrial, or commercial developments within the vicinity are expected.

Views expressed at a public meeting held at the onset of the study phase allowed the public to view the proposed projects and to provide feedback. Overall, the majority of comments provided were in favor of the proposal, indicating public support and anticipation of project completion. No responses expressed any disagreement with the proposed project.

#### c) Displacement of People

No residential displacements would result from the proposed action.

#### d) Property Values and Tax Revenues

Property values and resulting tax revenues may increase because of the increased flood protection provided by the proposed project.

#### e) Public Facilities and Services

Public facilities located within the floodplain would benefit from a reduced threat of damages following project construction of improving the levee.

Birdland Park area provides recreational opportunities such as walking, biking, picnicking, and fishing. The integrity of the existing levee in this area is compromised by the trees growing through the levee. The trees would be removed when the levee is degraded and reconstructed. An alternate bike path would be provided for the recreationists during the time of the construction of the levee. In addition, a public handicap access ramp would be built to provide accessibility to the trail and neighborhood, which is not currently available.

The local Kiwanis Club currently maintains the Birdland Park area. The proposed levee alignment would essentially divide this recreation area in half and would restrict further development of the site by the Kiwanis.

Vehicle traffic in the downtown project area would be reduced to one lane during construction. There is potential for temporary closures at Birdland Avenue and Saylorville Road during the construction phase. Access to public roads throughout the project areas would be maintained to avoid disruptions to traffic flow and to minimize inconvenience for residents and emergency vehicles.

#### f) Life, Health, and Safety

Upgrading the City's existing flood protection in the proposed project areas would further reduce the potential for flooding in the areas and hence would further reduce life, health, and safety threats faced by area residents.

During the construction phase, disruption of traffic would occur in the project areas. Borrow material would need to be transported to the Birdland project site, and would increase traffic in the area by

approximately 90 truck trips per day. The trucks would travel approximately five miles along existing major traffic arteries to haul material to the placement site. Increased traffic would cause the most concern during the early morning hours when staff and students are traveling to school and residents are driving to work, and again in early evening when residents are returning home from work. During the construction phase of the Downtown area project, traffic would be reduced to one lane for approximately one to two months.

The City intends to monitor all of these locations during project construction and would provide flagmen to direct traffic and minimize safety concerns, if needed.

A hazardous, toxic, and radioactive waste (HTRW) compliance assessment was conducted. The findings of the assessment revealed recognized environmental conditions within the proposed project areas except the Downtown South area. The conditions were confirmed, revealing metals and PAH concentrations in excess of the Iowa State Land Recycling Program Standards. Before construction can proceed, all lands must receive a No Further Remedial Action Planned Certificate.

#### g) Business and Industrial Growth

The proposed project would positively impact community business and industrial activity by reducing the threat of flooding. Business activity would temporarily increase during construction of the levee; no long-term impacts would result. No business relocations would be required for the proposed project.

#### h) Employment and Labor Force

The project would not directly affect the permanent employment or labor force in Des Moines, Iowa. However, the project would temporarily increase area employment during the construction phase.

#### i) Farm Displacement

The proposed project is located within an urban area; therefore, no farms would be displaced.

#### j) Noise Levels

Overall, heavy machinery would generate an increase in noise levels throughout the project areas during construction and temporarily disturb residents and recreationists.

The proposed project at Birdland is located near an existing light industrial area that already has a high noise level. A residential area is located on a bluff overlooking the construction site; however, it is unlikely that the construction would significantly affect the residences.

Once the project is completed, noise levels would return to existing conditions and no significant long-term noise impacts are anticipated.

#### k) Aesthetics

A main concern of many residents is the removal of the trees on the existing levee in the Birdland Park area and the resulting negative impacts on the aesthetics of the bike path throughout this area. Since the trees are growing through the existing levee and are compromising the integrity of the levee, it is necessary to remove the trees to provide a sound flood control system.

### 6.C.14. Relationship to Land Use Plans

The lands protected by the Birdland, Central Place, and Downtown levees are urban areas and heavily developed. The lands include commercial, industrial, and residential areas. This project proposes to replace existing levees at Birdland and Central Place and add permanent closure structures to the Downtown levee reaches. No new levees are proposed to be constructed, except for the northern portion of the Birdland levee. Therefore, the existing land use of the lands at the levee locations and the lands protected by the levees are not expected to change because of this project, and this project is compatible

with all existing land use plans. The Chichaqua compensatory mitigation site is owned by the City for use as a mitigation site, so the creation of wetlands and an upland forest area would be compatible with the existing land use plans of the site. It is also located within the larger Chichaqua Bottoms Greenbelt area, managed by the Polk County Conservation Board, which is a large restoration area located along the Skunk River with the intent to restore over 7,000 acres of bottomland area for natural resource and recreational purposes. The Central Place mitigation area involves the planting of trees in upland and wetland areas to compensate for upland and wetland forest losses associated with the project impacts. The mitigation area is located between the existing levee and the Des Moines River, so it currently functions as a natural area, and that would not change after the trees are planted in that area.

## 6. D. PRODUCT DELIVERY TEAM

**Table 36: Team Members/Qualifications**

| Name/Position | Brief Biography |
|---|---|
| Dennis Hamilton<br>Project Manager | Dennis Hamilton is a senior project manager in the Rock Island District with responsibility for flood damage reduction and recreation projects. Mr. Hamilton has been with the Rock Island District for 7 years and has over 20 years of experience in design, construction, and management of water resource projects. He has a BS in Civil Engineering from Iowa State University and is a registered Professional Engineer in Iowa and Colorado. |
| Roger Less<br>Project Engineer | Roger Less has been a Supervisory Civil Engineer in the Project Engineering Section of Design Branch for the Rock Island District, USACE for the past 4 years. Prior to this position, Mr. Less was a Project Engineer for 10 years and a Hydraulic Engineer for 6 years with the District and served as a Water Resources Engineer for the State of Iowa for 6 years. He has a BS in Civil Engineering from Iowa State University in 1978 and has been a Professional Engineer since 1983. |
| Dean Cerny<br>Project Engineer | Dean Cerny is a project engineer for Rock Island District. He graduated from the United States Military Academy in 1981 with a Bachelor of Science Degree in Engineering. He was assigned to a construction battalion and the US Army Engineer School prior to arriving at the Rock Island District in 1989. He has a master's degree in Construction Management from George Washington University and is a registered professional engineer in the State of Illinois. |
| George Staley<br>Hydrologist | George Staley is a hydraulic engineer at Rock Island District. He has an MS in Civil Engineering (water resources) and a BS in Mechanical Engineering. Most of his experience is with the government, although he worked in private industry for about ten years after graduating from college. |
| Rowland Fraser<br>Hydrology | Mr. Rowland Fraser currently is a Hydrologic Technician for the Corps of Engineers. He has been with the Rock Island District for 25 years, working in the Survey section for a year before moving to the Hydraulics and Hydrology section where he has excelled since 1980. |
| Don Bawmann<br>Geotechnical | Donald H. Bawmann is presently serving as a Senior Geotechnical Engineer Specialist for the Rock Island District. He has 47 years of geotechnical service, 43 with the government and 4 with the private sector. He received his education in the Civil Engineering curriculum from the University of Illinois, University of Iowa, University of Wisconsin, Michigan State University, Augustana College, Blackhawk College, and Virginia Polytechnic Institute and State University. |

| Name/Position | Brief Biography |
|---|---|
| Sibte Zaidi<br>Geotechnical | Sibte Zaidi has been working as a geotechnical engineer since 1981 for Rock Island District Geotechnical Branch. He was graduated in May 1977 with BS in Civil Engineering from University of Puerto Rico, Mayaguez. Prior to this assignment, he worked with Puerto Rico Aqueduct and Sewer Authority as a civil engineer. |
| Terri Kirkeeng<br>Cost Engineering | Ms. Terri Kirkeeng is currently a Civil Engineer for the Corps of Engineers and is leading the Cost Estimating section. She received a Bachelors in Civil Engineering from Iowa State University, and has been with the Corps for 21 years. During that time she has worked in both Programs Branch and Engineering Branch. She had been a Cost Engineer for the eight years before taking lead of the section. |
| Terry Riddell<br>Real Estate | Terry Riddell has been a Realty Specialist with the Corps for over 11 years, with 15 years with the Federal Government. He started with a year of real estate classes at El Camino College in Torrance, California. He then received a real estate sales license and a broker's license (1980) through private schools for the State of California. He moved from California to Arizona in 1986 and attended another private school in Arizona to receive a broker's license for the State of Arizona in 1987. All of the licenses were acquired after a four hour examination process in each state. |
| Dan Fetes<br>Economist | Dan Fetes has been employed by the Rock Island District as a Regional Economist for more than 20 years. He was previously employed as a Bank Examiner for the FDIC. Mr. Fetes received his bachelor's degree in Finance from the University of Wisconsin, Eau Claire, and an MBA from the University of Iowa. |
| Gail Clingerman<br>Biologist | Gail Clingerman has been a biologist in the Economic and Environmental Analysis Branch of the Planning, Programs, and Project Management Division for three years. Prior to that, she worked as a wetland consultant for an engineering consulting firm in Iowa City. She came to that position after working as a biologist in the Regulatory Division of the New England District. Gail began working for the Corps of Engineers, Rock Island District, as a co-op student in 1993. She received her bachelor's degree in biology from Augustana College, Rock Island, Illinois and became a certified Professional Wetland Scientist in 2001. |
| Jim Ross<br>Archeologist | James Ross has been an archeologist for the Rock Island District for the last ten years having graduated from North Texas State University with a BA in Anthropology in 1985 and from Southern Illinois University-Carbondale with an MA in Anthropology in 1991. Mr. Ross served as a project manager for a private archeological consulting firm for four years prior to his employment with the Rock Island District. |
| Sue Simmons<br>Public Involvement | Suzanne R. Simmons has been employed by U.S. Army Corps of Engineers, Rock Island District, for 29 years, serving as Public Involvement Specialist since 1988. |
| Tracy Street<br>Social Impacts | Tracy M. Street has been employed by U.S. Army Corps of Engineers, Rock Island District, for five years, serving as a student aide and co-op student. Ms. Street graduated Black Hawk College with and Associates in Arts and currently is working on a Bachelors degree at Western Illinois University, Quad City Campus. Ms. Street is working closely with Sharryn Jackson on learning to write Social Impacts for projects. |

| Name/Position | Brief Biography |
|---|---|
| Kara Mitvalsky<br>Environmental Engineer | Kara Mitvalsky has been an environmental engineer for Rock Island District since 1998. Prior to working for the Corps, Ms. Mitvalsky was a radiation specialist for the U.S. Nuclear Regulatory Commission. Ms. Mitvalsky is a registered professional engineer in the State of Iowa. Ms. Mitvalsky received her M.S. from the University of Iowa, and her B.S. from Northwestern University, both degrees in the field of Environmental Engineering. |
| Amy Moore<br>Hazardous, Toxic and Radioactive Waste Specialist | Amy Moore has been a civil engineer for the Rock Island District since 2001. Ms. Moore is a registered Engineer Intern in the state of Michigan. Ms. Moore received her M.S. and B.S. from Michigan Technological University, both degrees in civil engineering. |
| Steve Russell<br>Study Manager | Steve Russell has been a planner/study manager for Rock Island District for the last three-and-a half years having graduated from Kansas State University with a BS in Mechanical Engineering in 1985. Prior to this assignment; he worked for several DoD agencies as a program manager in environmental and other engineering disciplines. |

# 7. PLAN IMPLEMENTATION

This section summarizes cost-sharing requirements and procedures necessary to implement the flood damage reduction measures of the selected/recommended plan. Table 37 table summarizes the schedule of activities needed to implement the projection dates.

**Table 37: Summary of Action Items and Schedule to Complete Project**

| Action Item | Estimated Completion Date |
|---|---|
| Washington Level Policy Review | Oct-05 |
| Chief of Engineers Report | Dec-05 |
| Administration Review | Apr-06 |
| Congressional Authorization | Sep-06 |
| Submit draft Project Cooperation Agreements (PCA) for review | Jul-07 |
| Federal Construction Fund Appropriation | Oct-07 |
| PCA Review and Approval | Dec-07 |
| Execute PCA | Jan-08 |
| Complete Plans & Specifications | Jun-08 |
| Real Estate Acquisition | Aug-08 |
| Construction Contract, Advertisement & Bidding | Sep-08 |
| Construction Contract Award | Nov-08 |
| Complete Construction | Nov-10 |
| Project Closeout | Sep-11 |

## 7. A. INSTITUTIONAL REQUIREMENTS

The following are procedures necessary for authorization and construction of the recommended plan:

(1) USACE, Mississippi Valley Division Commander will review the final report, and then issue a public notice announcing completion of the final Feasibility Report. This is referred to as the Division Engineer's Notice, or DE's Notice.

(2) This report will be submitted for review by the Headquarters of USACE, Washington D.C.

(3) The Chief of Engineers will seek formal review and comment by the City and interested federal agencies.

(4) Following City and other agency review, the report will be sent to the Assistant Secretary of the Army for Civil Works.

(5) Upon approval of the Assistant Secretary, the report will be forwarded to the Office of Management and Budget to obtain the relationship of the project to programs of the President.

(6) The Assistant Secretary of the Army for Civil Works will then forward the final report of the Chief of Engineers to Congress.

(7) Congressional review of the feasibility report and possible authorization of the project would follow.

(8) Pending project authorization for construction, the Chief of Engineers could include funds where appropriate, in his budget requests for preconstruction engineering and design of the project.

(9) Following receipt of funds, preconstruction engineering and design would be initiated and surveys and detailed engineering designs would be accomplished.

(10) Following Congressional authorization of the project, the District Engineer would accomplish plans and specifications.

(11) Subsequent to appropriation of construction funds by Congress, but prior to construction, formal assurances of local cooperation would be required from non-federal interests.

(12) Bids for construction would be initiated and contracts awarded.

(13) Upon completion of construction, the project will be turned over to the City, who will be responsible for OMRR&R (operating, maintaining, replacing, repairing, and rehabilitating) in accordance with guidelines provided by the USACE.

## 7. B. DIVISION OF PLAN RESPONSIBILITIES COST ALLOCATION

### 7.B.1. Federal Responsibilities

Cost sharing for construction of this project would be in keeping with current USACE policy for flood control projects. The Federal Government will be responsible for preparation of the Feasibility Study, PCA (Project Cooperation Agreement), Design Documentation Report, and Plans and Specifications for this project.

A State Flood Plain permit will be required. A Section 402, National Pollution Discharge (NPDES) permit, is required because more than 5 acres of land will be disturbed.

Additionally, Clean Water Act Section 404 and 401 permits would be required for construction at Reach 1, Birdland Park and Reach 2, Central Place, due to approximately 2.8 to 3.7 acres of wetland impacts and 2.7 to 3.8 acres of open water impacts.

### 7.B.2. Non-Federal Responsibilities

It is recommended that the flood damage reduction improvements defined in this report be authorized subject to the Sponsor agreeing to comply with applicable federal laws and policies, including the following requirements:

(1) Provide a minimum of 35 percent, but not to exceed 50 percent, of total project costs allocable to structural flood control and 50 percent of total project costs allocable to recreation, as further specified below:

(a) Enter into an agreement which provides, prior to construction, 25 percent of design costs;

(b) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(c) Provide, during construction, a cash contribution equal to 5 percent of total project costs attributable to structural flood control;

(d) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(e) Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(f) Provide, during construction, any additional cash contribution as necessary to make its total contribution equal to 35 percent of total project costs allocable to structural flood control and 50 percent of total project costs allocable to recreation.

(2) For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable federal and state laws and any specific directions prescribed by the Government.

(3) Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local Sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

(4) Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating the project or completed functional portions of the project, including mitigation features without cost to the Government, in a manner compatible with the project's authorized purpose and in accordance with applicable federal and state laws and specific directions prescribed by the Government in the Operation and Maintenance manual and any subsequent amendments thereto.

(5) Support the Government's obligation to comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project, or separable element thereof, until the Sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

(6) Hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

(7) Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

(8) Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the Sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

(9) Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

(10) As between the Federal Government and the Sponsor, the Sponsor shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

(11) Prevent future encroachments on project lands, easements, and rights-of-way which might interfere with the proper functioning of the project.

(12) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR, Part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

(13) Comply with all applicable federal and state laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-federal preparation and implementation of floodplain management plans.

(14) Provide the non-federal share of total cultural resource preservation mitigation and data recovery costs attributable to structural flood control and to recreation that are in excess of 1 percent of the total amount authorized to be appropriated for structural flood control and recreation.

(15) Participate in and comply with applicable federal floodplain management and flood insurance programs.

(16) Do not use federal funds to meet the Sponsor's share of total project costs unless the federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

(17) Inform affected interests, at least annually, regarding the limitations of the projection afforded by the project.

(18) Prescribe and enforce regulations to prevent obstruction of or encroachment on the Project that would reduce the level of protection it affords or that would hinder operation or maintenance of the Project.

(19) Provide and maintain necessary access roads, parking areas and other public use facilities, open and available to all on equal terms.

### 7.B.3. Non-Federal Sponsor Financial Analysis

Financial information on the non-federal Sponsor's ability to fund its share of the plan is required to proceed with the project as required by USACE Principles and Guidelines. The information includes a preliminary financing plan outlining the costs, schedule of expenditures, and a statement of financial capability by the Sponsor. The City has expressed their financial capability in their Letters of Intent. A Statement of Financial Capability and Financing Plan can be found in Appendix B on pages B-25 and B-29-31. The City intends to provide its financial requirements through its normal annual budget appropriations process (Capital Improvements Budget). The following table shows the estimated distribution of the project costs.

**Table 38: Project Cost Distribution, Des Moines Iowa (Oct 2005 Price Level)**

| Project Alternative | Birdland Park 500-Year | Central Place 500-Year | Downtown East 500-Year | Downtown West 500-Year | Downtown South 500-Year | Flood Damage Reduction Totals | Birdland Recreation Trail | Totals |
|---|---|---|---|---|---|---|---|---|
| Total Project Cost Estimate | 5,221,000 | 4,032,000 | 678,000 | 274,000 | 32,000 | 10,237,000 | 254,000 | 10,491,000 |
| Federal Cost Share | 3,394,000 | 2,621,000 | 441,000 | 178,000 | 21,000 | 6,655,000 | 127,000 | 6,782,000 |
| Non-Federal Cost Share | 1,827,000 | 1,411,000 | 237,000 | 96,000 | 11,000 | 3,582,000 | 127,000 | 3,709,000 |
| Lands, Damages, Relocations | 773,000 | 164,000 | 9,000 | 9,000 | 8,000 | 963,000 | 0 | 963,000 |
| Cash Contribution | 1,054,000 | 1,247,000 | 228,000 | 87,000 | 3,000 | 2,619,000 | 127,000 | 2,746,000 |
| Non-Federal Cost-Share Percentage | 35.00% | 35.00% | 35.00% | 35.00% | 35.00% | 35.00% | 50.00% | |

### 7.B.4. Ability to Pay

Based on the provisions of Section 103 of Public Law 99-662, Des Moines, Iowa has the ability to provide the normal share percentage of project costs. This Public Law considers the magnitude of a project benefit-to-cost ratio and the per capita income of the state and county of the Sponsor. Des Moines does not qualify for reduced cost-sharing. Table B-19 in Appendix B, *Economic Analysis*, summarizes the required information.

### 7.B.5. Real Estate Requirements

The project is located in Polk County, Iowa. All of the project lands are on Sponsor-owned fee lands or levee easement lands accept for four private small ownerships that the Sponsor will acquire for project needs. A full description of the project area and Real Estate information is noted in the attached Real Estate Plans, included as Appendix F, Real Estate.

### 7.B.6. Environmental Requirements

A Clean Water Act (CWA), Section 404(b)(1) Evaluation has been prepared since dredged or fill material would be placed in the waters of the United States during the period of construction. This report fulfills those requirements. Unavoidable adverse impacts resulting from the placement of dredged or fill material in the waters of the United States will be mitigated to the extent appropriate and practicable, to demonstrate compliance with the CWA Section 404(b)(1) Guidelines. State water quality certification is required prior to construction, in compliance with CWA Section 401.

An archeological survey of the study areas was performed in accordance with the National Historic Preservation Act. If cultural resources are discovered during construction and cannot be avoided, work will be suspended in that area until the properties are evaluated for eligibility for listing in the National

Register of Historic Places in consultation with the Iowa State Historic Preservation Officer (SHPO). If the properties are determined to be eligible, the effects of the proposed construction will be taken into consideration in consultation with the SHPO; and the Advisory Council on Historic Preservation will be provided the opportunity to comment.

As stated earlier, Clean Water Act Section 404 and 401 permits will be required prior to construction of Reach 1 Birdland levee, due to approximately 1.6 to 2.5 acres of wetland impacts and 2.7 to 3.8 acres of open water impacts from construction of the levee. In addition, Clean Water Act Section 404 and 401 permits will be required prior to construction of Reach 2 Central Place levee. This is due to approximately 1.2 acres of wetland impacts from construction of the levee.

No 404 or 401 permits are expected to be required for the Downtown closure structures, since no wetland or open water areas are expected to be impacted.

#### 7.B.7. Sponsorship Agreements

The City has provided a Letter of Intent acknowledging Sponsorship requirements for the Des Moines and Raccoon Rivers Project. Prior to construction, the Sponsor will be required to enter into an agreement with the Federal Government that it will comply with Section 221 of the Flood Control Act of 1970 (P.L. 91-611), and the Water Resources Development Act of 1986 (P.L. 99-662), as amended.

# 8. SUMMARY of COORDINATION, PUBLIC VIEW, and COMMENTS

## 8. A. COORDINATION

The Des Moines and Raccoon Rivers Feasibility Study was conducted as a partnership between the City and the District. This partnership included extensive coordination with numerous groups including federal, state, county, and city agencies; neighborhood associations; businesses; landowners; the media; and the unaffiliated public. These groups also were included on the study's distribution list of approximately 300 interested parties.

Appendix H, *Public and Agency Coordination*, contains detailed information about how the outreach activities listed below were an integral part of the public involvement plan:

- Study Newsletters: Feb 2000; Jan and Dec 2002; March 2004
- Study website: http://www.mvr.usace.army.mil/DesMoinesFP/
- Public Open house: Jan 2003
- Initial coordination letter to resource agencies
- USFWS

The USFWS has no objection to the selection of the preferred alternative of improvements to the existing Birdland Park and Central Place levee systems, installation and construction of downtown closure structures, and implementation of the comprehensive mitigation plan on-site at Central Place and off-site at the Chichaqua mitigation area.

#### 8.A.1. State Historic Preservation Officer

The District determined that the proposed flood control measures of the preferred plan would have No Effect on historic properties. This determination was provided to the SHSI and interested public for review and comment by letter dated July 21, 2004. The SHSI concurred with a portion of the District's determination by letter dated August 9, 2004 (R&C#: 000377008). The SHSI concurred with the "No Effect" determination as it pertained to Reach 1, Reach 2, and those project features located outside of

known historic district and individual historic property boundaries. The SHSI recommended a "No Adverse Effect" determination for those project features within known historic property boundaries in Reaches 3, 4, and 5. The Otoe-Missouria Tribe notified the District by letter dated August 26, 2004 that they had no knowledge of properties within the project "Area of Potential Effect" but that they would like to be notified in the event of inadvertent discoveries during project construction. No additional historic properties or concerns were identified as a result of the consultation.

### 8.A.2. Iowa Department of Natural Resources (Iowa DNR)

The Iowa DNR would like the District to investigate mitigation within the Des Moines River watershed or explain in the EA why it is not practicable. If mitigation occurs in a nonadjacent area as it does with the Chichaqua site, the Iowa DNR would prefer that the "mitigation ratio" is greater than 1 to 1. In addition, any mitigation plan should include all three types of wetlands being impacted (emergent, scrub-shrub, and bottomland forest) and provide as much in-kind mitigation as possible, taking into consideration the maturity and diversity of the wetland being impacted.

### 8.A.3. Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency was made aware of all the hydrology and hydraulic studies throughout the study's process. Currently FEMA is digitizing existing Flood Insurance Flood Rate Maps in the Des Moines area.

## 8. B. SUMMARY OF PUBLIC INVOLVEMENT

The goals of the public involvement and coordination process were met via the varied public involvement activities throughout the study. Numerous publics (listed in the coordination paragraph above) were identified as target audiences for public involvement and coordination. Newsletters, the study's website, and an open house were vehicles used to inform, educate, and involve the public and offer them opportunities to provide feedback to the study team. The feedback was gathered into a content analysis report and used by the study team to shape the plan formulation process and to develop the recommended plan.

**FEASIBILITY REPORT**
**FLOOD DAMAGE REDUCTION**
**FOR**
**DES MOINES AND RACCOON RIVERS PROJECT**
**DES MOINES, IOWA**

**WITH INTEGRATED**
**ENVIRONMENTAL ASSESSMENT**

## 9. RECOMMENDATIONS

The Great Flood of 1993 demonstrated the need for improved flood protection for the City of Des Moines. The Birdland Park and Central Place levees do not meet Federal standards and do not provide a certifiable level of protection. The existing federal levees protecting the downtown areas do provide a certifiable level of protection; however improvements to the levee closures would substantially increase the reliability of these levees.

I have considered all significant public interest aspects of the recommended plan for flood damage reduction and associated recreation developments at Des Moines, Iowa. This multi-purpose project is feasible from an economic, engineering, environmental, and social perspective. The recommended plan will provide reliable permanent flood protection and improved recreation opportunities for nearly 200,000 citizens of Des Moines and will provide average annual net National Economic Development benefits of over $1 million. The total cost to implement the recommended project is $10,491,000* of which an estimated $3,709,000* would be the Local Sponsor's responsibility.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

The Local Sponsor understands its responsibilities as discussed in Section 7.B above and has indicated its willingness to execute a Project Cooperation Agreement with the Federal Government for implementation of the recommended plan. I recommend approval of the recommended plan as presented in this report, with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable.

9/16/2005

(Date)

Melody D. Smith
Major, U.S. Army
Acting District Engineer

* updated to Oct 05 prices, 5-1/8%