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Draft Integrated Definite Project Report and Draft Environmental Assessment

Blacksnake Creek Section 205
Flood Risk Management
St. Joseph, Missouri

PN # 105940
April 21, 2016

This report presents the findings of a feasibility study conducted under the Continuing Authorities Program, Section 205 Authority. Section 205 of the Flood Control Act of 1948, as amended by the Water Resources Development Act of 1986 provides the U.S. Army Corps of Engineers (USACE) authority to plan, design, and construct small flood control projects that have not been specifically authorized by Congress. The study addresses flood risk in the Blacksnake Creek basin, located in Andrew and Buchanan Counties, Missouri. The study was sponsored by the City of St. Joseph, Missouri.

For this study, the Definite Project Report (DPR) and environmental assessment (EA) are integrated into a single decision document that fulfills the requirements of the National Environmental Policy Act (NEPA).

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Draft FINDING OF NO SIGNIFICANT IMPACT
BLACKSNAKE CREEK SECTION 205
FLOOD RISK MANAGEMENT
April 2016

The feasibility study has been conducted under the Continuing Authorities Program, Section 205 Authority. Section 205 of the Flood Control Act of 1948, as amended by the Water Resources Development Act of 1986 provides USACE authority to plan, design, and construct small flood control project that have not been specifically authorized by Congress. The authorization provides the authority to study, adopt, and construct flood risk reduction projects to reduce the risks of flooding, loss of life, and property damage in partnership with state and local governments. The study was conducted and cost-shared in partnership with the City of St. Joseph, Missouri.

The study was conducted to develop a feasible flood damage reduction project that would reduce flood risk to the community from flood threats within the Blacksnake Creek Basin, in St. Joseph, Missouri.

Several alternatives, including the no-action alternative were considered to meet the purpose and need of the proposed project. A range of eight structural alternatives were identified each of which included an excavated impoundment (detention basin). Four of the alternatives included structural features, such as levees, flood walls, and a dam feature in combination with an excavated detention basin. Four alternatives consisted of a range of size and configurations of excavated detention basin that would not include additional flood risk management structural features. One non-structural alternative consisting of an acquisition plan was carried through the economic analysis.

The Recommended Plan (Alternative 8) would meet the project, purpose, and need and is the National Economic Development (NED) Plan. The Recommended Plan consists of construction of a dry detention with a volume of approximately 440 acre-feet and has a construction footprint of approximately 35.6 acres. The Recommended Plan would result in similar environmental impacts as the other plans due to commonality of an excavated basin in the same general area.

No-Action Alternative

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative is not anticipated to appreciably change the existing land use within the watershed or project area as it is highly urbanized, but would continue to result in major, periodic adverse impacts to the business and residences impacted by flooding. Some businesses and/or

residents may eventually choose to relocate to existing urban, higher-ground areas to avoid flooding.

Summary of Environmental Impacts

Environmental impacts would be relatively similar for each of the structural alternatives as they are similar in regard to location and general configurations. The construction footprint incrementally increases for alternatives 5 through 7 up to 37 acres and decreases slightly to 35.6 acres for Alternative 8, the Recommended Plan.

A moderate, adverse long-term environmental impact would occur to aquatic habitat, terrestrial habitat and aesthetics for all of the action alternatives proposed, primarily due to the clearing of 13.4 acres of riparian vegetation along Blacksnake Creek and the ephemeral stream to the east. However, a moderate, positive long-term impact would occur due to widening the incised creek and stream channel and placing rock in the creek that would prevent erosion and create small creek meanders.

There is no known Hazardous Toxic Radiological Waste (HTRW) at the site. Any removal of existing unknown HTRW or HTRW discovered during construction is the responsibility of the project sponsor and would occur prior to construction. Removing any existing HTRW is considered a long-term, positive impact.

A long-term, moderate positive impact would also occur to water quality as combined sewer overflows and flooding would decrease with implementation of the Recommended Plan. Similarly, the Recommended Plan would result in long-term, moderate positive impacts to socioeconomics and stabilized land use. The Recommended Plan results in no environmental justice impacts as no minority or low-income populations are adversely impacted by the Recommended Plan.

Minor, long-term adverse impacts are anticipated to occur to, fish and wildlife, geology and soils, recreation, access, and aquatic habitat. Short-term, minor adverse impacts to air quality, water quality, noise, and disposal areas would occur during construction. The project is not anticipated to appreciably affect extreme climate and weather events, drought, or climate change in general. No adverse impacts are anticipated to occur to wetlands, cultural resources, or threatened and endangered species.

The Recommended Plan will not increase the 100-year flood elevation over existing conditions. Accordingly, floodplain impacts due to the construction of the project are considered to be short-term and minor.

The project would have an impact to recreation facilities for the area, with removal of a ball field and basketball courts within the vicinity of the construction project. Minor adverse cumulative impacts would occur to terrestrial habitat, aquatic habitat, fish and wildlife and aesthetics. Positive cumulative impacts would occur to flood risk management, socioeconomics and water quality. Cumulative impacts

to resources as a result of implementing the Recommended Plan are considered less than significant. Mitigation measures are discussed below.

Mitigation Measures

The Recommended Plan would result in clearing approximately 13.4 acres of riparian vegetation and 22.2 acres of turf. As part of the project, trees would be planted by the construction contractor within the vicinity of the impacted riparian corridor, north and south of the project area within a total area of 95 acres. Disturbed areas would be seeded concurrently or as soon as practicable following construction.

The Recommended Plan results in impacts to both Blacksnake Creek and an ephemeral stream to the east of the creek. Based on the stream impact assessment using the Missouri Stream Mitigation Method calculations to determine debits and credits, the project would impact approximately 2,650 linear feet of perennial stream and 240 feet of adjacent ephemeral stream. Based on these measurements and the type of impacts, a total net debit of 9,388.02 was calculated. In-kind stream mitigation would be conducted using an in-lieu fee mitigation program as no available stream bank mitigation credits are available within the vicinity of the Blacksnake Creek watershed.

The Recommended Plan results in a change in use for the Northside Recreation Complex sports fields located between Karnes Road and Northwest Parkway. This affected area of the Northside Recreation Complex is set aside for recreational use under Section 6(f)(3) of the Land and Water Conservation Fund Act. The City of St. Joseph, Missouri will obtain a change of use approval through the National Park Service. The application will be submitted for conversion of the affected area to passive recreational use and replacement of the ball park and basketball courts to an area within the Northside Annex park area, although specific locations have not been identified. Therefore, no mitigation is proposed for project impacts to recreational facilities.

The Recommended Plan is not likely to adversely impact the Indiana bat or the northern long-eared bat. In accordance with the U.S. Fish and Wildlife Service (USFWS) guidance, provided within their May 2, 2013, project coordination letter, tree clearing would be scheduled between November 1 and March 31 of the given year to avoid adverse effects to these species and because the project exceeds 10 acres of woodland habitat removal an Indiana bat habitat assessment is required. A habitat assessment would be conducted during the project design phase before completion of the Section 7 consultation for Endangered Species Act (ESA) to ensure no significant adverse effects to the Indiana bat.

Public Availability

The project was coordinated throughout the study with resource agencies and the public at public meetings, including a public meeting held on October 9, 2014.

Prior to a decision on whether to prepare an Environmental Impact Statement, USACE circulated a Notice of Availability (Notice) to the public and resource agencies with a thirty day comment period ending on July 30, 2015. The Notice was

emailed to individuals/agencies/businesses listed on the Kansas City District's Regulatory Office email mailing list. The Notice informed these individuals that the Draft Integrated DPR is available on the USACE webpage or that they could request a hard copy in order to provide comment.

Conclusion

After evaluating the anticipated environmental, economic, and social effects of the proposed activity, it is my determination that construction of the proposed Section 205 Blacksnake Creek Flood Risk Management Project to decrease the impacts of flooding within the City of St. Joseph, Buchanan County, Missouri, does not constitute a major federal action that would significantly affect the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.

_____	_____
Date	Andrew D. Sexton Colonel, Corps of Engineers District Commander

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Acronyms

ACE	Annual Chance Exceedance
BMP	best management practices
CEQ	Council on Environmental Quality
cfs	Cubic feet per second
CFR	Code of Federal Regulations
City	St. Joseph, Missouri
CSS	combined sewer system
DPR	Definite Project Report
EA	Environmental Assessment
EAD	equivalent annual damage
ESA	Endangered Species Act
FDA	Flood Damage Analysis
FEMA	Federal Emergency Management Agency
FY	Fiscal year
H	horizontal
HEC	Hydrologic Engineering Center
HEC-FDA	Hydrologic Engineering Center-Flood Damage Reduction Analysis
HEC-HMS	Hydrologic Engineering Center-Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HMS	Hydrologic Modeling System

HTRW	Hazardous, Toxic and Radioactive Waste
IPaC	Information for Planning and Conservation
KCD	U.S. Army Corps of Engineers, Kansas City District
KCP&L	Kansas City Power & Light
KV	kilovolt
LERRD	Lands, Easements, Rights-of-Way, Relocations, or Disposal Areas
LOMA	Letter of Map Amendment
LTCP	Long-Term Control Plan
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MRLS	Missouri River Levee System
MII	Second Generation
NED	National Economic Development
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NEPA	National Environmental Policy Act
NPDES	national pollutant discharge elimination system
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
OMRR&R	Operation and Maintenance, Repair, Replacement, and Rehabilitation
SHPO	State Historic Preservation Officers
TPC	Total Project Cost
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
V	vertical
VE	Value engineering

Executive Summary

This report presents the findings of a feasibility study conducted under the Continuing Authorities Program, Section 205 Authority. Section 205 of the Flood Control Act of 1948, as amended by the Water Resources Development Act of 1986 provides the U.S. Army Corps of Engineers (USACE) authority to plan, design, and construct small flood control projects that have not been specifically authorized by Congress. The study addresses flood risk in the Blacksnake Creek basin, located in Andrew and Buchanan Counties, Missouri. The study was sponsored by the City of St. Joseph, Missouri.

St. Joseph, Missouri (City) is the county seat of Buchanan County and the eighth largest city in Missouri with 76,780 residents (2010 Census). The City encompasses approximately 44 square miles and intersects eight basins including the Blacksnake Creek watershed. Blacksnake Creek, a left bank tributary of the Missouri River, conveys storm water runoff from the Blacksnake Creek watershed through a combination of an open natural channel in the upper reach above Karnes Road to an enclosed combined sewer system (CSS) at Karnes Road. Daily flow runs through the wastewater treatment plant. During storm events where flow exceeds the treatment plant capacity, the excess flow is discharged into the Missouri River directly via a diversion structure. Historically there have been several major flood events that have caused major damages to developed property.

This report focuses on identifying, describing, and offering recommendations to reduce the damages incurred by flooding within the watershed. The reduction in damages is accomplished by construction of a detention basin to be located at Karnes Road. The detention basin provides reduction in flood damages to properties in the downstream reach. The Recommended Plan has less than significant indirect, direct, or cumulative environmental impacts. Consistent with Executive Order 11988 the Recommended Plan does not increase downstream risk or encourage future development within the floodplain.

The Recommended Plan for the Blacksnake Creek Section 205 is Alternative 8, the NED Plan. The Recommended Plan is for the construction of a dry detention basin. It has a construction footprint of 35.6 acres and involves clearing of about 13.4 acres of riparian vegetation and 22.2 acres of turf and open field. The Recommended Plan uses natural topography and excavation north of Northwest Parkway to create 440 acre-feet of detention storage. There are no traditional structural flood risk management measures required; thus no dam, levees, or floodwalls are proposed. Excavation is approximately 660,000 bank cubic yards at a depth estimated between five feet to 20 feet, and the area will include a low flow channel. Primary and secondary spillways will deliver excess runoff over the top of Northwest Parkway at approximately 4 percent annual chance exceedance (ACE) event and less frequent events. Roadways and utilities will be impacted. The needed utility relocations, the City's road improvement plan and combined sewer improvement plan were all duly considered in the development of the Recommended Plan. The Recommended Plan

includes erosion control to be strategically placed at locations of potential high erosion.

The feasibility-level socioeconomics analysis of the Blacksnake Creek federal flood risk management project in St. Joseph, Missouri, has found that a strong federal interest exists in implementing the NED plan. The Recommended Plan, estimated to cost $14,761,000, exhibits very strong economic justification. At the current fiscal year (FY) 2016 federal water resources interest rate of 3.125 percent, the Recommended Plan's benefit-cost ratio is 4.8, with net annual benefits of $2,410,000. At the 7 percent interest rate, the benefit-cost ratio is 2.5. The project would represent a strong contribution to national economic outputs.

Blacksnake Creek Benefit Cost Data	
FY16 prices; $000s	
Interest Rate	3.125%
First costs*	$14,761.0
Annual Benefits	$3,052.0
Annual Costs	$642.0
Benefit-Cost Ratio	4.8
Net Benefits	$2,410.0

Note: Project First Costs for socioeconomics include estimated non-compensable costs.

The Total Project Cost (TPC) for implementation (design and construction, fully funded) is estimated at $13,958,000. The project will be cost shared at 65 percent federal cost and 35 percent non-federal cost. The estimated federal share is $9,072,700 and the non-federal share is estimated at $4,885,300. For the non-federal sponsor (City of St. Joseph, Missouri) share, $3,177,300 is the estimated cash contribution. The sponsor will receive credit for the cost of lands, easements, right of way, relocations, or disposal areas (LERRD). The estimated cost for LERRD is $1,708,000.

The statutory cost share limit for federal participation in a Section 205 project is $10 million. This limit is inclusive of all federal participation in the project. The federal participation cost for feasibility phase was $899,000. This amount, in combination with the estimated federal participation cost for the implementation phase of $9,072,000 totals $9,971,000, and is within the statutory limits.

The project conducted a cost risk analysis to develop the TPC. Based on cost risks identified, appropriate contingencies are included in the certified estimate. The City of St. Joseph, Missouri will be the sponsor for the project. The City understands the requirements for cost sharing and the statutory limit for federal contribution. The sponsor will take ownership of the project and assume all operation, maintenance, repair, and replacement costs of the completed works.

Section 1
Introduction

1.1 Study Authority

This study is authorized under Section 205 of the Flood Control Act of 1948, as amended by the Water Resources Development Act of 1986. Section 205, one of several existing authorities in the Continuing Authorities Program, gives the U.S. Army Corps of Engineers (USACE) authority to plan, design, and construct small flood control projects that have not been specifically authorized by Congress. Federal participation in Section 205 projects is limited by statute to $10 million.

1.2 Purpose and Scope

This report presents the results of the USACE feasibility study conducted to identify, evaluate, and recommend an appropriate and implementable solution for flood damage reduction in the Blacksnake Creek Basin in St. Joseph, Missouri. The feasibility study included an assessment of existing conditions, plan formulation, cost estimates, socioeconomic analysis, engineering and design analysis of the Recommended Plan, and NEPA documentation.

1.2.1 NEPA Compliance

NEPA established a national environmental policy and goals for the protection, and maintenance of the environment. It also provides a process for federal agencies to implement federal actions while considering environmental impacts. It requires all federal agencies to incorporate environmental considerations in planning and decision-making. NEPA also established the President's Council on Environmental Quality (CEQ) and empowered the Council to develop regulations by which all federal agencies would comply with NEPA. These regulations are published in the Code of Federal Regulations (CFR) at 40 CFR 1500-1508.

USACE has promulgated their own procedures for implementing NEPA (ER 200-2-2) to provide guidance for the procedural provisions of NEPA. ER 200-2-2 supplements, and is used in conjunction with, the CEQ regulations. Within the CEQ NEPA regulations and ER 200-2-2, a process is set forth where agencies must assess the environmental impact of proposed federal actions and consider reasonable alternatives to their proposed actions. This Draft Definite Project Report (DPR) with integrated EA has been prepared in accordance with NEPA and CEQs Regulation as well as ER 200-2-2.

1.3 Description of the Study Area

The City is the county seat of Buchanan County and the eighth largest city in Missouri with 76,780 residents (2010 Census). The City encompasses approximately 44 square miles and intersects eight basins, including the Blacksnake Creek watershed. Blacksnake Creek, a left bank tributary of the Missouri River, conveys storm water runoff from the Blacksnake Creek watershed through a combination of an open,

natural channel in the upper reach to an enclosed CSS at Karnes Road. The Blacksnake Creek watershed, which is the focus of the feasibility study, conveys storm water runoff through a combination of an open, natural channel in the upper reach above Karnes Road to an enclosed system at Karnes Road that ultimately discharges to the Missouri River. The study area is shown in Figure 1-1.

1.4 Existing Conditions

Blacksnake Creek enters the City of St. Joseph about 4.3 miles above its mouth and flows south-southwest through the City to join the Missouri River. The watershed has a total drainage area of 8.2 square miles. The channel in the lower 3.2 square miles of the basin is enclosed in a combined sewer of varying size up to 17 feet in diameter. The upper five square miles of the basin above the combined sewer inlet at Karnes Road is drained by open channel. During intense storm events (greater than or equal to a 0.20 ACE), the Karnes Road combined sewer inlet capacity is exceeded. When this occurs, flow from Blacksnake Creek overtops Karnes Road and flows south via streets and yards to flood residential, commercial, and industrial properties within the City. Flooding within the Blacksnake Creek watershed affects approximately 200 residential, commercial, and industrial properties along the St. Joseph Avenue corridor.

There have been at least six major flood events in recorded history, each causing major damages to developed property. One of the most damaging floods occurred on June 9, 1984, and caused several million dollars in damages. The remaining five significant storms happened in June 1943, June 1949, May and August of 1959, and May 1962. Ongoing upper basin development and floodplain encroachment are potential factors in ongoing flood related damage during larger storm events.

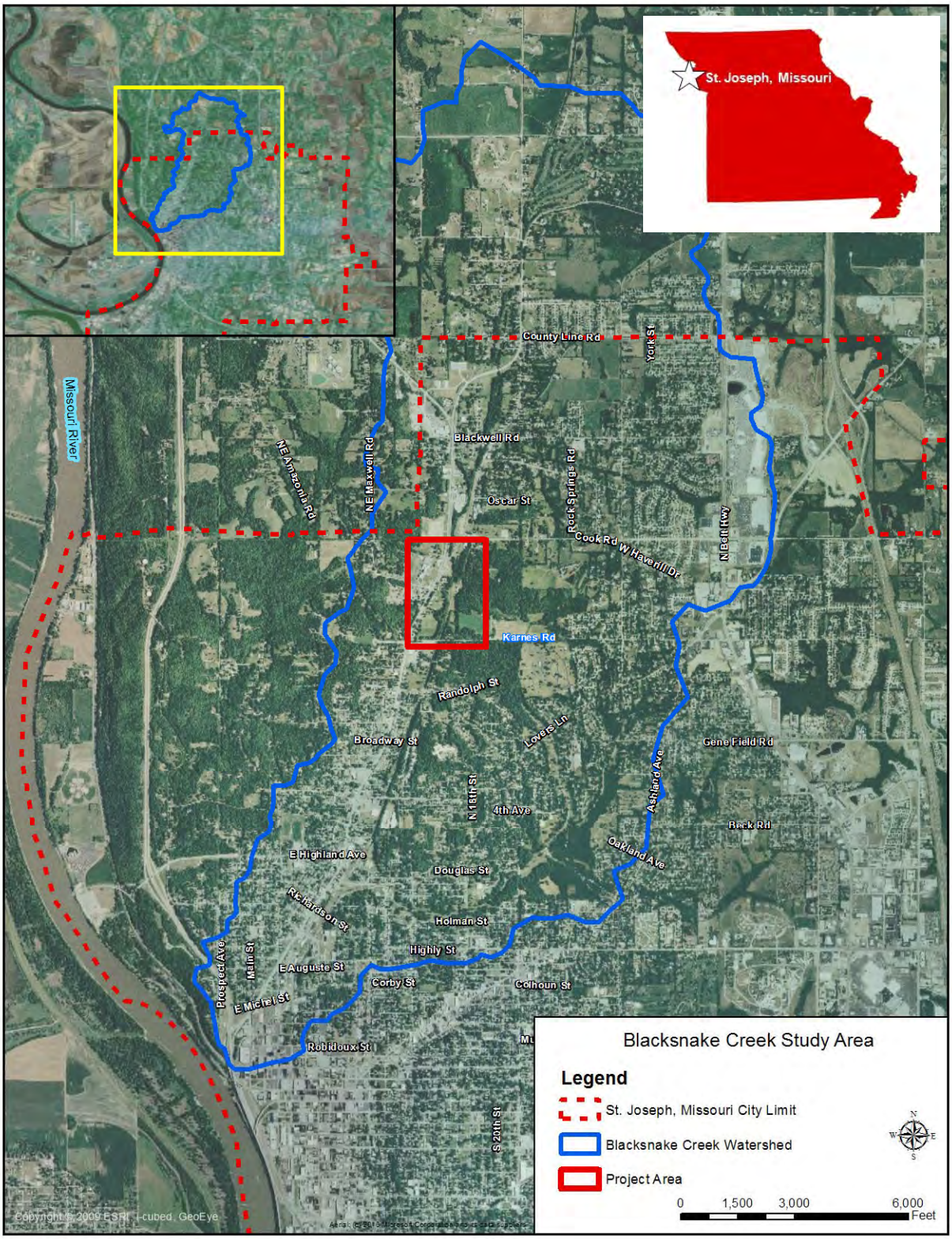

Figure 1-1 Blacksnake Creek Study Area

1.5 Prior Studies and Reports

As a result of the June 9, 1984, flood, USACE Kansas City District (KCD) conducted a reconnaissance study[1] of the flooding issues in the City. The purpose of the study was to examine alternatives for flood damage reduction in the City and to determine the federal interest and local support for such alternatives. The tributaries evaluated include Blacksnake Creek, Charles Street Drainage, Brookdale, Whitehead Creek, Brown's Branch, and Contrary Creek. Flood damages were found to be most severe along Blacksnake Creek, Whitehead Creek, and in the Southwest portion of the City (Contrary Creek and Brown's Branch). Structural and nonstructural measures were identified and evaluated to reduce flood damages at those locations. The reconnaissance study assessed construction of a detention structure/road raise within the Blacksnake Creek basin at Karnes Road. Based upon the potential impacts to landowners in the basin and to flood-prone occupants downstream of the detention structure, two different elevations of detention structures, 898 and 905 National Geodetic Vertical Datum (NGVD), were developed for further analysis. The 898 NGVD detention structure would control the 50 percent ACE flood event and would be overtopped by larger events. The 905 NGVD detention structure would control the 4 percent ACE flood event and would be overtopped by larger events. The evaluation of those alternatives, based on economic and environmental criteria, indicated there was a federal interest in continuing planning studies to the feasibility phase. It was recommended that feasibility phase studies be undertaken with the City of St. Joseph as the non-federal sponsor.

In 1998, Black and Veatch, an engineering firm hired by the City, completed a storm water management plan[2] for the City to identify flooding problem areas, analyze the drainage system, and identify improvements to mitigate the flooding. Three separate detention basin alternatives were considered to reduce flooding in the Blacksnake Creek watershed: (1) between St. Joseph Avenue and Savannah Road, (2) north of Cook Road near Savannah Road, and (3) just upstream from the entrance of the CSS north of Karnes Road and east of St. Joseph Avenue. Only the detention basin at Karnes Road and St. Joseph Avenue was carried forward into the feasibility study. The other basins were located too far upstream to provide a significant reduction in flow.

In 2002, a preliminary assessment of flood control opportunities in the Blacksnake watershed was completed for USACE by contractor URS [3]. The preliminary assessment considered an array of alternatives for flood damage reduction in the Blacksnake Creek watershed. These included construction of a detention basin north of Karnes Road, increasing the capacity of the existing combined sewer, nonstructural measures within the floodplain, and diverting water away from the flood prone areas. The detention basin alternative north of Karnes Road was chosen for further analysis. The preliminary analysis indicated that the proposed detention basin would

[1] Reconnaissance Report, St. Joseph, Missouri, USACE Kansas City District, December 1987
[2] Storm water Management Report, Black & Veatch, November 20, 1998
[3] Blacksnake Creek, St. Joseph, Missouri, Preliminary Assessment, Section 205 Feasibility Phase, URS, November 2001

significantly reduce flood damages in the study area and that potential economic benefits exceed project costs.

Black and Veatch, under contract with the City, evaluated and summarized potential alternatives to separate and remove creek flows (i.e., storm water) from the City's CSS. The 2010 technical memorandum[4] recommended removing creek flows from the CSS by diverting them through a storm water separation conduit aligned along an existing City owned right-of-way (abandoned railway) east of St. Joseph Avenue. Further study and design of the storm water separation conduit was not part of the feasibility study.

It is noted that prior reports and public information regarding this project have referred to hydrologic events (rainfall or flood events) in terms of the return interval in years, such as a 100-year event. This report adopts an updated convention of referring to hydrologic events of a specific magnitude in terms of the probability of the hydrologic event occurring in any given year. The event having a one-in-100 probability (formerly referred to as the "100-year flood") would have a 1 percent ACE. The event is interchangeably designated as the 1 percent ACE or the 1 percent chance event. Similarly the event having a 25 in 100 probability (formerly referred to as a "25-year flood") would be the 4 percent ACE or 4 percent chance event. The change is intended to better convey the relative chance of the hydrologic events occurring in a given year.

[4] Technical Memorandum No. TM-CSO-5, Storm water Separation Conduits, Black & Veatch, January 15, 2010

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Section 2
Plan Formulation

2.1 USACE Section 205 Policy

The Continuing Authorities Program Section 205 projects are small-scaled flood control projects. The solutions investigated can include structural (levees, channel, detention ponds, etc.) or non-structural (flood proofing, relocations, etc.) measures or a combination of both. Flood risks and damages must stem from over land flooding by a stream or a major drainage-way. To qualify for assistance under the authority, watersheds contributing to flood problems must have a drainage area of at least one square mile and a peak flow of at least 800 cubic feet per second (cfs) for a 10 percent ACE event. The Blacksnake Creek basin meets this criteria with a discharge at the 10 percent ACE event of between 2,191 to 3,332 cfs. The basin covers approximately 8.2 square miles. The upper reach (above Karnes Road) watershed drainage area is approximately five square miles and is open channel flow.

2.2 The Study Process

The study is the first phase in a two phase process: The feasibility phase which results in a DPR; and the design and implementation phase which would result in final design plans and specifications and construction of the project. Feasibility costs in excess of an initial $100,000 are cost-shared 50 percent federal and 50 percent non-federal in accordance with a Feasibility Cost-Sharing Agreement specific to the feasibility study. If the project is approved and advances to the design and implementation phase, all costs for that phase are cost-shared 65 percent federal and 35 percent non-federal in accordance with the terms of a Project Partnership Agreement to be prepared for the start of the implementation phase.

The feasibility phase consists of conducting detailed analysis to quantify flood problems (risks and damages), definition of objectives and constraints for developing alternatives, formulation and evaluation of alternatives to meet objectives and avoid constraints, comparison of the alternatives based on the project objectives and the application of the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation, Water Resources Council, 1983 for evaluation of NED, Regional Economic Development, Environmental Quality, and Other Social Effects, and the identification of a recommended plan. The results of the feasibility study are documented in this report and form the basis for a decision on project implementation.

2.3 Planning Criteria

Under feasibility studies, alternative plans are formulated within the context of four fundamental planning criteria; completeness, effectiveness, efficiency, and acceptability.

1. *Completeness* is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the Recommended Planned effects. This may require relating the Recommended Plan to

other types of public or private plans if the other plans are crucial to realization of the objective.

2. *Effectiveness* is the extent to which an alternative plan alleviates the specified problems and achieves the specified objectives.

3. *Efficiency* is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.

4. *Acceptability* is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility with existing laws, regulations and public policies.

2.4 Assessment of Problems and Opportunities

2.4.1 Future Without-Project Conditions

Under without-project future conditions, homes and businesses will continue to be subject to flooding. Although much of the lower basin is highly urbanized and the population of the City has remained stable, at least some development is likely to continue in the upper portion of the watershed and could potentially contribute to an increase in flooding in the City. While no large scale changes or redevelopment are confirmed for the upper reach of the basin, at least some development would be reasonably anticipated in future years due to the upper basin's proximity to the urban area. The flood-prone area in the downstream portion of the basin is substantially developed and contains few suitable locations for additional development. Climate change was analyzed to determine the likely impacts to the future conditions and is further discussed in Section 2.5.4.

2.4.2 Problems and Opportunities

During storm events greater than or equal to a 20 percent ACE, the capacity of the Karnes Road combined sewer inlet is exceeded, flooding the area downstream of Karnes Road. When this occurs, flow from Blacksnake Creek overtops Karnes Road and flows south via streets and yards to flood residential, commercial, and industrial properties within the City. There are over 200 residential, commercial, and industrial structures along the St. Joseph Avenue corridor. Attenuation of peak flows from the more rural upstream 5.6 square miles of the Blacksnake Creek watershed would minimize damages.

2.5 Objectives and Constraints

2.5.1 Objectives

Develop a recommended plan to substantially decrease flood risk and damage susceptibility to the population, investment and infrastructure on the St. Joseph Avenue corridor for a 50-year period of performance.

2.5.2 Constraints

Minimize the impacts to and/or relocation of homes and businesses in the St. Joseph Avenue corridor due to implementation of flood risk management alternatives.

A recommended plan should be compatible with the City of St. Joseph's surrounding infrastructure and storm water improvement plans within the Blacksnake Creek basin.

Avoid significant adverse environmental impacts.

2.6 Affected Environment

Blacksnake Creek is a small left bank tributary of the Missouri River that enters the City of St. Joseph, Missouri about 4.3 miles above its mouth and flows south-southwest to join the Missouri River at Mile 449.1. The Blacksnake Creek watershed encompasses an 8.6-square-mile basin in Buchannan and Andrew Counties in the northern portion of the City. It has an elliptical shape that is about six miles long north-south with a maximum width of about two miles east-west. The bed slope of the watershed is defined as "steep."

The project area consists of an approximate 37-acre area located along Blacksnake that extends west towards the residences along St. Joseph Avenue, and east towards Karnes Road. The project area extends north-south from Cook Road to Northwest Parkway and encompasses the proposed detention basin boundary and adjacent land (Figures 1-1 and 3-1).

The City's ongoing road improvements for the area and utility realignments are discussed in detail in sections 3.2.3 and 3.2.4, respectively.

The Missouri River is located approximately two miles west of Blacksnake Creek and the creek enters the Missouri River approximately 2.5 miles downstream of the project area. Potential impacts to the Missouri River are only discussed in the water quality section as the River would not be impacted by physical construction of the action alternatives proposed.

Resources of concern identified during the NEPA process include: air quality, water quality, noise, aesthetics, climate, recreation, geology and soils, land use, disposal areas, HTRW, aquatic habitat, terrestrial habitat, wetlands, fish and wildlife, threatened and endangered species, roads, socioeconomics, archeological and cultural resources, and floodplain. These resources as well as disposal areas proposed to be used for the action alternatives are discussed below.

2.6.1 Air Quality

In accordance with the Clean Air Act, the U.S. Environmental Protection Agency (USEPA) set National Ambient Air Quality Standards for "criteria" pollutants considered harmful to the environment and public health. Criteria pollutants monitored in the St. Joseph, Missouri area include carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, inhalable particles, and fine inhalable particles. Based on air quality index reports, St. Joseph overall air quality is generally "good" (USEPA, 2013). Sources of criteria

pollutants in the St. Joseph area include auto emissions, coal burning, road traffic and construction, and industrial processes.

2.6.2 Water Quality

Blacksnake Creek is mapped as an unnamed intermittent stream that is not listed on Missouri's water quality (305b) report or 303(d) list of impaired waters. Due to urbanization within the watershed and increasing urbanization upstream, creek water quality is likely impacted by both rural and urban nonpoint source pollution.

The Missouri River in the vicinity of St. Joseph is classified as a permanent flow general warm water fishery resource. The River provides protection to both game and non-game fish occurring in the area. The River provides a water source for irrigation, livestock/wildlife watering, aquatic life protection, boating, drinking-water supply, and industrial withdrawal (USFWS, 2006).

2.6.3 Noise

Noise within the study area generally includes traffic and periodic construction. Sensitive noise receptors within the vicinity of the study area include Robidoux Middle school, which is located about 0.10 miles southwest of Savannah Road. Northwood Terrace Apartments are located directly to the west of St. Joseph Avenue and the project area. A few private residences are located along St. Joseph Avenue to the west, and a relatively dense row of private residences lines St. Joseph Avenue to the east. Krug Park is a 163-acre area directly west of Karnes Road, which includes walking trails, picnic areas, playgrounds, an amphitheater, and additional amenities. St. Peter Lutheran Church is located about 0.16 miles south of Karnes Road and Marvin McMurry United Methodist Church is located about 0.28 miles south of Karnes Road. The Northside Complex basketball courts, baseball field, and associated parking are located directly south of Karnes Road.

2.6.4 Aesthetics

Aesthetics within the project area primarily include riparian vegetation, open field, manicured lawn, urban dwellings, businesses, and associated infrastructure. The creek channel is generally not visible as it is incised and contained within the riparian corridor.

2.6.5 Climate

The climate of the area is characterized by wide fluctuations in temperature and precipitation, both daily and seasonal. The coldest month is generally January, with an average temperature of 24.9°F (-3.94°C). The warmest month is July, with an average temperature of 78.5°F (25.8°C).

The annual average precipitation in the area is 34.06 inches. Summer precipitation is generally in the form of high intensity thunderstorms and short duration rains. Hourly rainfall in the range of 1 inch to 1.5 inches is common. The maximum 24-hour rainfall reported in St. Joseph was 7.12 inches in May 1962. The majority of rainfall occurs between April and September, with the greatest amount of precipitation received during spring and summer.

2.6.6 Recreation

Krug Park is a 163-acre area located just west of the project area that includes trails, playgrounds, and additional recreation amenities. The Northside Recreational Complex, located south of Karnes Road. along St. Joseph Avenue, is a multiuse facility that has a swimming pool, baseball field, basketball and tennis courts, and associated parking facilities. Football fields, also a part of the Northside Recreational Complex are located further south of the study area, just north of Randolph Street. Blacksnake Creek provides some recreation as observed by the presence of abandoned fishing hook and line. The Northside Recreation Complex is protected under Section 6(f)(3) of the Land and Water Conservation Fund Act. This act allows for matching grants to states and local units of government for the acquisition and development of public outdoor recreation sites and facilities. As such, any permanent conversion of use or significant change of use to the Northside Recreation Complex would need to be submitted to the National Park Service and approved before any modifications to this area would be allowed.

2.6.7 Geology and Soils

The geology within the majority of the city limits of St. Joseph and project area consists of pre-Illinoisan to Early Wisconsin Loess (Langer et al, 2002). The depth to bedrock within the project area is unknown. Shallow limestone is known to occur north of Karnes Road to the east of the abandoned railroad right-of-way.

Soils within the watershed are primarily Marshall-Contrary soils characterized by well drained soils, with slopes from 2 percent to 20 percent. These are predominately silt-loam soils. Near the confluence with the Missouri River, the floodplain soils are poorly drained and predominately clay.

The vast majority of the project area from north to south is mapped as Colo silty clay loam. The area south of Karnes Road is mapped as “urban land, bottomland”, and the southeastern portion of the project site is mapped as Judson-Colo complex. Colo silty clay loam is designated by the NRCS as “prime farmland if drained.” All areas of Judson-Colo complex are considered prime farmland. Both Colo silty clay loam and Judson-Colo complex are listed as hydric on the NRCS Buchanan County hydric soils list. “Urban land, bottomland” is not classified as prime farmland, but may be hydric in localized areas. Soil samples taken within the project area confirmed that the primary soil type is Colo silty clay loam with a hue, value and chroma of 10YR3/1.

2.6.8 Land Use

The land use of the watershed is divided between predominately urban land use in the lower basin, which encompasses the southern half of the watershed, and a mix of suburban residential and rural land use in the upper, northern half of the basin.

The Blacksnake Creek watershed is approximately 57 percent residential, six percent commercial/industrial, 12 percent parks, 20 percent agriculture, and five percent other. The composite impervious percentage for the watershed is 29 percent. The project area is generally urbanized with some open land bordering the creek and residences.

2.6.9 Disposal Areas

Disposal areas would be required for some of the action alternatives proposed. Disposal areas are discussed in Section 3.6.8 of the feasibility report with locations shown on Figure 3-11. The Heritage Park Softball Complex would be used for material separation, and impervious material would be hauled and stored in Elwood Bottoms. These locations were chosen out of four proposed disposal locations as they are closest to the project area and would result in cost savings over the other locations proposed. In addition to softball fields and parking, the Heritage Park Softball Complex contains areas of open land. Unusable material separated from impervious material would be stockpiled for future fill or spread and compacted onto existing land. A portion of Elwood Bottoms has been recently cleared of trees and a portion of the area is leased agricultural land. Due to the relatively large volume of the impervious material that would be stockpiled, soil would likely be placed in both cleared and leased agricultural portions of Elwood Bottoms. The Elwood Bottoms site is located on Missouri River Recovery Program mitigation land owned by the federal government. Current agricultural leases would be terminated for a temporary stockpiling and renewed once the stockpiled material is removed for fill. This site would not be eligible for LERRD.

2.6.10 Hazardous, Toxic, and Radioactive Waste

A Phase I Environmental Site Assessment was performed by KCD within the project area in March 2004 to identify HTRW concerns and potential impacts to HTRW as a result of the proposed flood risk management project (Appendix A). A database search of appropriate federal and state records was performed as well as a site reconnaissance. Available Sanborn Maps were obtained to identify historical land use. Proposed disposal areas including the Heritage Park Softball Complex and Elwood Bottoms were field surveyed for the presence of hazardous waste in June 2013.

2.6.11 Aquatic Habitat

Blacksnake Creek is an urbanized stream that flows for about 3,200 linear feet through the project area. The channel was straightened and the bottom concrete lined for the last 530 linear feet of the channel before subverting into an underground channel (combined sewer) through an inlet located immediately north of Karnes Road. The storm system north of Karnes Road consists mostly of open channels, while the system south of Karnes Road is largely piped. The substrate of the unlined portions of the creek is composed of silt and clay. There is a large amount of concrete debris and asphalt in the channel, as well as a variety of litter. Therefore, viable aquatic habitat is very limited.

The piped portion of the system is a combined sewer and dry weather flows are routed to the existing water protection facility or waste water treatment plant via a 36-inch diameter diversion structure located just upstream of the Missouri River. The combined sewer consists of piping ranging in size from 12-foot diameter at the upstream end just south of Karnes Road, to a 16-foot, 10-inch high oval-shaped pipe near its outlet at the Missouri River. There is a large wooden flap gate at the combined sewer outlet.

Several tributaries, both open channel and piped, enter Blacksnake Creek. In the upstream open channel area between Blackwell and Green Valley Road, there is a large tributary that enters the left bank of the main stem via an eight-foot diameter pipe.

An additional large open channel enters along the left bank just north of the sewer entering the main stem combined sewer at Grand Avenue. There are also numerous smaller piped and un-piped tributaries entering the main stem along its length.

Similar to the creek, there is a small ephemeral tributary to the east of Blacksnake Creek with a width of about 15 feet, riparian corridor and a substrate composed of silt and clay. The ephemeral stream functions more as a natural system as it does not contain a concrete lined channel, a low water crossing, or numerous culverts.

A preliminary jurisdictional determination was conducted by the KCD Regulatory Office on April 10, 2015, to determine the jurisdictional status of potential waters of the U.S. including Blacksnake Creek and the tributary to the east of Blacksnake Creek located within the southeast portion of the project area (Appendix J). The KCD Regulatory Office determined that both the creek and the ephemeral tributary to the east of the creek are jurisdictional waters of the U.S. within the project area.

2.6.12 Terrestrial Habitat

The project area is located within the Missouri River Loess Woodland/Forest Breaks land type association, typified by steep slopes, narrow drainages, historically oak and mixed hardwoods but is now second growth forest. Open areas in this region are generally cool season pasture. However, increasing urbanization has resulted in the increasing conversion of open areas to fescue.

The terrestrial habitat within the project area primarily consists of the Blacksnake Creek riparian area, riparian lined drainage to the east of the creek and north of Karnes Road, and open field and lawns to the west of the creek. For the purposes of this report, both the Blacksnake Creek riparian area and the riparian lined ephemeral drainage to the east of the creek are collectively referred to as the Blacksnake Creek riparian area or corridor. The open field west of the creek that is not maintained fescue is dominated by woody shrubs (locust, slippery elm, and box elder), fescue, grapevine, wild onion, red clover, sweet clover (Melilotus), ground ivy, ragweed, asters, and plantain.

The extent of riparian vegetation is variable depending on the depth of the riparian area and the amount of edge available adjacent to top of bank. Dominant interior riparian vegetation includes silver maple, walnut, slippery elm, dock (Rumex), Japanese honeysuckle, honey locust, white mulberry, hackberry, poison ivy, Virginia creeper, box elder, garlic mustard (Alliaria), Virginia and Canada wild rye, asters, and cottonwood.

Edge species were generally dominated by black walnut, white mulberry, locust, grapevine, gallium, aster, ragweed, Japanese honeysuckle, silver maple, box elder, and poison ivy. The northern riparian edge also contained slippery elm, American elm, and hackberry. The riparian lined drainage to the east of the creek contained similar species, but also contained catalpa, occasional small red and white oaks and basswood, sugar maple, gooseberry, and lots of slippery elm. The field north of the riparian lined drainage was dominated by fescue, red and white clover, thistle, and occasional Rumex.

There is considerable variety in the age of the trees within the riparian area, as periodic maintenance and floods have removed the vast majority of older second growth trees. The average age of trees within the corridor is estimated to be 10 years to 20 years. Some of the larger trees including cottonwood and sycamore had circumferences of about 26 inches, with a few larger cottonwoods present.

Some areas of the Heritage Park Softball Complex and Elwood Bottoms (disposal areas) also contain riparian vegetation dominated by species similar to those along Blacksnake Creek including cottonwood, sycamore, and silver maple. A portion of Elwood Bottoms was recently cleared of trees and part of the area is leased agricultural land. Tree clearing was not conducted as a result of this project and is not related to this project. Tree clearing was conducted to minimize the potential for the area to become an attractive bird habitat due to concerns with bird air strike hazards by the nearby Rosecrans Memorial Airport. The riparian areas within the Heritage Park Softball Complex are generally located both north and south of the ball fields and associated facilities, adjacent to the Missouri River.

2.6.13 Wetlands

National wetland inventory (NWI) database maps of the vicinity of the project indicate that one palustrine forested wetland and one palustrine emergent wetland are present north of Karnes Road and east of Joseph Avenue (Figure 2-1 Blacksnake Creek NWI). The entire project area and vicinity including the locations of NWI-mapped wetlands was surveyed during field reconnaissance conducted on August 29, 2003, June 19, 2008, June 7, 2013, and September 9, 2014. The project area is generally developed and disturbed with relatively flat topography. Soil samples taken within the project area confirmed that the primary soil type is Colo silty clay loam with a hue, value and chroma of 10YR3/1. Although project area soils are hydric, no wetlands including NWI-mapped wetlands were identified during field surveys, primarily due to the absence of wetland hydrology. The banks of Blacksnake Creek are relatively steep and not conducive to wetland development. Very limited bank shelving was observed during field surveys. Overbank flow was not observed to have resulted in wetland development in the vicinity of Blacksnake Creek including the drainage to the southeast of the creek. No additional sources of wetland hydrology were observed within the project area.

The areas proposed for soil disposal and stockpiling, which include the Heritage Park Softball Complex and the Elwood Bottoms contain NWI-mapped wetlands. Wetlands mapped in the vicinity of the Heritage Park Softball Complex are primarily located in the southern portion of this area, and adjacent to the Missouri River. Some wetlands are mapped adjacent to the sports fields (Figure 2-2 Heritage Park Softball Complex NWI). Elwood Bottoms has been severely disturbed due to tree clearing, earthmoving, and agricultural activity. One emergent wetland is NWI-mapped within the area of proposed spoil placement (Figure 2-3 Elwood Spoil Area NWI). This wetland was not identified during field reconnaissance. All areas of borrow and spoil placement will be assessed for changed conditions prior to construction.

Figure 2-1 Blacksnake Creek at Karnes Road National Wetlands Inventory Map

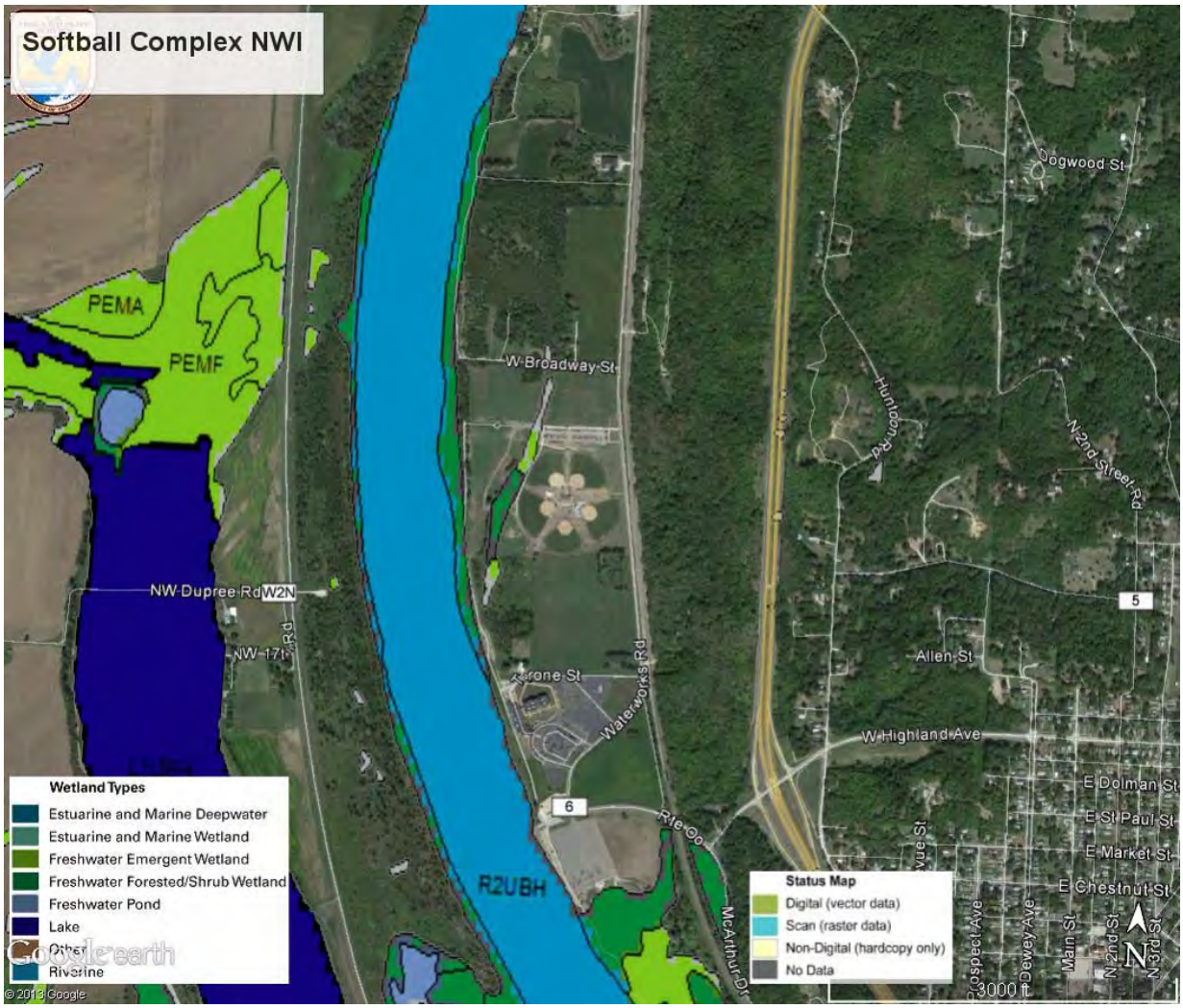

Figure 2-2 Heritage Park Softball Complex National Wetlands Inventory Map

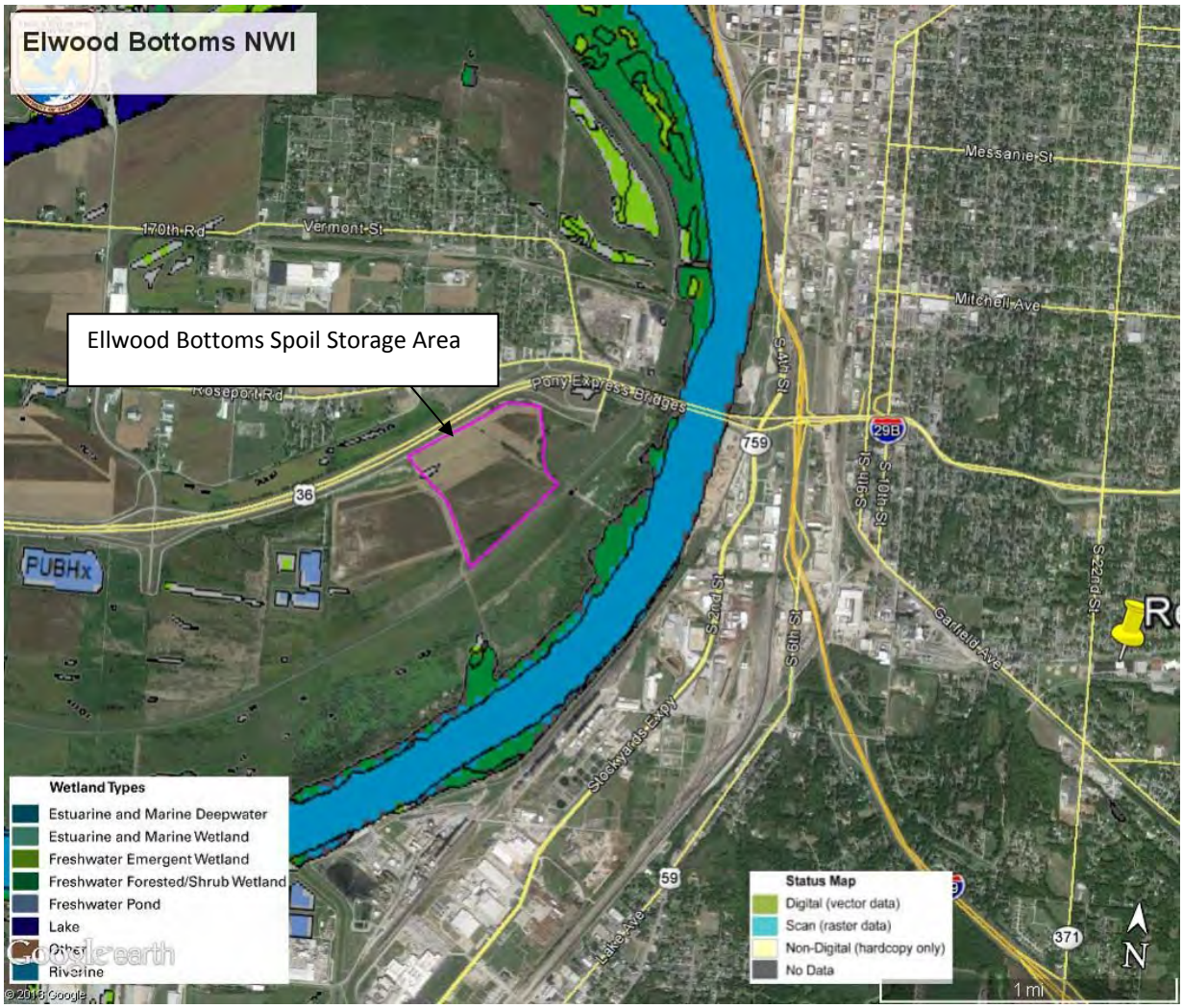

Figure 2-3 Elwood Bottoms Spoil Area National Wetlands Inventory

2.6.14 Fish and Wildlife

Information regarding the fish and wildlife of the Missouri River and adjacent habitat that may be found within the vicinity of the project area was obtained from USFWS, 2006. Buchanan County fish and wildlife information was obtained from Missouri Department of Conservation (MDC) Natural Heritage Database, 2015 (Appendix B).

Mammals associated with wooded riparian habitat include white-tailed deer, eastern cottontail, and red and gray squirrels. Aquatic and terrestrial furbearers present in the area include beaver, mink, and muskrat (dependent on aquatic habitat), opossum, coyote, raccoon, and striped skunk (dependent on terrestrial habitat). However, small mammals, such as mice, voles, rats, and bats account for the majority of the species present. The white-tailed deer is the only naturally occurring large mammal still common in developed urban areas. Eastern wild turkeys are present in the open, less developed floodplain areas.

The avifauna of the area includes permanent residents, summer residents, transients, and winter residents. The project area provides year-round habitat for approximately 31 bird species, with another estimated 67 species using the project area for nesting and another 14 species as winter-only residents.

Over 110 species use the river corridor during the fall migration. Summer resident species associated with aquatic habitats include waterfowl, wading birds, and some passerines. Summer waterfowl are dominated by wood ducks which nest in wooded bottomlands and rear their young in nearby aquatic habitats. Nesting by other waterfowl, primarily mallards, is minor. Wading birds, such as the great blue heron and green heron, utilize shallow areas as foraging habitat. Additional migrating species include the Canada goose, mallard, pintail, and snow goose.

Amphibians that may be found within the vicinity of the project area likely include the bullfrog, leopard frog, northern cricket frog, plains spadefoot toad, eastern American toad, western narrow-mouthed toad, Woodhouse's toad, and Cope's gray treefrog. Reptiles likely found within the vicinity of the project area include the snapping turtle, ornate box turtle, painted turtle, smooth soft-shelled turtles, common five-lined and Great Plains skink. The prairie ringneck snake, eastern hognose snake, racer, bullsnake, prairie kingsnake, watersnake, red milksnake, red-sided garter snake, copperhead, and timber rattlesnake likely occur within the vicinity of the project area. Additional amphibians and reptiles may occur within and adjacent to the study area.

The Missouri River's fishery is characterized by species typical of large, turbid rivers including the smallmouth buffalo, bigmouth buffalo, common carp, river carpsucker, shortnose gar, and channel catfish (USFWS, Missouri River Levee System (MRLS) 471-460 DCAR). Gizzard shad is the most dominant forage species. In addition to channel catfish, sport species present include flathead and blue catfish, white crappie, freshwater drum, green sunfish, and bluegill. Other forage and nongame species present include various minnows and shiners.

Unidentified small fish, crayfish burrows, water striders, and a bullfrog were observed within the Blacksnake Creek channel. The creek is generally shallow and narrow, and may contain common fish species such as red shiner, fathead minnows, bullhead catfish, bluegill, green sunfish, and common carp. However, creek fauna is considered rather limited based upon field observations.

Wildlife within the project area is typical of an urbanized area. Wildlife observed during field surveys includes eastern cottontail rabbit, opossum, white-tailed deer, southern leopard frog, bullfrog, wild turkey, mourning dove, black-capped Chickadee, northern cardinal, mallard, dragonflies and damselflies. Many species of mammals, birds, reptiles, and amphibians likely use the habitat provided by the riparian corridor and adjacent habitat.

2.6.15 Threatened and Endangered Species

All agency correspondence is included in Appendix B. In an agency coordination letter dated December 10, 2003, the USFWS stated that the Indiana bat (*Myotis sodalis*) was the only federally listed species likely to occur within the project area and that tree

clearing should occur between October 1st and March 30th. During the summer, Indiana bats roost in trees with exfoliating bark. Overwintering occurs in caves, or occasionally abandoned mines. In a follow-up letter to the USFWS in April 2013 regarding project status, the USFWS responded in May 2013 and stated that they had no additional comments in addition to what they had already provided and still recommended tree removal within a specific timeframe to minimize impacts to the Indiana bat. Follow-up coordination with the USFWS occurred in June 2015 with an email that included Recommended Plan information and a figure of the proposed construction footprint. The USFWS responded in June 2015 with an email suggesting entering project information on the Information for Planning and Conservation (IPaC) website (http://ecos.fws.gov/ipac). The IPaC-generated response contained a list of threatened and endangered species that may occur in the proposed project location and/or may be affected by the proposed project. These species included the threatened piping plover, red knot, northern long-eared bat, endangered least tern, pallid sturgeon, and Indiana bat.

The piping plover is a rare transient species that inhabits ponds, lakes, or reservoirs with sand or rubble shores, wetland edges, and mudflats. The red knot is a rare transient species that is associated with ponds, lakes, and reservoirs with sandy or stony beaches. The least tern occurs on sand or gravel bars of streams, ponds, lakes or reservoirs and nests in areas where vegetation is sparse or absent. This species is a rare summer resident with small nesting colonies on large, open sandbars along major rivers. The pallid sturgeon is a migratory species that inhabits large, turbid rivers with swift current and a firm sand or gravel bottom. Northern long-eared bats and Indiana bats hibernate in caves or mines only during the winter. The rest of the year they roost under loose tree bark or in tree crevices or cavities during the day and forage around tree canopies of floodplain, riparian, and upland forests at night. Trees which should be considered potential roosting habitat include those exhibiting loose or shaggy bark, crevices, or hollows. Tree species often include, but are not limited to shellbark hickory, shagbark hickory, white oak, cottonwood, and maple.

The MDC Natural Heritage Database was accessed in June 2008 and September 2014 prior to field investigations and again in April 2015 for updated county species information. MDC was contacted directly in 2008 due to a Database record of regal fritillary butterflies within Buchanan County, currently state ranked “vulnerable.” MDC Policy Coordination indicated that the regal fritillary record was due to a fifteen year old record of a population located within 6 miles of the Blacksnake Creek Project and that the project area likely did not contain the regal fritillary. This butterfly species is found in areas that contain violets, where they lay their eggs. The Database was queried again in April 2015 for an updated list of Buchanan County sensitive species and habitats. Additional species on the 2015 list include the brassy minnow (*Hybognathus hankinsoni*), state listed as vulnerable, tall agrimony (*Agrimonia gryposepala*), state listed as unrankable, eastern tiger salamander (*Ambystoma tigrinum*), status unrankable, and long-tailed weasel (*Mustela frenata*), state rank S3 (vulnerable). The brassy minnow inhabits pools of small, moderately clear streams with sand or gravel bottoms and little or no current, and also uses seasonally flooded habitats for spawning, recruitment, and growth. This species occurs in a few small tributaries of the upper

Chariton River and rarely in northwest Missouri in the Missouri River and its tributaries, and in two tributaries of the upper Mississippi River (Missouri Fish and Wildlife Information System, 2015). Tall agrimony generally occurs in rocky woodlands and thickets. The eastern tiger salamander occurs in woodlands, swamps, grasslands, and near farm ponds and breeds in fishless ponds or marshes. The long-tailed weasel prefers forests, thickets and brushy fencerows with the presence of water. Heritage Database results from 2015 are included in Appendix B.

2.6.16 Roads

Roads within the project area primarily include Savannah Road to the north, St. Joseph Avenue to the west, Maxwell Road Connector located in the approximate center of the project area, Karnes Road and Northwest Parkway to the south. One resident uses the Maxwell Connector, a private drive, to access St. Joseph Avenue and additional roads to the west of the Maxwell Connector. Roads are addressed in Section 3.2.3 and shown in Figure 3-2.

2.6.17 Socioeconomic Conditions

The U.S, Census Bureau, American Community Survey, five-year estimates 2008-2012, indicates the estimated total population of St. Joseph was 77,176 which is 3.8 percent more than in 2000. The population growth rate is lower than both the state average rate of 7.0 percent and the national average rate of 9.7 percent. The most prevalent races in St. Joseph include white, which represent 88.3 percent of the total population, followed by black (5.2 percent), and persons of Hispanic or Latino origin (5.7 percent). St. Joseph per capita income ($21,440) is slightly lower than Buchanan County ($22,184) and significantly lower than for the state ($25,546) and the nation ($28,051). A larger proportion of St. Joseph's residents (18.4 percent) were below the poverty line than in the state (15 percent) and the U.S. (14 percent). The median age is 35, with 16.7 percent of the population age 62 years and over. The housing stock in St. Joseph of which 53.8 percent was built before 1960, is much older than for the state (31.5 percent) and for the nation (30.3). The average St. Joseph home value of $121,234 was significantly lower than the comparable values for the county ($135,418) and the state (169,314), and was less than half that national value of $254,710.

Additional socioeconomic analysis is presented in Section 2.9.1.

2.6.18 Archaeological and Cultural Resources

A cultural resource background review of the proposed Blacksnake Creek Flood Risk Management Project area was conducted by the Kansas City District (KCD) Archeologist. The review consisted of an examination of the National Register of Historic Places (NRHP); background files in the KCD office; the Missouri Department of Natural Resources (MDNR) Archaeological Viewer (on-line); files supplied by the Missouri State Historic Preservation Office (SHPO); and geological and soil maps were examined to determine if there is potential for unrecorded archeological sites in the area.

The background review found one NRHP listed district, the St. Joseph Park and Parkway System, which crosses the proposed project area. The NRHP district consists

of 983 acres of park land and includes 11.5 miles of parkways and boulevards. Northwest Parkway located along the southern end of the project area is included in this District. Adjacent park elements including a ball park, tennis court, and swimming pool are not considered contributing elements to the historic district.

No archeological sites are mapped within or near the project area or within the proposed spoil deposition areas in St. Joseph and near Elwood, Kansas. However, the project area had not been previously surveyed for archeological sites. The field survey identified no archeological sites. The proposed project location was found to have been largely disturbed by past urban development including construction of a rail bed and roadways, park development, housing and commercial construction surrounding the area, and park development. Because of these previous disturbances, it is unlikely that any archeological sites eligible for the NRHP would be impacted by the project. In compliance with the National Historic Preservation Act, USACE has coordinated and received concurrence of a finding of “no adverse effect” for the proposed project with the Kansas and Missouri SHPO (Appendix B).

2.6.19 Floodplain

The 1 percent ACE floodplain within the project area generally includes the area encompassing the Blacksnake corridor west towards the residences along St. Joseph, Avenue (Figure 2-4), and north past Maxwell Avenue encompassing the creek riparian corridor. At least six major flood events in this area in 75 years have caused major damage to developed properties. The area of most concern is the lower, urbanized portion of the basin, southwest of Karnes Road. This area experiences the most flooding and is served by the CSS. Approximately 101 homes and 42 businesses, utilities, etc. are located within the 1 percent ACE floodplain below Karnes Road. The City participates in the Federal Flood Insurance Program. Upper basin development and floodplain encroachment has historically contributed to increased flood-related risk.

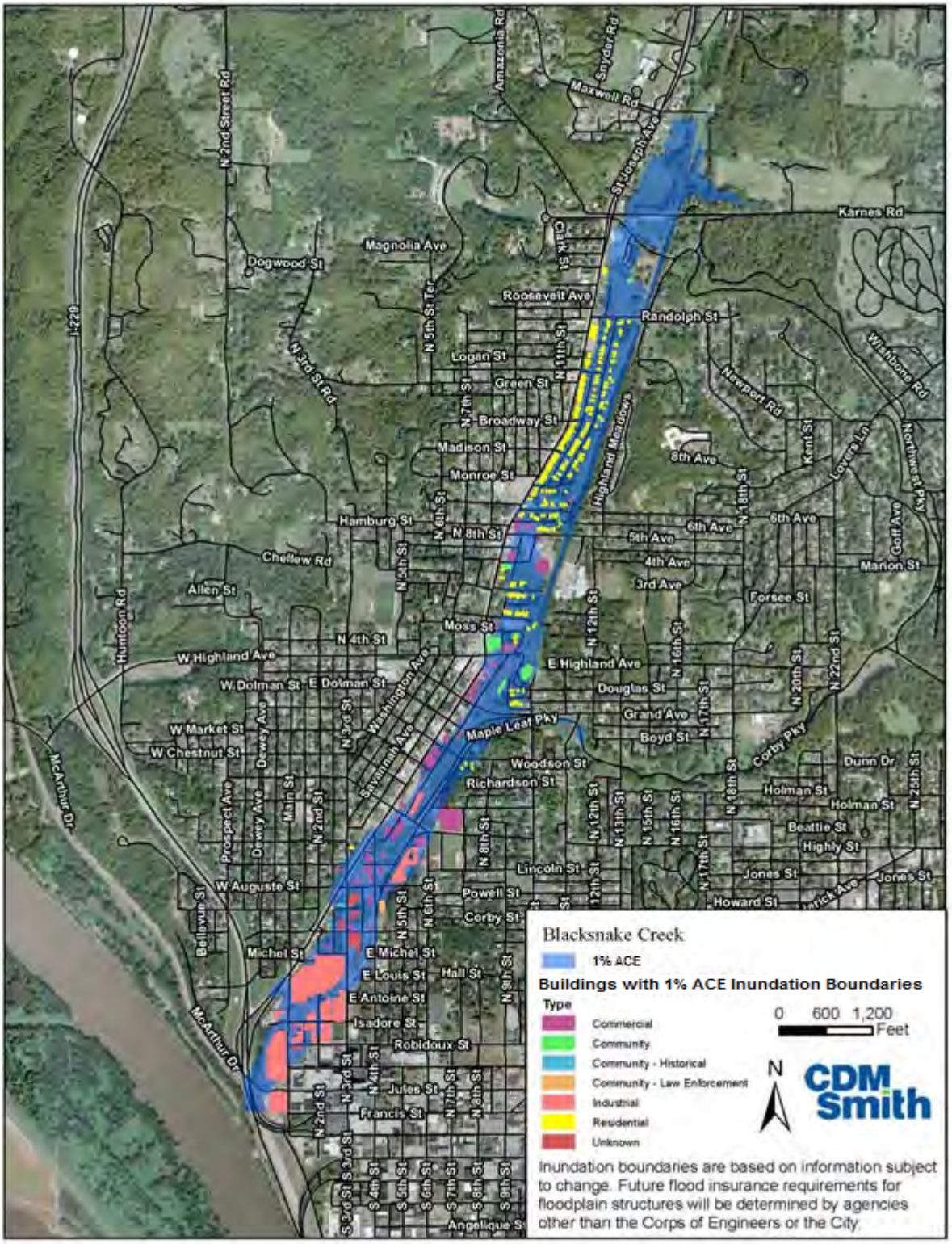

Figure 2-4 Floodplain Inundation Boundaries

2.7 Plan Formulation

Plan formulation included evaluation of structural and non-structural measures. Structural measures are presented in Section 2.7.1. The non-structural measures considered are discussed in the section of the report under Section 2.7.2. While non-structural measures were identified and evaluated a non-structural alternative was not carried through economic screening or presented in the public review draft of the study due to a qualitative determination of overall impracticability for implementation. However, subsequent to this determination, a non-structural alternative was added and was designated as Alternative 9. This alternative was evaluated through the economic screening only. This screening presented in the discussion of economic screening in Section 2.9. Based on the economic screening, this alternative was not determined to be economically viable and was eliminated from further consideration and potential environmental impacts were not evaluated. The screening of Alternative 9 is presented in this report in response to guidance issued subsequent to the public review. This guidance, Corps of Engineers Planning Bulletin 2016-01 requires economic evaluation of non-structural alternatives before eliminating these from further consideration.

2.7.1 Structural Measures

Structural flood mitigation measures reduce flood hazard by keeping the floodwaters away from people and damageable property. The structural measures considered during development of the Recommended Plan included the excavation of a detention basin and construction of a detention dam, levee, and floodwall. Initial plan formulation included the development and engineering review of four dry detention plans for the area north of Karnes Road and east of St. Joseph Avenue, with levels of protection in the range of a 10 to 4 percent ACE flood event. The detention plans included:

- Raising Karnes Road to act as a detention dam, with associated drainage and outlet structures.
- Construction of a levee on the west side of the detention basin from Karnes Road to Savannah Road and a floodwall on the east bank of Blacksnake Creek north of Savannah Road to protect existing residences and structures.
- Excavation of the Blacksnake Creek floodplain north of Karnes Road to increase detention.
- Site grading, utility/sewer relocations and other appurtenances.
- Acquisition/buyout of properties.

The four initial dry detention plan alternatives are shown in Figure 2-5 and briefly outlined below.

Alternative 1 - Alternative 1 raises Karnes Road to elevation 905 North American Vertical Datum (NAVD) to act as a detention dam but includes no excavation of the existing basin to increase storage. This alternative also includes construction of a levee and a floodwall upstream of Karnes Road to provide protection to existing residences and structures. The levee would be located to the east of and parallel to St. Joseph

Avenue. The floodwall would be located farther upstream, just to the north of Savannah Road. In this alternative, an overflow spillway at Karnes Road would be the point of overtopping.

Alternative 2 - Alternative 2, in addition to the features of Alternative 1, would excavate the detention basin within the Blacksnake Creek floodplain north of Karnes Road between St. Joseph Avenue and an abandoned railroad right-of-way to increase the detention capacity.

Alternative 3 - Alternative 3 would increase the detention capacity of Alternative 2 by extending the detention area to the east of the abandoned railroad right-of-way. The abandoned railroad right-of-way would be removed to access the additional detention volume to the east.

Alternative 4 - Alternative 4 would increase the detention capacity of Alternative 3 by removing a portion of Karnes Road, extending the levee downstream of Karnes Road to Northwest Parkway, and additional excavation within the basin area. This alternative does not include the replacement of Karnes Road. In this alternative, an overflow spillway at Northwest Parkway would be the point of overtopping.

For Alternatives 1-4, estimating assumptions were made for structures (detention dam, levee, etc.), geotechnical and civil/utilities modifications, and relocations. Primary material quantities, labor, land acquisition, and design cost estimates were used to develop a preliminary cost estimate for each alternative. USACE agency technical review was conducted of these alternatives. The review resulted in recommendations for more robust design of structural features (levee and Karnes Road detention dam) that would significantly increase the estimated implementation costs for each of these alternatives.

Figure 2-5 Detention Plan Alternatives 1 through 4

Based on the initial value engineering (VE) review of the alternatives and discussions regarding the relatively high costs of the initial alternatives with the sponsor, and on

public comment (negative views of locating levees and floodwalls behind the residences along St. Joseph Avenue), three additional alternatives were developed using the natural topography and a lower pool height to eliminate the need for the traditional and costly structures (detention dam, levee, and floodwall) in Alternatives 1 through 4. Alternatives 1-4 are presented in this report and were carried through the analysis; however, additional refinement (development of more detailed implementation phase costs) was not conducted on these alternatives after the initial formulation because these alternatives were already too costly and would not be reasonably expected to result in favorable net economic benefits compared to other alternatives. The structural features (dam, levees, and floodwalls) would have required more design considerations for safety assurance, further increasing costs.

The City original goals were for a project that would provide for flood protection for the 1 percent ACE flood event, however due to the high costs and the potential for additional costs associated with safety assurance considerations, additional formulation was conducted. The newly formulated alternatives would eliminate the need for the built-up structures but would look at best options for locating and sizing the basin. The sponsor recognized that these alternatives would not perform at the 1 percent ACE event. However, there was interest in seeing if significant flood damage reduction benefits could be achieved with a smaller project.

Three additional alternatives (5, 6 and 7), were developed that did not include a levee, floodwall or dam feature but would instead rely on existing topography and excavation to create a detention basin. The detention plan for Alternatives 5, 6, and 7 are shown in Figure 2-6 and outlined below:

Alternative 5 - The Blacksnake Creek floodplain north of Karnes Road between St. Joseph Avenue and an abandoned railroad right-of-way would be excavated to increase the detention capacity. The abandoned railroad right-of-way along the east side of the basin would be removed to access additional detention volume to the east. An overflow spillway would be constructed at an elevation of 895 NAVD on Karnes Road. In this alternative, an overflow spillway at Karnes Road would be the point of overtopping.

Alternative 6 - Alternative 6 would increase the detention capacity of Alternative 5 by excavating the area between Karnes Road and Northwest Parkway. Culverts would be constructed to provide a connection between the areas north and south of the Karnes Road. In this alternative, an overflow spillway constructed at an elevation of 895 NAVD at Northwest Parkway would be the point of overtopping.

Alternative 7 - Alternative 7 would increase the detention capacity of Alternative 6 by expanding the basin north of Karnes Road to the west. This alternative would require the purchase and demolition of the residences on the west side of the basin along St. Joseph Avenue. In this alternative, an overflow spillway constructed at an elevation of 895 NAVD at Northwest Parkway would be the point of overtopping.

As part of the reformulation effort, a new Hydrologic Modeling System (HMS) model and HEC-RAS model were developed, and structural alternatives (1-7) were evaluated for performance using the updated models.

Subsequent to the development of Alternatives 1 through 7, the City approved a transportation plan that included the City's abandonment of the Karnes Road section crossing the basin. Therefore, one additional alternative that excavates the abandoned Karnes Road was formulated. The detention plan for Alternative 8 is shown in Figure 2-6 and briefly outlined below.

Alternative 8 - Alternative 8 modifies Alternative 6 by removing Karnes Road. The removal of Karnes Road reduces the construction cost by eliminating the need to raise, reconstruct, and armor the road, and for the installation of culverts to provide a hydraulic connection between the basin areas north and south of the road. Alternative 8 also uses the volume gained by the removal of Karnes Road to construct utility pads around three 161 kilovolt (KV) power poles that were to be relocated under Alternative 6 while maintaining the same detention volume. While the detention volume remained the same, the screening level costs were reduced by approximately $1 million.

The Blacksnake Creek base flow currently enters a combined sewer inlet at Karnes Road. It is the City's intention to construct a separate storm water conveyance and to re-direct the base flow from Blacksnake Creek to the new storm water conveyance. This conveyance, when built, will be retrofitted to the detention basin. The combined effect of a detention basin and the separate storm water conveyance would result in both flood damage reduction benefits for the downstream community and a reduction in the amount of combined sewer flow that requires treatment at the City's sewage plant. The City's planned separate storm water conveyance was analyzed for its potential impact to the flood risk reduction project. It was determined that it would not negatively affect the performance of any of the alternatives.

Figure 2-6 Detention Plan Alternatives 5 through 8

2.7.1.2 Localized flood reduction measures

Localized flood reduction measures, such as berms or floodwalls, are effective in preventing floodwaters from reaching buildings and other structures. A berm is typically an earthen structure constructed out of suitable local materials (e.g., impervious soils). Floodwalls are usually constructed out of reinforced concrete and anchored into the ground. Floodwalls are generally considered only for properties that are too small for berms or where flood velocities may erode earthen berms. Based on the field visit and review of available geographic information system data, locations where berms or floodwalls could mitigate flooding without causing significant increases in floodwater surface elevations were identified. These were sited to protect buildings on the flood fringe as well as any buildings of historical or community value. The potential locations of localized flood reduction measures are shown in Figures 2-7, 2-8, 2-9 and 2-10. General information for each is summarized in Table 2-1.

The localized flood reduction measures identified would remove up to 47 residential and up to 43 non-residential buildings from the 100-year floodplain, leaving approximately 98 buildings in the floodplain. These remaining buildings could not be protected by flood reduction measures, as doing so would be impractical due to site constraints or would encroach upon the flow path of flood waters, resulting in significant increases in water surface elevations. The estimated cost for design and construction of the localized flood reduction measures is $8.3 million. This estimate is a high level preliminary screening cost that does not include associated costs such as:

- Easements and land acquisition.
- Road crossings over the berms.
- Road crossings through floodwalls.
- Rerouting traffic patterns around berms and floodwalls.
- Drainage systems to convey water from behind the berms and floodwalls. Depending on the drainage area to the flood reduction measure, the drainage system required could range from a small gravity system to a large pump system.
- Utility relocation at floodwall sites. It is expected that the foundations for floodwalls would extend to the frost line or below, and any utilities, including sanitary sewers, storm sewer, gas, water, and any others, which intersect the floodwall site would need to be rerouted.

These additional factors would have a major impact on the design and construction of localized flood reduction measures and the final cost would be significantly higher.

Table 2-1 Summary of Localized Flood Reduction Measures

Localized Flood Reduction Measure	Length (feet)	Number of Residential Buildings Removed from 100-year Floodplain	Number of Non-residential Buildings Removed from 100-year Floodplain	Potential Major Utility Conflict?	Dry-Side Drainage System Required?	Potential Traffic Rerouting?	Long-Term Maintenance Required?
Berm 1	230	2	1	No	Yes	No	Yes
Berm 2	400	0	2	No	Yes	No	Yes
Berm 3	720	0	3	No	Yes	Yes	Yes
Berm 4	700	0	4	No	Yes	Yes	Yes
Floodwall 1	280	0*	0*	Yes	No	No	Yes
Floodwall 2	420	0	1	No	Yes	Yes	Yes
Floodwall 3	290	0	1**	Yes	Yes	No	Yes
Floodwall 4	1,960	0	1	Yes	Yes	No	Yes
Floodwall 5	2,080	0	10***	Yes	Yes	Yes	Yes
Floodwall 6	410	0	1***	Yes	Yes	No	Yes
Elevate Road 1	230	-	-	No	No	No	No
Elevate Road 2	350	-	-	No	No	No	No
Elevate Road 3	950	-	-	No	No	No	No

* Floodwall 1 protects a community pool
** Floodwall 2 protects Robidoux Row Museum, which is listed on the National Historic Record
*** Floodwalls 3 and 4 protect WireCo WorldGroup Factory, which is listed on the National Historic Record

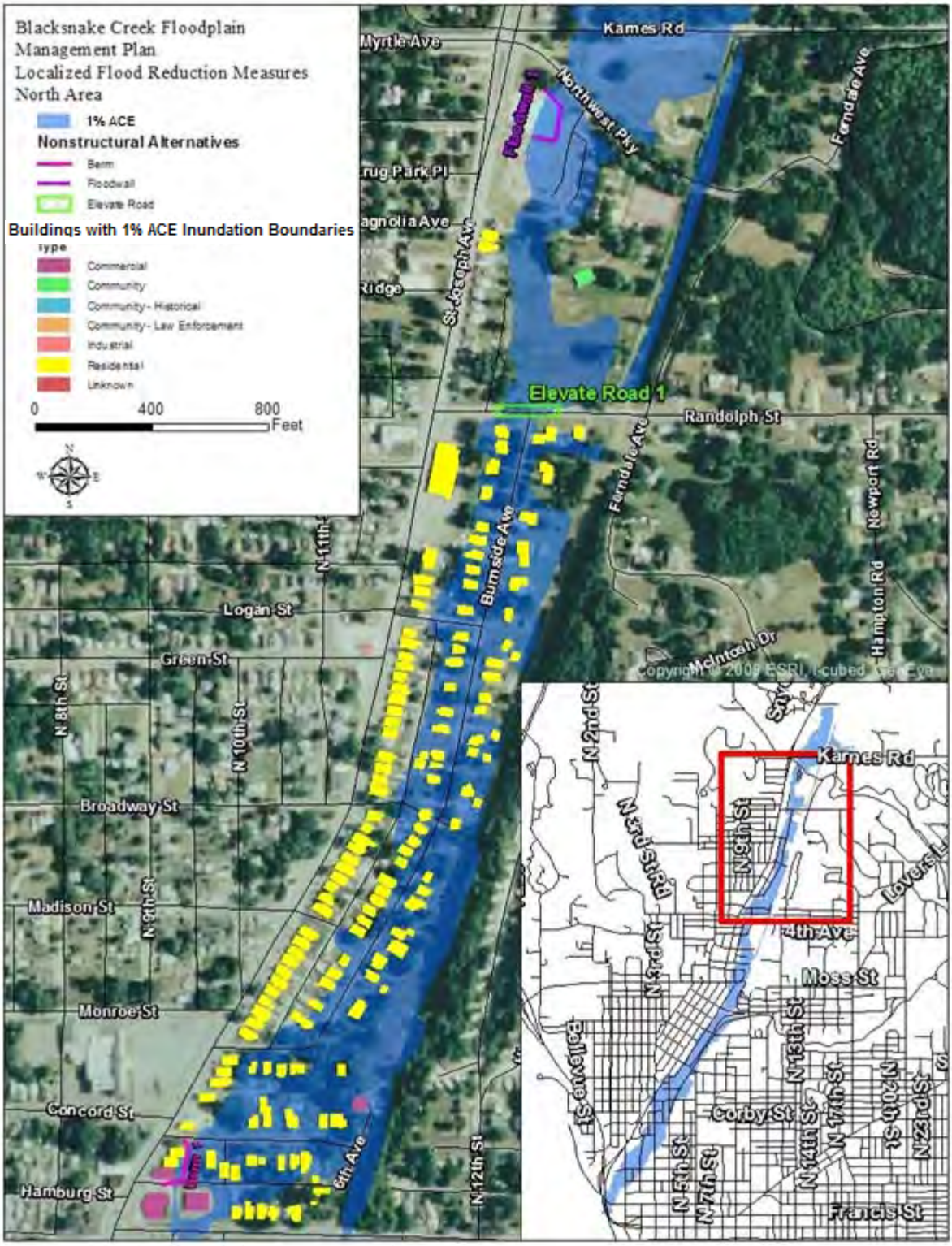

Figure 2-7 Localized Flood Reduction Measures North Area

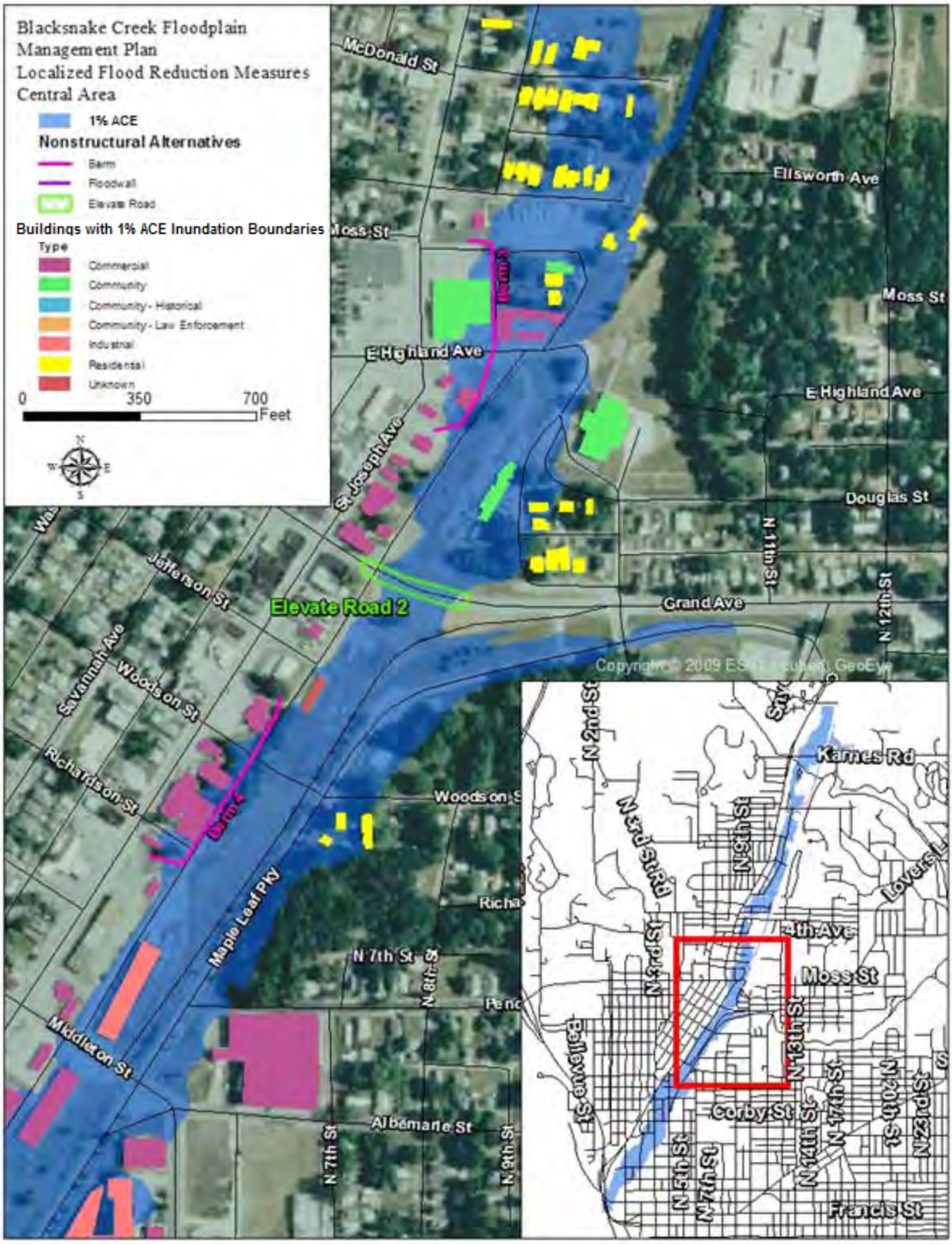

Figure 2-8 Localized Flood Reduction Measures Central Area

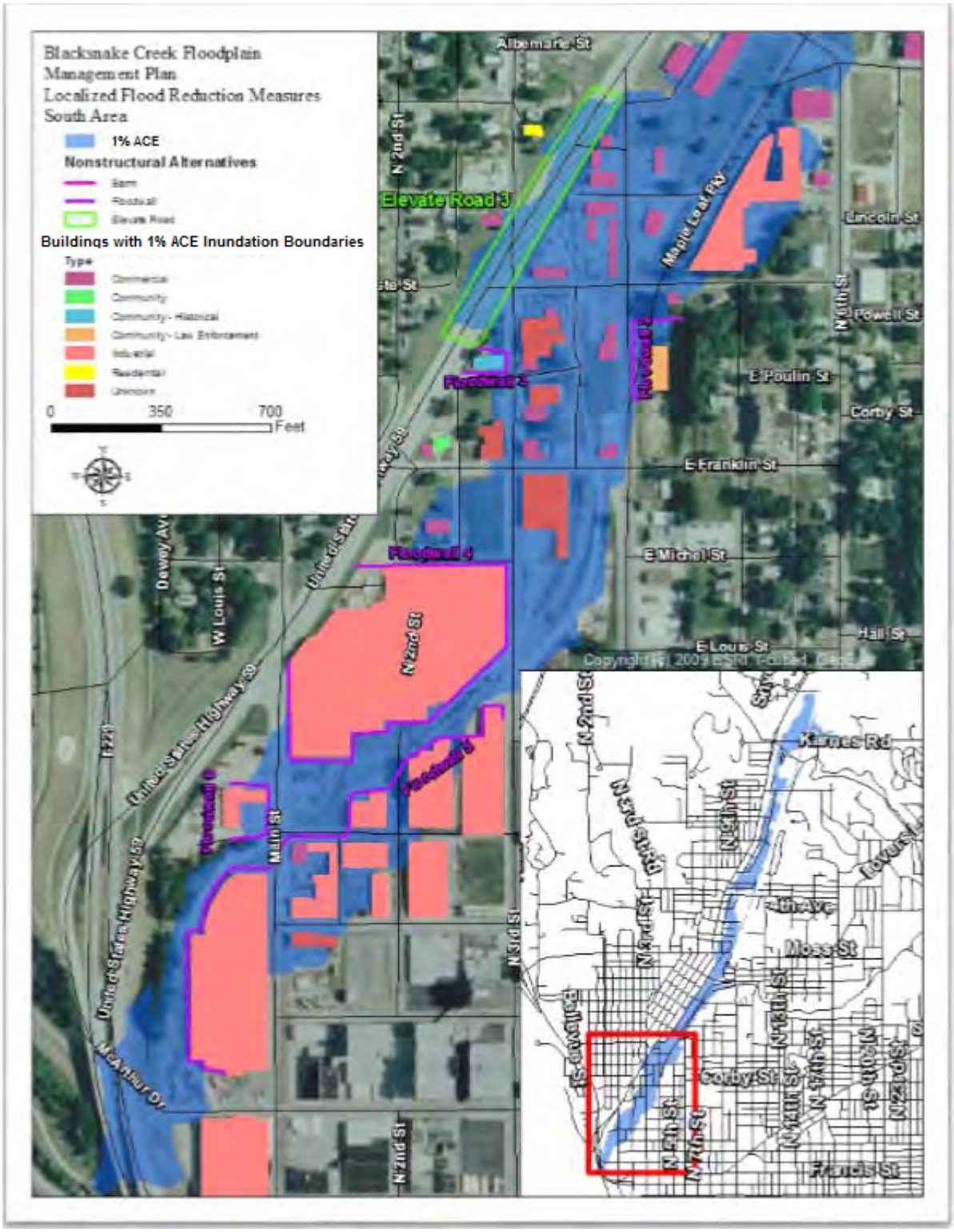

Figure 2-9 Localized Flood Reduction Measures South Area

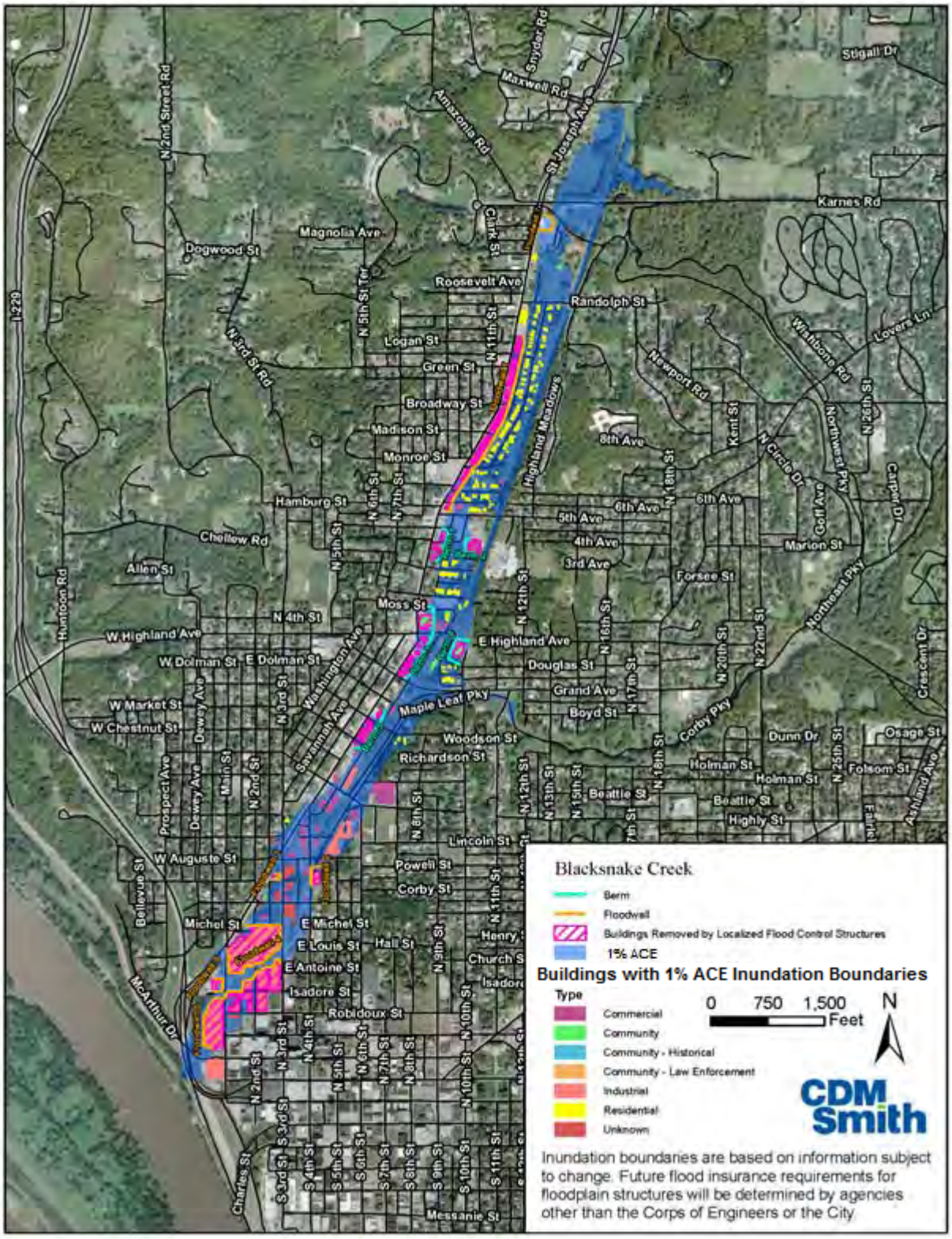

Figure-2-10 Localized Flood Reduction Measures – Full Area

Berms and floodwalls could remove a substantial number of buildings from the floodplain. However, as a stand-alone measure, they would not provide comprehensive flood risk reduction and would leave a significant number of structures at full risk. In addition, while localized measures reduce flood risk to buildings in the form of economic damages, they do not necessarily protect the population at risk dispersed throughout and nearby the floodplain during flash floods and would likely meet with community disapproval for this reason. When considered along with seepage considerations, extensive road modifications, building and foundation impacts, lands and utility impacts and other LERRD factors, the costs would be well beyond and ineffective compared to the detention array considered. These measures were not integrated into the Recommended Plan because implementation costs are relatively high and would add significantly more costs than benefits.

Select localized flood risk management measures were identified as measures with potential to address residual risk in the future and are included in the draft floodplain management plan prepared for the sponsor as part of the feasibility study process.

2.7.2 Nonstructural Measures

Several types of nonstructural measures were considered during preliminary evaluation and screening. The intent of nonstructural measures is to reduce the damages and consequences caused by the flooding by modification or relocation of property susceptible to flooding or through implementation of community warning and evacuation procedures. The measures do not prevent flooding from occurring by means of flood flow modification as would occur with implementation of structural measures. Measures considered for the Blacksnake Creek study area included flood proofing, elevation and acquisition/relocation. The Flood Damage Reduction Matrix (Figure 2-11) developed by the National Nonstructural Flood Proofing Committee of USACE for use in screening decisions involving nonstructural measures was consulted in each case. Specific types of non-structural measures considered in early phases of the study are summarized below.

FLOOD DAMAGE REDUCTION MATRIX	FLOOD DAMAGE REDUCTION MEASURES																		
	NON-STRUCTURAL MITIGATION MEASURES															STRUCTURAL MITIGATON MEASURES			
														NFIP					
	Elevation on Foundation Walls	Elevation on Piers	Elevation on Posts or Columns	Elevation on Fills	Elevation on Mill	Relocation	Buyout/ Acquisition	Floodwalls and Levees	Floodwalls and Levees with Closures	Dry Flood Proofing	Wet Flood Proofing	Flood Warning Preparedness	Flood Plain Regulation	Flood Insurance	Flood Mitigation [1]	Channel	Levee/Wall	Dams	Diversions
Flooding Characteristics																			
Flood Depth																			
Shallow (<3 ft)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Moderate (3 to 6 ft)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Deep (greater than 6 ft)	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Flood Velocity																			
Slow (less than 3 fps)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Moderate (3 to 5 fps)	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Fast (greater than 5 fps)	N	N	N	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Flash Flooding																			
Yes (less than 1 hour)	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
No	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ice and Debris Flow																			
Yes	N	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
No	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Site Characteristics																			
Site Location																			
Coastal Flood Plain																			
Beach Front	N	N	N	Y	N	Y	Y	N	N	N	N	Y	Y	Y	Y	N	[7]	N	N
Interior (Low Velocity)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N
Riverine Flood Plain	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Soil Type																			
Permeable	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Impermeable	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Building Characteristics																			
Structure Foundation																			
Slab on Grade	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Crawl Space	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Basement	Y	N	N	N	N	Y	Y	Y	Y	N	Y	Y	y	Y	Y	Y	Y	Y	Y
Structure Construction																			
Concrete or Masonry	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Metal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wood	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Structure Condition																			
Excellent to Good	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fair to Poor	N	N	N	N	N	N	Y	Y	Y	N	N	Y	Y	Y	[5]	Y	Y	Y	Y
NED/NER/Recreation/Social Characteristics																			
Economic																			
Structure Protected	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	[5]	N	Y	Y	Y	Y	Y
Cost to Implement	M	M	M	M	M	H	H	M	M	L	L	L	L	L	H/M	H	H	H	H
Potential Flood Insurance Cost Reduction (Residential)	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	Y	-	Y	Y	Y	Y	Y
Potential Flood Insurance Cost Reduction (Commercial)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	-	Y	Y	Y	Y	Y
Potential Adverse Flooding Impact on Other Property	N	N	N	N	Y	N	N	Y	Y	N	N	N	Y	N	N	Y	Y	Y	Y
Reduction in Admin Costs of NFIP	N	N	N	N	Y	Y	Y	N	N	N	N	N	[5]	-	[5]	[7]	[7]	[7]	[7]
Reduction in Costs of Disaster Relief	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Reduction in Emergency Costs	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	[5]	Y	Y	Y	Y
Reduction in Damage to Public Infrastructure	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	[5]	Y	Y	Y	Y
Potential for Catastrophic Damages if Design Elevation Exceeded	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	Y	Y	N
Promotes Flood Plain Development	N	N	N	N	N	N	N	N	N	N	N	N	N	[8]	N	Y	Y	Y	Y
Environmental																			
Ecosystem Restoration Possible	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N
Potential Adverse Environmental Impact	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y
Recreation																			
Recreation Potential	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	[5]	N	N	Y	N
Social																			
Community Remains Intact	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	[5]	Y	Y	Y	Y
Population Protected	N	N	N	N	N	Y	Y	N	N	N	N	Y	N	N	[5]	Y	Y	Y	Y
Potential Structure Marketability Increase	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	[5]	N	Y	Y	Y	Y	Y

[1] NFIP Flood Mitigation may vary but it is usually bu acquisition or elevation
[2] Not generally recommended
[3] Buyout/acquisition only
[4] Elevation only
[5] Post FIRM construction only
[6] Post FIRM structures elevation on fill
[7] Yes, if project provides 100 year or greater protection
[8] Yes, if in flood plains less frequent than the 100-year

Y= Applicable
N-Not Applicable
M-Medium Cost
L-Low Cost
H-Hig Cost

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The US Army Corps of Engineers National Nonstructural/Flood Proofing Committee (NFPC) is available to assist in any aspect of formulating and implementing nonstructural flood damage reduction measures and realizing the opportunities that exist with nonstructural.

For more information, please contact the NFPC Chairman, Mr. Joe Remondini at 918-669-7198/ e-mail joseph.remondini@usace.army.mil or contact the NFPC website at www.nwo.usace.army.mil/newinternet/nfpc/pages

Figure 2-11 Non-Structural Measures Matrix

Flood Proofing

Flood proofing consists of activities to modify buildings or their contents to keep water out or to reduce damage caused by water exposure. Typical flood-proofing methods include raising existing contents and equipment or rearranging or protecting damageable property within an existing structure (i.e., wet flood proofing); or temporary and permanent closures for openings in existing structures (dry flood proofing).

Dry flood proofing involves sealing buildings to prevent the entry of floodwaters into structures and is applicable in areas of shallow, low velocity flooding. Dry flood-proofing measures were considered, both as a primary means of flood risk reduction and as a means of reducing residual risk alongside a structural project. The appropriateness of these measures was considered in regard to construction types, structure age and physical condition, and flooding characteristics:

- Construction types – Typical residential structures in the study area are shown in Figure 2-12. Residential structures here are predominantly of the older wood-frame type, which generally are not considered good candidates for dry flood proofing since they are difficult to effectively seal. In addition, a high percentage of the residential structures in the study area have either basements or crawl spaces at their foundations, which is an additional obstacle to sealing. Newer commercial and industrial buildings in the study area ("newer" meaning approximately 40 years to 50 years old in general) are predominantly metal. Metal structures, like wood-frame structures, are generally considered undesirable for dry flood-proofing measures since they are difficult to adequately seal. Not all of these characteristics would make it impossible to use dry flood-proofing measures, but they would in all likelihood make it much more expensive.
- Age and condition – Advanced age and lower-than-average physical condition are typical of structures in the study area, particularly residential structures. Dates constructed are available for 83 percent of the homes in the study area, and within this large sample (which includes structures throughout the study area and is therefore reasonably representative of the entire housing stock) the average age of homes is 97 years. Commercial and industrial buildings in the study area are in general somewhat newer than the residential stock, but even most of these structures are approximately 40 years to 50 years old. As might be expected of older structures still in use, most of the structures in the floodplain, both residential and commercial/industrial, are in fair (that is, below average) condition. Advanced age and below-average condition indicate the potential for structural soundness issues that would preclude dry flood proofing.
- Flooding patterns – Blacksnake Creek floods are flash floods with rapid build-ups to peak stages and higher than average flow velocity. Dry flood-proofing measures usually require some warning time for structure occupants to carry out protective measures, but adequate warning time is unlikely to be available in most Blacksnake Creek flood events. The high flow velocity is also a concern since it creates an increased potential for scour, which could exacerbate structural integrity concerns among the predominantly aged, wood-framed residential buildings in fair (below average) condition.

All in all, based on the Flood Damage Reduction Matrix, dry flood proofing would be disqualified in the Blacksnake study area by five different considerations: flood velocity, flash flooding, basement foundations, wood and other construction, and fair building condition. This measure was eliminated from further consideration.

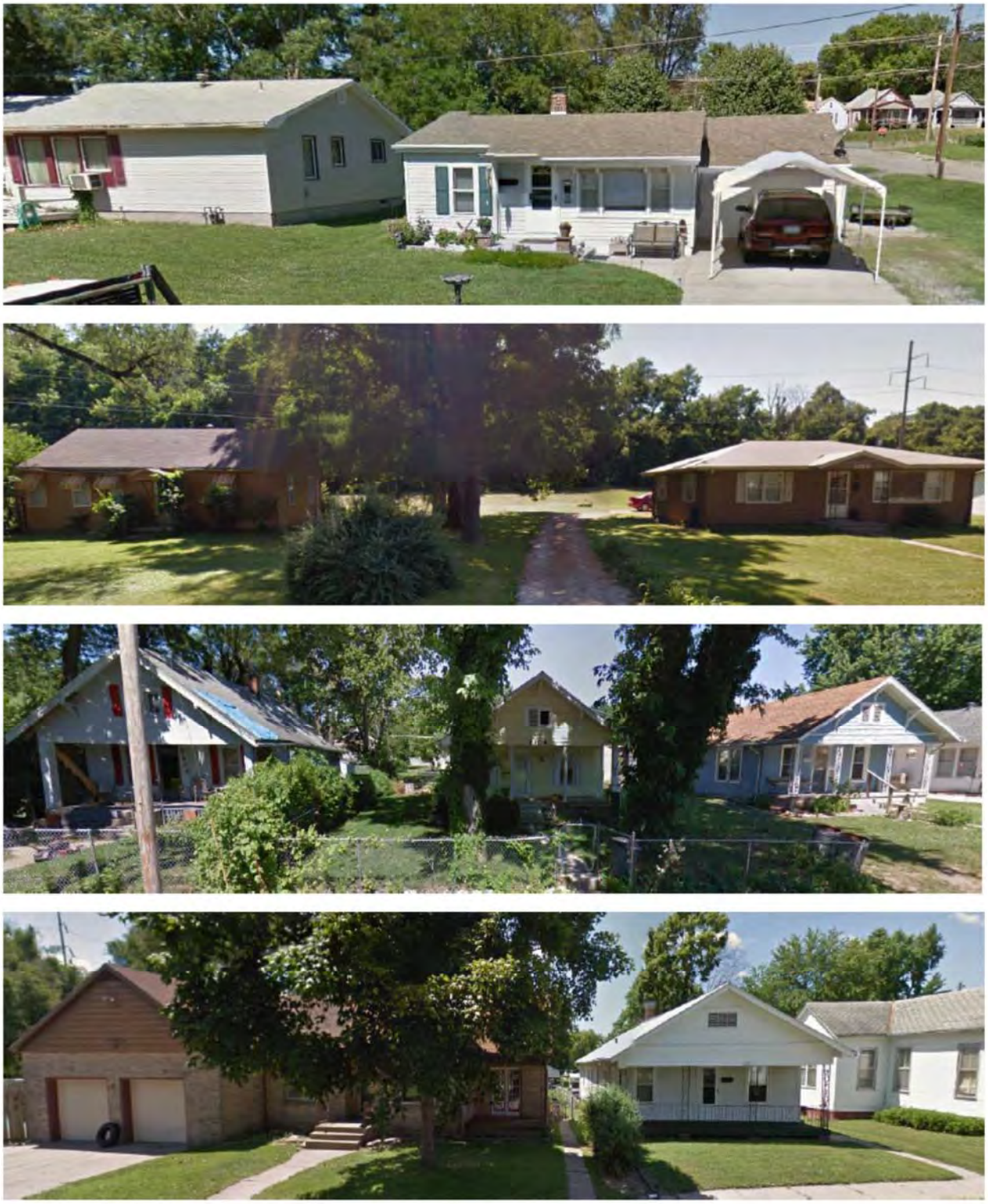

Figure 2-12 Typical Residential Structures in Blacksnake Creek Floodplain
Wet flood proofing relocates or waterproofs vulnerable items such as utilities, appliances, and furnaces from floodwaters that enter the structure. Wet flood proofing

can reduce but not eliminate the risk of structural damage. All items that would be exposed to water must be resistant to water damage. Wet flood proofing is usually discouraged for residential structures and is most often used for commercial and industrial structures, where it can take on a wide variety of applications about which it would be difficult to generalize; certain types of wet flood proofing might be useful in some cases. It should be noted that two of the largest companies in the study area, WireCo and Lawhon Construction, already have existing emergency plans that include appropriate wet flood-proofing measures, limiting the potential annualized economic benefit of further such measures. In addition, one important limitation of wet flood-proofing measures is that significant warning time usually is required to implement the measures. This makes the measures more appropriate in slow-building main stem flood events than in flash floods such as those that typically occur in the Blacksnake Creek floodplain. The decision support matrix in Figure 2–11 indicates that wet flood proofing should be screened out for the Blacksnake study area due to at least four factors (high flow velocity, flash flooding, wood or metal building construction, and fair or poor building condition). In light of these considerations, wet flood proofing was eliminated from further consideration for the array of study alternatives, but certain businesses might be able to investigate and develop individualized flood proofing schemes that would be of some benefit to them.

Structure Elevation

Raising or elevating a structure reduces the frequency and/or depth of flooding during high-water events. Elevation techniques include lifting the home and adding to or building a new foundation, building an elevated floor within the home, or adding a new upper story and converting the ground level to an enclosure used only for parking, access, or storage. A preliminary plan was considered to raise all structures within the 1 percent ACE floodplain to a first-floor elevation of one foot above the 1 percent ACE water surface elevation. However, economic feasibility is a potential concern since elevation plans tend to be expensive. The cost of physically raising an average-sized home is typically $90,000 to $100,000, based on the nonstructural analysis prepared for the Fargo-Moorhead Metropolitan Area Flood Risk Management report in 2010 as well as a 2015 KCD nonstructural analysis for Manhattan, Kansas. In addition to the cost of raising the structures, most residential structures in the study area have basements that would need to be filled in, adding a cost to fill the basement and an additional cost to recompense the reduced structure value of the home due to loss of the functional basement. Alternatively, it might be possible to construct a new space beside the structure and above the one percent water surface elevation to replace the lost basement, but this would be unlikely in most of this area given the density of development. In any case, this approach would simply switch the cost items from fill and lost structure value compensation to the cost of building the addition. Temporary hotel lodging, moving and storage and administrative costs would be additional cost items for residential structures. Commercial/industrial buildings are even more difficult to raise economically since their construction types are very diverse and usually require non-standard elevation methods.

Economic feasibility would be doubtful for an elevation plan, but a bigger obstacle would be technical feasibility due to the typical age and condition of the buildings and the

nature of the flood risk in the Blacksnake floodplain. For raises, the structural integrity of the existing building is necessary, but as already discussed, structures in the study area tend to be in below-average condition, due in large part to advanced age. The Flood Damage Reduction Matrix in Figure 2-11 indicates that raises are not recommended when structure condition is fair or poor due to structural integrity concerns. The matrix additionally indicates that elevation is not recommended in a context of flooding conditions with moderate or high flow velocities such as would be experienced along Blacksnake Creek during flash flooding. An elevation alternative also is unlikely to be acceptable to this community. For these reasons, an elevation plan was eliminated from further consideration.

Structure Acquisition/Demolition and Relocation

Structure acquisition/demolition and relocation are measures that involve vacating structures from the 1 percent ACE floodplain to not merely reduce but eliminate their flood exposure while allowing new land uses consistent with wise floodplain management. Figures 2-4 and 2-10 illustrate the extent of structures within the 1 percent ACE floodplain, extending through residential, commercial, and industrial areas of the City. The 1 percent floodplain contains 146 residential and commercial/industrial structures that would need to be acquired or relocated.

Relocation plans involve moving structures to new locations outside the floodplain. The structures must be in good enough condition to survive the move, and the Flood Damage Reduction Matrix indicates that this measure is not recommended in cases of the fair to poor structure condition that is characteristic of the Blacksnake study area. Due to these limitations pertaining to technical feasibility, relocation measures were not carried forward for further analysis.

Acquisition or buyout plans involve the purchase of both land and structures in the floodplain, which are then dismantled. Acquisition would be technically feasible but would likely be economically impractical due to the large number of homes and businesses in the flood prone area and the unlikelihood that buyouts could be successfully implemented in a contiguous or comprehensive plan. The average depreciated replacement value for a residential structure in this study, in 2012 dollars, is $56,000, and for commercial/industrial buildings, the average is $488,000. (This total is skewed by a few very large industrial structures.) The total estimated depreciated replacement value for the 146 structures in the 1 percent ACE floodplain was more than $33 million in 2016 dollars, not including land costs or other costs that would be required in a buyouts plan, such as relocation assistance and administrative costs. Buyouts of these structures would significantly reduce the City's tax base and would harm the urban, cultural and economic integrity of the St. Joseph Avenue Corridor, which would be unacceptable to the sponsors and would potentially cause adverse socioeconomic impacts such as destabilization of the community. However, since acquisitions, unlike most other nonstructural measures that might be proposed for this area, would at least be technically feasible, an acquisition alternative was carried forward into the screening of alternatives for further analysis and consideration.

In summary, the nonstructural flood risk management measures considered as comprehensive plans for the Blacksnake floodplain would not be technically feasible except for buyouts and do not, in most cases, warrant benefit-cost analysis. In addition, the measures, or a combination of these measures, would not meet the constraints imposed by the City's storm water improvement plan. That said, could nonstructural measures be combined with a more comprehensive structural plan to further reduce flood risk at the margin? From an NED economic standpoint, comprehensive structural alternatives such as those formulated for this project, which involve detention located upstream of the study area that reduces flood peaks along the entire downstream floodplain, potentially provide very efficient approaches to attaining a high level of flood risk management in all but the more extreme events. Localized risk reduction beyond the NED plan's performance levels would involve ameliorating the impacts of extreme floods, which is difficult to do in an economically efficient manner. Flood proofing is not suited for the inundation levels of extreme events, and any nonstructural approach would encounter high costs at the margin combined with limited overall improvement in flood risk management performance, resulting in an extremely limited potential for additional annualized NED benefits. From the standpoint of federal interest, these measures were not considered further for combination with a structural plan. However, if a comprehensive structural plan is implemented, the sponsor acting on its own may subsequently wish to investigate localized measures to further reduce residual risk.

2.7.3 Floodplain Management

Floodplain management is the operation of a community program of corrective and preventative measures for reducing flood damage. These measures take a variety of forms and generally include zoning, subdivision, or building requirements, and special-purpose floodplain ordinances.

A draft Floodplain Management Plan was developed as part the cost-shared Feasibility Study. The draft Floodplain Management Plan outlines applicable city floodplain policies and ordnances and identifies a recommended action and implementation plan. The sponsor will continue to evaluate local measures for flood risk reduction as they finalize their Floodplain Management Plan, including with input and data from USACE design process as the design effort is underway. The Floodplain Management Plan will remain in draft form pending construction of a project, at which time the City may elect to update and implement the Recommended Plan. The City maintains emergency response through its Emergency Operations Plan. Floodplain regulation is accomplished through the City's Floodplain Management Ordinance.

One of the potential action items identified is to implement localized flood reduction measures to supplement the dry detention project once it is in place. The localized measures would target habitable structures remaining in the floodplain after the implementation of the project that could benefit from being better protected from flood hazards. Some structures could potentially be removed from the 1 percent ACE floodplain with the construction of free standing structures such as small berms or floodwalls. This could serve to complement the effectiveness of the detention basin in further reducing damages. The implementation of these actions are separate actions that may be pursued after the project is in place and were not included with the

performance analysis of the structural alternatives. The City implements applicable measures through their Emergency Operations Plan, floodplain ordnance, land use plan, and storm water code to address flood and storm water management within the City limits.

The flood-fighting (non-structural) measure attempts to reduce flood damages and address all objectives through temporary means implemented during a flood event. Plans for flood fighting procedures are in-place under the City's Emergency Operations Plan. This plan includes plans related to emergency warning, disaster response, post disaster assessment, and communication. The Emergency Operation Plan addressed multiple types of disaster events, including flood events and applies to the portions of the Blacksnake Creek watershed that lies within the City limits. Due to the temporary nature of any flood-fighting measure it offers no complete or effective long-term solutions for major flood risk management problems. Additional measures for flood fighting beyond existing response measures implemented through the City's Emergency Operation Plan were not identified and carried forward for the study.

Land use planning measures are implemented through the City's Floodplain Management Ordinance and the City's Land Use Plan. The development of the Floodplain Management Ordinance and the Land Use Plan include setting restrictions for development where land is unsuited for such development due to potential flood hazards.

The City Floodplain Management Ordinance is found in Chapter 31 of their Code of Ordinance. Article IV Floodplain Management Section 31-200 to Section 31-225. The purpose of this ordinance is to minimize losses related to periodic flood inundation, including: loss of life and/or property, hindered health and safety, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base. Additionally this code was adopted as part of the eligibility requirement for the National Floodplain Insurance Program. The Floodplain Management Code focuses on the following areas: Restricting or prohibiting uses which are dangerous to health, safety, or property in times of flooding or which cause increases in flood heights or velocities, requiring uses which are vulnerable to floods, including public facilities to be provided with flood protection at the time of constructions, and protecting individuals from buying lands with are unsuited for proposed development purposes due to flood hazard.

The City's 2004-2024 Land Use Plan's purpose is to provide a framework which will direct future growth in the City. Specific goals in this plan include: preventing development from occurring in environmentally sensitive areas such as floodplains and wetlands; minimizing development in floodplain areas which represent a threat to public health, safety, individual welfare, and the economic viability of property; and supporting the development of conservation focused designs.

The Floodplain Management Ordinance and the City Land Use Plan are applicable to all development, re-development, and capital improvement activities within the Blacksnake Creek watershed within the City limits. No new measures for land use planning or ordinances were identified and carried forward for the study.

2.8 Hydrologic and Hydraulic Analysis

Hydrologic studies involve estimating the discharges or flows resulting from rainfall runoff associated with specific design storms, while hydraulic studies use the resultant hydrology flows to estimate water surface elevations along a creek or river. The Blacksnake Creek hydrologic and hydraulic analysis is summarized below. A detailed account of this analysis is provided in Appendix C.

2.8.1 Previous Hydrologic and Hydraulic Studies

A Flood Insurance Study was published for the City of St. Joseph, Missouri in September 1984. The study included flood profiles for Blacksnake Creek that were mapped from its confluence with the Missouri River up to the City's corporate limits, approximately 4.2 miles. It was noted in the Flood Insurance Study that peak discharges were based on data previously developed by USACE in 1979; however the actual discharges used were not listed. Other studies that included hydrologic and hydraulic evaluations for Blacksnake Creek are noted in Section 1.5 of this report.

2.8.2 Existing Conditions Hydrologic Analyses

A hydrologic evaluation of the Blacksnake Creek watershed in St. Joseph, Missouri, was conducted using USACE, Hydrologic Engineering Center - Hydrologic Modeling System (HEC-HMS), Version 3.5, computer model. The HEC-HMS model was used to simulate the existing conditions runoff hydrographs resulting from rainfalls corresponding to the 100, 50, 20, 10, 4, 2, 1, 0.4, and 0.2 percent ACE storm events. Estimates of rainfall for the noted return periods were originally developed using the Rainfall Frequency Atlas of the Midwest (Bulletin 71). However, since the initial development of the Blacksnake Creek HEC-HMS model, updated rainfall estimates for the Midwestern States were published by the National Oceanic and Atmospheric Administration (NOAA) in 2013. The report is titled "NOAA Atlas 14 – Precipitation Frequency Atlas of the United States – Volume 8 – Version 2.0: Midwestern States." Because this update was released prior to finalizing the feasibility study report the rainfall estimates have been modified to reflect the most current data.

The HMS model divides the watershed into 32 subareas ranging in size from 84 acres to 313 acres and aggregates the flows from this network of contributing subareas into discharges at various points within the channel and watershed. The model takes into account characteristics of the basin such as land use, imperviousness, channel length, and channel slope to estimate discharges. Figure 2-13 depicts the Blacksnake Creek watershed and the delineated HMS subareas. Table 2-2 shows computed discharges at two key points in the watershed.

Table 2-2 HEC-HMS Modeling Results

Hydrologic Location ID	Description	Existing Conditions Peak Flow Rates in cfs								
		100% ACE	50% ACE	20% ACE	10% ACE	4% ACE	2% ACE	1% ACE	0.4% ACE	0.2% ACE
Junction 13	Karnes Road	1533	1996	2856	3705	4978	6069	7296	8988	10715
Junction 01	Confluence with Missouri River	2069	2725	3943	5135	6994	8578	10325	12717	15099

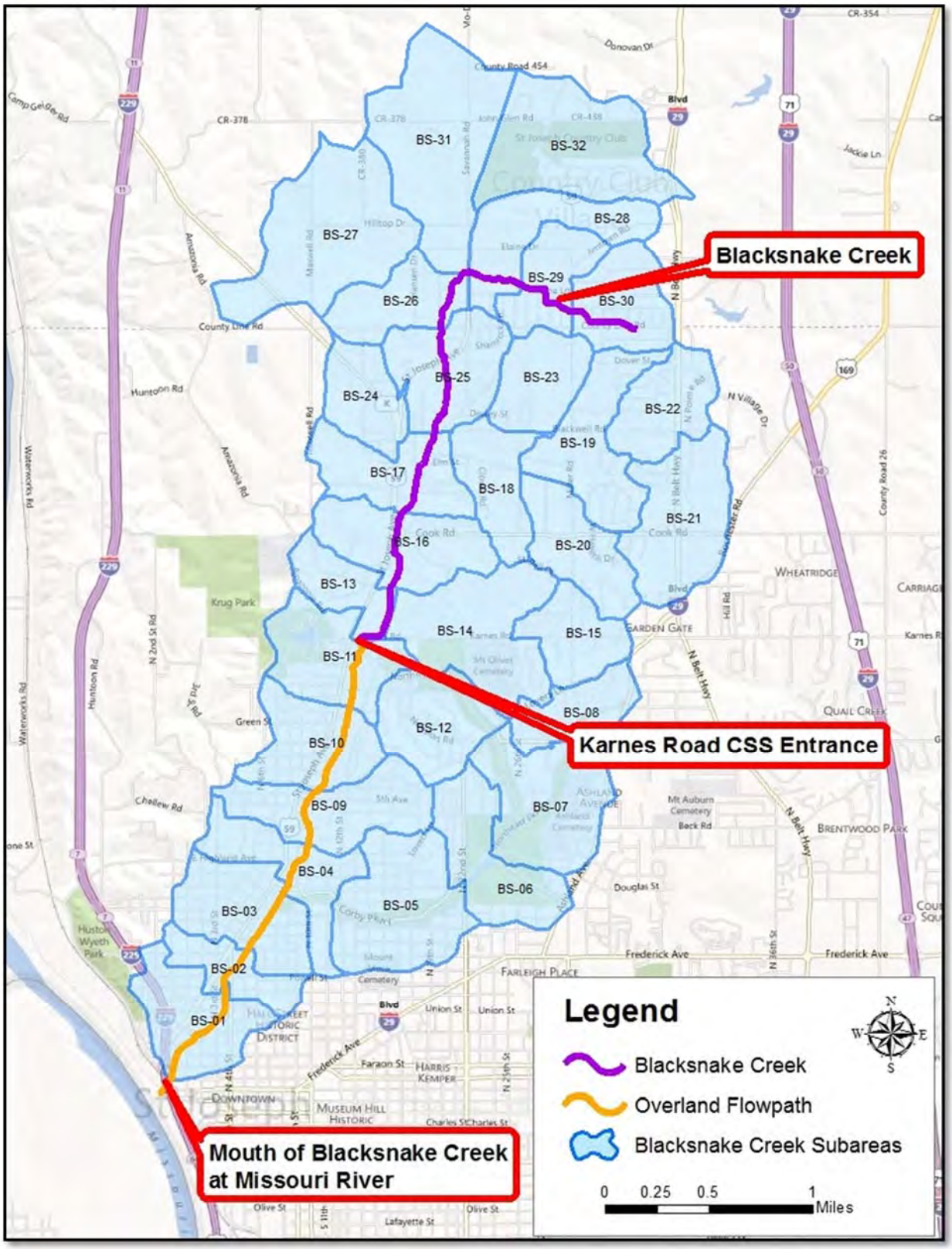

Figure 2-13 Blacksnake Creek Watershed and Subareas

2.8.3 Existing Conditions Hydraulic Analyses

Hydraulic modeling was performed using the Hydrologic Engineering Center-River Analysis System (HEC-RAS) Version 4.1.0 steady state option. The objective was to produce a detailed hydraulic model that reflects the complexities in local topography, provides an effective tool for assessing flood risk, and can be used to evaluate options for reducing flood risk. Based on existing topography and land use conditions, the HEC-RAS model simulates the watershed's primary storm water flow path in the lower portion of the basin. The model extends from just upstream of Karnes Road to the confluence with the Missouri River.

Profiles were developed depicting the 100, 50, 20, 10, 4, 2, 1, 0.4, and 0.2 percent ACE storm event water surface elevations for the overland flow path downstream of Karnes Road. Frequency flows were based on output from the HEC-HMS model described in Section 2.8.2. Peak flows used in the HEC-RAS model cross sections downstream of Karnes Road only include the portion of flow that does not enter the CSS. Based on studies by others the average full flow capacity of the CSS was estimated to be 1803 cfs. It should be noted that flow within the CSS was not evaluated as a part of this study. The flows used within the HEC-RAS model are listed in Table 2-3. In addition, the HEC-RAS model cross section locations and flow load points are shown in Figure 2-14.

Table 2-4 lists HEC-RAS model results at three selected cross-sections. Detailed HEC-RAS model output is included in Appendix C.

Table 2-3 Flows Used in Existing Conditions HEC-RAS Model

		Event/Peak Flow, cfs								
HEC-HMS Junction ID	XS[1] Station ID	100% ACE	50% ACE	20% ACE	10% ACE	4% ACE	2% ACE	1% ACE	0.4% ACE	0.2% ACE
J-16	15365	1331	1732	2489	3234	4369	5350	6458	7983	9559
J-14	14527	1485	1933	2770	3595	4835	5899	7100	8754	10447
J-13[2]	13763	5	192	1053	1901	3175	4265	5493	7185	8911
J-11	11909	5	343	1272	2191	3577	4756	6082	7912	9774
J-10	9407	5	366	1312	2242	3662	4867	6214	8065	9937
J-09	7879	5	427	1401	2359	3824	5067	6452	8360	10285
J-04	6520	198	829	1995	3139	4914	6421	8082	10365	12650
J-03	4847	230	872	2061	3227	5040	6580	8279	10611	12939
J-02	3740	236	881	2077	3250	5073	6626	8340	10687	13026
J-01	480	266	922	2139	3332	5190	6774	8522	10914	13295

1 XS = cross section
2 Flows downstream of J-14 reflect the 1803 cfs flow reduction to account for the CSS capacity.

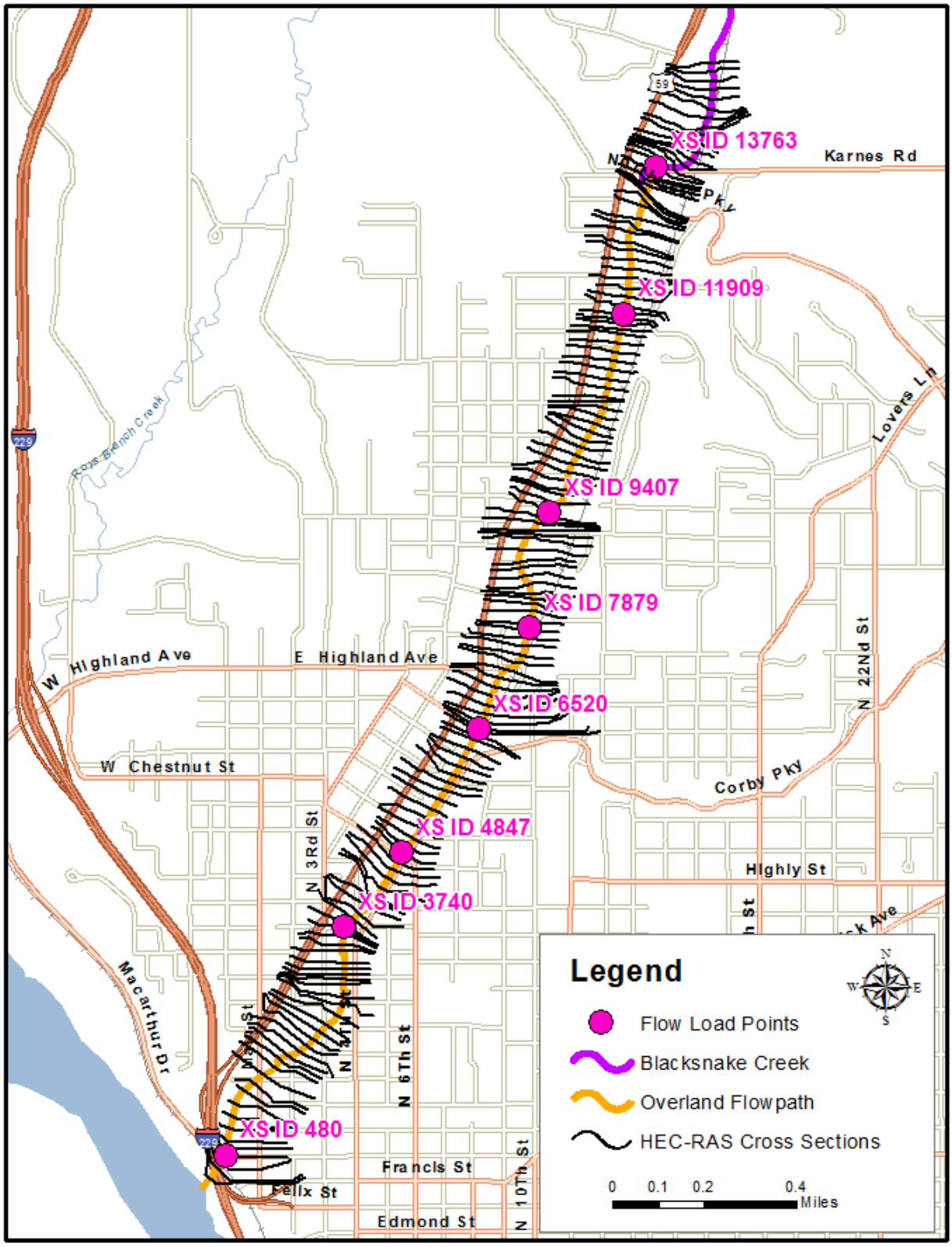

Figure 2-14 HEC-RAS Model Cross Section Locations and Flow Load Points

Table 2-4 Existing Conditions HEC-RAS Model Results at Selected Cross-Sections

Cross Section	Description	Profile	Q Total* (cfs)	W.S. Elev* (feet)	Vel Chnl* (feet/second)
13763	Karnes Road	1	5	893.01	00
		0.50	192	894.47	0.1
		0.20	1053	896.3	0.6
		0.10	1901	897.16	0.9
		0.04	3175	898.11	1.2
		0.02	4265	898.79	1.4
		0.01	4593	899.46	1.5
		0.004	7185	900.27	1.7
		0.002	8911	901.03	1.9
8987	5th Street	1	5	868.36	0.3
		0.50	366	870.62	1.6
		0.20	1312	872.03	3.9
		0.10	2242	872.78	4.8
		0.04	3662	873.62	5.8
		0.02	4867	874.09	6.5
		0.01	6214	874.47	7.4
		0.004	8065	875.19	8.4
		0.002	9937	875.9	8.9
6520	Grand Avenue	1	198	858.07	0.6
		0.50	829	859.11	4.0
		0.20	1995	860.01	7.3
		0.10	3139	860.72	8.8
		0.04	4914	861.95	9.6
		0.02	6421	862.91	10.5
		0.01	8082	864.05	10.7
		0.004	10365	865.52	10.1
		0.002	12650	866.96	9.5

* Q Total = total flow, cfs
W.S. Elev = water surface elevation, feet
Vel Chnl = velocity in the channel, fps

2.8.4 Climate Change

Guidance provided in the USACE Engineering and Construction Bulletin 2014-10 was used to conduct a qualitative evaluation of potential climate change impacts at this location. Based on this evaluation a warming trend of about three to five degrees Fahrenheit and a precipitation trend very slightly toward wetter conditions can be expected through the next 50 years, although significant uncertainty is expected with

these estimates. Supporting information for the qualitative evaluation is provided in Appendix C. Based on this slight trend toward wetter conditions, frequency flows over the study basin may increase, but these increases are being treated in this evaluation to be retained within the bands of uncertainty in the Existing Condition Feasibility hydrologic analysis.

2.9 Plan Screening

2.9.1 Socioeconomic Analysis

USACE completed a socioeconomic analysis of each alternative to identify the NED plan, which is the alternative with the highest annual net benefits.

Socioeconomic Conditions

St. Joseph, Missouri, which lies approximately 55 miles north of Kansas City on the Missouri/Kansas border, is a regional center for a four-county metro area and for several other rural counties beyond the metro area. St. Joseph's population of 76,780 as of the 2010 Census made it the eighth-largest city in Missouri, while the St. Joseph metropolitan statistical area, had an estimated population of 127,927. Based on block data from the 2010 Census for blocks adjoining Blacksnake Creek, the study area population is estimated at 2,525. The population at risk of the study area, which includes workers and others temporarily in the area in addition to residents, is estimated at 3,500.

Blacksnake Creek originates in a rural area of Andrew County immediately north of St. Joseph and subsequently flows through the northwestern portion of the City, eventually arriving at its mouth in downtown St. Joseph. The creek generally follows U.S. Highway 59, known locally as St. Joseph Avenue, throughout almost the entire study area. Generally the creek is located just to the east of St. Joseph Avenue and the busy commercial strip along the street. Land uses gradually shift from rural and residential uses upstream to commercial and industrial uses downstream. The Blacksnake basin, especially the urbanized portion, is one of the oldest parts of the City. A community known as Industrial City developed along the railroad tracks in this area soon after the 1827 establishment of a trading post near the mouth of Blacksnake Creek.

Today, the City's dominant industries are health care and manufacturing, and in particular, the City has a large cluster of businesses, academics, agencies and educators working in the animal-health and life-sciences sector. This sector, known as the KC Animal-Health Corridor, includes businesses, academics, agencies, and scientists working in a regional corridor in Missouri and Kansas that includes St. Joseph, Kansas City, Topeka, Lawrence, and Columbia. Nearly one-third of the $19 billion global animal-health industry is concentrated within this corridor.

The Blacksnake Creek study area as of 2016 contains 101 homes and 42 businesses, primarily small- and medium-sized, many in retail and the Census designation "other services" which includes auto repair garages. Total investment in the study area, which is summarized in Table 2-5, is estimated at $71.7 million (2016 dollars).

Although the toll of flash flooding along this small stream has never been well quantified, it is clear that flooding became an issue as early as a major flash flood in 1849 and has remained one to the present day. Another major flash flood is known to have occurred in 1943, although details are not readily available. In 1959, the Blacksnake basin experienced two major flash flooding events. The most severe of the 1959 events occurred in May, sending a high-velocity wave of water six to eight feet deep down St. Joseph Avenue and the railroad right-of-way. Newspaper accounts indicated significant damage to about 130 homes and 23 businesses. One death was reported in the flood, at a location that is key to this study: the covered channel entrance at Karnes Road. Further flash flood events culminated in a June 1984 event believed to have been a 200-year to 300-year storm. One post-flood estimate put the damage at $3.6 million, or about $8.8 million in 2016 dollars. A USACE reconnaissance study followed the 1984 event, culminating in the 1987 report which identified an interest in federal action.

Plan Screening – Socioeconomic Analysis

For the economic analysis, the study area was originally divided into three reaches. One of these was not carried over into the final stages of the study, and the economic analysis results will be reported in relation to two reaches. The reaches are illustrated on Figure 2-15 and are discussed below:

Reach 1 – Reach 1 is the most downstream reach, extending from the mouth of Blacksnake Creek upstream to Fillmore/Grand Street just north of downtown St. Joseph. The stream in this area is a covered channel flowing through a primarily industrial portion of the City. This reach has a small amount of residential land use, but is mostly industrial and commercial. As of 2016, Reach 1 included seven homes and 28 businesses spread between 46 non-residential structures. WireCo and Lawhon Construction are major business presences in this reach, but most of the businesses are small and medium-sized enterprises. Most structures in this reach are older structures in fair condition.

Reach 2 – Like Reach 1, Reach 2 is covered channel. Reach 2 runs from Fillmore/Grand Street upstream to Karnes Road, where the open stream enters the covered channel. Reach 2 contains much more residential land use than Reach 1 but also has a commercial/retail strip along St. Joseph Avenue/Highway 59. There are 94 homes and 14 non-residential structures housing 18 businesses in Reach 2.

The other original reach, which was removed from the later stages of the economic analysis, was Reach 3. This reach is the upstream portion of Blacksnake Creek, from Karnes Road upstream to the headwaters in southernmost Andrew County. This segment is an open channel, running through rural areas and residential neighborhoods of northern St. Joseph. Homes in this area are generally newer and larger than further downstream, and the great majority of these homes are near Blacksnake Creek but are on high ground above the floodplain (with a few exceptions where homes could be affected by the largest potential flood events).

Since the proposed project would be constructed just north of Karnes Road, benefits from less frequent/severe flooding would affect only Reaches 1 and 2. Reach 3 was

included in the study to ensure that any adverse induced impacts from the project are fully considered. As the study developed, it became clear that impacts from the project in this area would be negligible and it was dropped from further economic analysis.

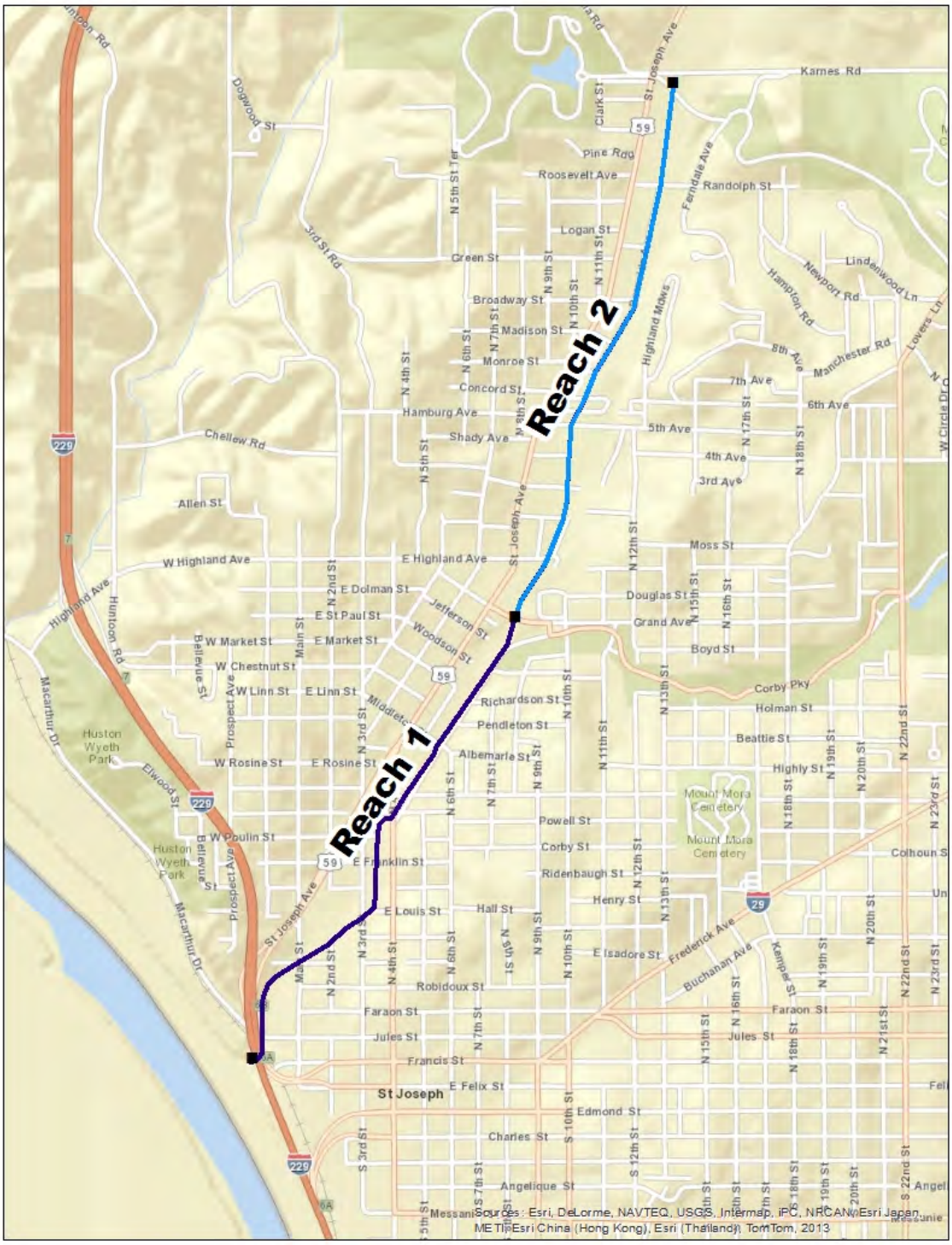

Figure 2-15 Economic Study Reaches

The existing conditions analysis is indexed to conditions of 2016. The base year for the analysis, i.e., the year when the project would be completed and operational, is 2020. A future condition is also included in the analysis, indexed to 2040. However, it should be noted that all three of these conditions are identically characterized in the risk and uncertainty analysis. That is to say, engineering data, including water surface profiles, and economic development assumptions are considered constant in all respects from 2016 through 2066, the economic period of analysis.

Except for the screening analysis, the economic analysis in this report is based on a FY 2016 price level (index: 1 October 2015), a 50-year period of analysis, and the current federal interest rate for water resource projects of 3.125 percent.

The economic database for the Blacksnake Creek analysis was based on a complete, structure-by-structure field survey supplemented by data from tax records. Economic data collected for the inventory included structure characteristics such as occupancy, construction quality/class, number of stories, exterior wall type, basement type, garage type, and condition. Areas of buildings and garages, which were not available from the tax data, were estimated from maps. District staff used the building characteristics in conjunction with Marshall and Swift estimating data to estimate depreciated replacement values for residential, commercial, and public structures. Streets also were added to the economic database using typical replacement costs per mile based on an average of estimates made by transportation departments of Missouri and several other states; however, streets in the Blacksnake floodplain generally consist only of side streets sloping down into the floodplain, and flood damage potential for streets is minimal. Elevations, stream stations, and first floor elevations were assigned to each structure using aerial photography and two-foot contour mapping provided by the City of St. Joseph. Emergency costs and disaster relief costs also were added to the economic analysis. For details on the valuation and damage characterization of the residential and nonresidential properties, streets and emergency costs, see Appendix I.

Water surface profiles were prepared for without- and with-project conditions for eight flood events: 50, 20, 10, 4, 2, 1, 0.4, and 0.2 percent ACE. These profiles were prepared for all alternatives, and together with the economic data, they were loaded into the Hydrologic Engineering Center-Flood Damage Reduction Analysis (HEC-FDA) program. This program is standard in USACE economic risk analyses for flood risk studies, and the newest, certified version, 1.4, was used in the analysis. The program utilizes Monte Carlo analysis, which randomly samples multiple probability distribution functions to produce thousands of possible flood events instead of a few discrete scenarios. The results provide a single expected value for damages that represents an average of the thousands of synthetic events. Even though it is a single value, it embodies a number of variables along with their uncertainty distributions. The goal of the economic screening of alternatives is to identify the NED plan. The NED plan is the Recommended Plan with the highest net benefits. This is considered the most economically efficient alternative.

Without-Project Conditions Analysis

Investment in the Blacksnake study area, including residential and non-residential structures and contents and streets, is estimated at $71.7 million (2016 prices). As shown in Table 2-5, the two project reaches include 101 homes, valued at $11.2 million, and 64 non-residential structures, valued at $56.9 million. These totals include contents as well as structure value. The remaining $3.6 million of total investment is accounted for by streets. These investment totals are assumed to remain constant under existing, base year and future without-project conditions.

Table 2-5 Blacksnake Creek Total Investment ($1,000s; FY 2016 prices)

	Reach 1	Reach 2	Total
RESIDENTIAL			
Quantity	7	94	101
Value - Structures	$352.4	$5,285.1	$5,637.5
Value - Contents	$281.2	$5,280.4	$5,561.6
Value - Total	$633.6	$10,565.4	$11,199.0
NON-RESIDENTIAL			
Quantity	46	18	64
Value - Structures	$23,170.7	$5,474.4	$28,645.1
Value - Contents	$22,467.8	$5,819.2	$28,287.0
Value - Total	$45,638.5	$11,293.6	$56,932.1
ROADS & STREETS			
Value	$3,024.4	$594.6	$3,619.0
TOTAL VALUE	$49,296.5	$22,453.5	$71,750.0

Reach 1 is the floodplain area from the mouth of Blacksnake Creek at the Missouri River, upstream to Fillmore.
Reach 2 is the floodplain area from Fillmore to Karnes Road.

Equivalent annual damage (EAD) as calculated in the HEC-FDA analysis is summarized in Table 2-6. Risk and uncertainty-based estimates concerning the probability of damaging floods also result from the HEC-FDA analysis. These results are applicable to existing, base year, and future conditions. The totals in Table 2-6 therefore represent the future without-project condition which serves as a base for subsequent alternatives evaluation. A few noteworthy points can be made based on execution of the HEC-FDA risk analysis model:

- Total EAD for the project reaches is estimated at $3,483,000 in FY 2016 prices. (Note that an earlier estimate of $2,890,000, in FY 2012 dollars, was calculated for the screening analysis and is seen in Table 2-7, but the benefit-cost data for the NED plan are based on without-project condition EAD of $3,483,000.

- Approximately 78 percent of the EAD is associated with Reach 1, the downstream reach with the highest commercial and industrial development, while Reach 2 accounts for the remaining 22 percent of investment.
- Approximately 82 percent of total EAD is non-residential, while 12 percent is residential, one percent streets, and six percent emergency costs and disaster relief.
- The risk and uncertainty-informed estimate of the threshold at which damaging overbank flooding occurs, over the long run, is 25.8 percent. This statistic represents the expected annual exceedance probability. This result is in contrast to earlier estimates in the study that the threshold was at least a 20 percent flood – an estimate based only on nominal estimates and not informed by risk and uncertainty considerations.)

Table 2-6 Existing & Future Without-Project Conditions Results (FY 16 $$)

Reach	Residential ($1,000s)	Non-Residential ($1,000s)	Streets ($1,000s)	Emerg. Costs ($1,000s)	Total ($1,000s)
1	38.6	2,525.9	27.5	127.4	2,719.4
2	363.6	330.1	0.0	69.8	763.5
Total	402.3	2,856.0	27.5	197.2	3,483.0

Plan Screening – Comparison of Plans

Nine action alternatives ultimately were developed and quantitatively evaluated for this study during FY 2012. This array included eight structural and one nonstructural flood risk reduction alternatives. Alternatives 1 through 4 formed one group of similar (although separate) alternatives, while Alternatives 5 through 8 were a second group of similar alternatives. Alternative 9 was a nonstructural alternative. The pertinent features of the alternatives are summarized below:

- Alternatives 1 through 4
  - These alternatives were variants of the same basic plan, which involved raising Karnes Road to act as a dry detention dam with an overflow spillway.
  - Alternative 1 included no excavation for the detention area upstream of Karnes Road, while 2, 3 and 4 involved increasing amounts of excavation.
  - All four alternatives would have included a levee/floodwall combination upstream of Karnes Road. This feature was meant to protect homes in that area from any adverse effects of the detention basin. It was not intended to reduce flood risk relative to the without-project condition.

  - Alternative 4 extended the detention basin downstream of Karnes Road, removing a short portion of Karnes Road and adding a second levee.

- Alternatives 5 through 8
  - These four alternatives were also variants of the same plan.
  - Like Alternatives 1 through 4, these plans involved dry detention upstream of Karnes Road.
  - Unlike Alternatives 1 through 4, Alternatives 5 through 8 used the natural topography and a lower pool height to avoid the need for the Karnes Road dam and levee/floodwall combination upstream.
  - The dry detention area in Alternative 5 was upstream of Karnes Road. Alternative 6 extended it a short distance downstream to Northwest Parkway, as in Alternative 4. Alternative 7 expanded the detention area upstream of Karnes Road to the west. Thus, project scale increased in moving from Alternative 5 to 6 to 7, as it did in moving from 1 to 2, 3, and 4.
  - Alternative 8 was similar to 6 but took into account the City's plan to abandon the section of Karnes Road crossing the basin as part of its approved area transportation plan. The City's decision to abandon Karnes Road allowed a reduction in project cost by eliminating the need to raise, reconstruct, and armor the road, and for the installation of culverts to provide a hydraulic connection between the basin areas north and south of the road. The volume gained by the removal of Karnes Road would be used to construct utility pads around three 161 KV power poles that were to be relocated under Alternative 6 while maintaining the same detention volume.

- Alternative 9 is an acquisition or buyouts plan that would remove all homes and businesses or public buildings from the 1 percent ACE floodplain. Of the 165 structures in the study area, 146 would be acquired along with their lots, and these properties would subsequently be used for purposes consistent with floodplain management.

The alternatives were initially costed in 2009 at an equivalent screening level of detail and were subsequently updated to FY 2012 dollars. Estimated first costs for the eight structural alternatives, which accounted for design, real estate and construction, ranged from $14.7 million to $25 million, as shown in Table 2-7. The acquisition alternative (Alternative 9) had an estimated first cost of $40.2 million, which was based on the sum of depreciated replacement values of the structures to be acquired (a proxy for structure acquisition costs), estimated land costs, relocation assistance, demolition costs and administrative costs.

The first costs in the 2012 analysis were annualized based on an assumed interest rate of 3.75 percent, a period of analysis of 50 years, and an assumed installation period of six years from preconstruction engineering and design to project completion. These assumptions were used in calculating interest during construction. Operation and

maintenance, repair, replacement, and rehabilitation (OMRR&R) costs also were estimated at the screening level and added to the annualized first costs. OMRR&R costs were estimated at $130,000 for Alternatives 1 through 4 and $24,000 for Alternatives 5 through 8. Alternatives 5 through 8 have lower OMRR&R costs because they do not include the Karnes Road detention dam and the levee/floodwall and are designed to work with rather than against the natural topography of the area. Alternative 9, the buyouts plan, did not have any OMRR&R costs.

Annualized costs for the eight alternatives were paired with the benefits evaluated in HEC-FDA for each alternative to arrive at the screening results for this analysis. Benefits were based on reduction of physical flood damages to homes, businesses, public facilities and streets. Emergency and disaster relief costs were not considered in the screening analysis but were later added to the benefit-cost analysis of the NED plan.

Screening Results

Table 2-7 summarizes the results of the 2012 screening-level benefit-cost analysis for the nine screening alternatives, Table 2-8 shows the annual exceedance probability ratings for each alternative (i.e., the likelihood that the project's capacity would be exceeded), and Table 2-9 provides a comparison of the estimated costs, benefits, benefit-cost ratio, and elements of the seven alternative plans. The main points emerging from the economic screening analysis were as follows:

- The HEC-FDA analysis estimated EAD of $2,890,000 (2012 dollars) for the without-project condition. (Again, the without-project EAD of $3,483,000 cited elsewhere in the appendix is a later estimate of EAD in 2016 dollars. It also includes items such as emergency costs and disaster relief costs that were not included in the screening analysis.) All structural alternatives reduced these damages by approximately 73 to 87 percent. All structural alternatives have benefit-cost ratios exceeding unity, ranging from 1.8 to 3.3.

- Alternative 9, the buyouts alternative, reduced EAD by 99 percent and was economically feasible with a benefit-cost ratio of 1.5. But the high cost of the project resulted in a net benefits total of just over $1 million, making it the lowest ranking alternative. Moreover, the $40.2 million cost would be well beyond the limits of the Section 205 program.

- Alternatives 5, 6, and 8 were the economically optimal alternatives. Alternative 5 had a small but insignificant margin of superiority in net benefits over alternative 6, but 5 and 6 came in second in the rankings to alternative 8. Alternative 8 had a margin of 3.2 percent in net benefits over the second-ranking alternative, Alternative 5.

- All alternatives dramatically alleviated long-term flood risk, but by no means did they eliminate it. Not only the largest flood events, but also those of more modest scale, would continue to result in damaging floods. The annual exceedance probabilities in Table 2-8 show that none of the structural alternatives could improve annual exceedance probability in Reach 1 to more than about 10 percent.

- However, the structural projects generally had a much greater effect on preventing damaging floods in Reach 2, which is the location of the entrance to the sewer.

Alternative 8 was identified as the NED plan emerging from the 2012 screening analysis. This alternative would provide $1,726,200 in net benefits, according to the screening analysis. Alternatives 5 and 6, two of the other three alternatives that provide dry detention just upstream of Karnes Road without the necessity of using Karnes Road as a dam, were the second and third-ranking alternatives, with net benefits of $1,672,300 and $1,665,800 respectively, but were 3.2 percent and 3.6 percent behind Alternative 8. Alternative 8 had a benefit-cost ratio of 3.3, with a cost of $15,105,000 to construct as well as an estimated $24,000 in annual OMRR&R costs. (These benefits and costs for the NED plan were later updated, with the current figures shown in section 3.)

According to the screening-level conditional non-exceedance probability statistics produced by the HEC-FDA analysis in 2012 and summarized in Table 2-8, the chance of a damaging flood over a 10-year period with Alternative 8 in place would be about 62 percent in Reach 1 and 11.2 percent in Reach 2. The Reach 2 is notable since the entrance to the covered channel and the frequently damaged Burnside Avenue area is in that reach. The same 10-year risk in the without-project condition exceeds 99 percent. For the reference 1 percent ACE flood event, Alternative 8 would have essentially no chance of substantially containing this event in Reach 1 and only about a 0.7 percent chance in Reach 2. But long-term EAD would be reduced to about 14 percent of without-project condition damages. More current estimates of project performance for the NED plan, based on subsequent HEC-FDA analysis, can be found in section 3.

Atlas 14 Impacts

Very late in the feasibility study (subsequent to the Alternative Formulation Briefing), NOAA published a new precipitation-frequency atlas for the U.S., known as Atlas 14. The new precipitation-frequency data potentially affects and alters the hydrology and hydraulics prepared for many USACE flood risk management studies, in many cases indicating significantly higher stages than previously estimated. Although the Atlas 14 data was released very late in the Blacksnake Creek study, KCD decided to perform a sensitivity analysis using the new data to find out whether economic justification or identification of the NED plan could be affected by the new data. KCD engineering staff prepared a new set of water surface profiles reflecting the Atlas 14 estimates for the events considered in the economic analysis. These profiles were entered into the HEC-FDA model and a sensitivity analysis was executed.

The effects of the Atlas 14 profiles were very minimal in the Blacksnake Creek study area. Without-project EAD increased by less than 2 percent, and residual damages with the alternatives in place increased by less than three percent in most cases. In terms of economic justification, none of the benefit-cost ratios for the alternatives changed by more than a point (i.e., from 3.0 to 3.1), and the benefit-cost ratio for Alternative 8, the NED plan, did not change at all. The other issue that required investigation was the screening rankings. Although the margin of superiority that Alternative 8 held in net

benefits over the other alternatives narrowed somewhat, the screening rankings did not change in any way and Alternative 8 continued to be the NED plan.

Since the effect of the Atlas 14 data on the economic analysis was essentially nonexistent in the sensitivity test, it was decided that no further action was required in response to the new data; i.e., damage and benefit computations previously completed for the study did not need to be revised to reflect the Atlas 14 data. Thus, no change was made in the damages and benefits previously computed for use in the study. All damages and benefits reported in the tables are based on the pre-Atlas 14 hydrologic/hydraulic data.

Table 2-7 Benefits and Costs by Alternative

Alternative	Features	TPCs ($1,000s)	Annual OMRR&R ($1,000s)	Annual costs ($1,000s)	Annual damages ($1,000s)	Annual benefits ($1,000s)	Benefit-cost ratio	Net benefits ($1,000s)
Existing	Existing conditions	n.a.	n.a.	n.a.	$2,890.0	n.a.	n.a	n.a.
1	Dry detention pond; levee/ floodwall upstream of Karnes Road; raise of Karnes Road to act as dam	$16,093.0	$130.0	$906.4	$657.8	$2,232.2	**2.5**	$1,325.8
2	Similar to 1, but larger detention pond requiring more excavation	$22,372.0	$130.0	$1,210.5	$524.0	$2,366.0	**2.0**	$1,155.5
3	Similar to 2, but larger detention pond, extending north of Karnes Road, with more excavation than either 1 or 2	$25,032.0	$130.0	$1,337.4	$447.0	$2,443.0	**1.8**	$1,105.5
4	Similar to 3, plus removal/relocation of segment of Karnes Road to increase storage and second levee to protect ball field	$24,838.0	$130.0	$1,328.2	$480.6	$2,409.4	**1.8**	$1,081.3

5	Detention basin with lower pool height; no levee, floodwall, or dam; excavation without impacting structures; overflow spillway on Karnes Road	$14,732.0	$24.0	$739.9	$477.7	$2,412.3	**3.3**	$1,672.3
6	Similar to 5, but more storage by excavation area between Karnes Road and Northwest Parkway	$16,298.0	$24.0	$813.9	$410.2	$2,479.8	**3.0**	$1,665.8
7	Similar to 6, but expanded storage in pond north of Karnes Road; requires acquisition and removal of homes west of St. Joseph Avenue	$22,950.0	$24.0	$1,134.0	$371.3	$2,518.7	**2.2**	$1,384.7
8	**NED Plan** - Similar to 6, but excavates an abandoned Karnes Road and uses the volume gained to construct pads around three 161 KV power poles that were to be relocated.	$15,105.1	$24.0	$753.6	$410.2	$2,479.8	**3.3**	$1,726.2

9	Buyouts plan - Acquisition of 146 structures in the 1% ACE floodplain.	$40,184.4	$0.0	$1,858.7	$26.7	$2,863.3	**1.5**	$1,004.5

OMRR&R = Operation and Maintenance, Repair, Replacement, and Rehabilitation
Price level – 1 October 2011;
interest rate – 3.75%

Table 2-8 Engineering Performance of Alternatives

Alternative	Annual Exceedance Probability*		Non-exceedance Probability in 1% Event		Chances of Flooding Over 10 Years	
	Reach 1	**Reach 2**	**Reach 1**	**Reach 2**	**Reach 1**	**Reach 2**
Existing	0.3893 < 5 year	0.3288 < 5 year	0.0000	0.0000	99.3%	98.1%
1	0.1244 < 10 year	0.0384 ~ 25 year	0.0000	0.0428	73.5%	33.8%
2	0.1128 ~ 10 year	0.0174 > 50 year	0.0000	0.1783	69.8%	16.1%
3	0.1007 ~ 10 year	0.0081 ~ 125 year	0.0000	0.9998	65.4%	7.9%
4	0.1052 ~ 10 year	0.0038 > 250 year	0.0000	0.9998	67.1%	3.7%
5	0.0966 ~ 10 year	0.0213 ~ 50 year	0.0000	0.1816	63.8%	18.8%
6	0.0922 ~ 10 year	0.0118 > 75 year	0.0000	0.0072	62.0%	11.2%
7	0.0841 > 10 year	0.0038 > 250 year	0.0000	0.9998	58.5%	3.8%
8	0.0922 ~ 10 year	0.0118 > 75 year	0.0000	0.0072	62.0%	11.2%

Alternative 9 not shown; HEC-FDA project performance estimates not available.
*Annual exceedance probability is the probability that a damaging flood (of whatever magnitude would occur during any given year
**Non-exceedance probability in the one percent event is the probability that the project would contain the one percent chance flood event without significant damage from overtopping or project failure.

Table 2-9 Summary of Alternative Plan Screening Analysis

Alternative Element	Alternative								
	1	2	3	4	5	6	7	8	9
Estimated Cost [1]	$16,093.0	$22,372.0	$25,032.0	$24,838.0	$14,732.0	$16,298.0	$22,950.0	$15,105.1	$40,184.4
Annual Benefit	$2,232.2	$2,366.0	$2,443.0	$2,409.4	$2,412.3	$2,479.8	$2,518.7	$2,479.8	$2,863.3
Annual Cost	$906.4	$1,210.5	$1,337.4	$1,328.2	$739.9	$813.9	$1,134.0	$753.6	$1,858.7
Benefit – Cost Ratio	2.5	2.0	1.8	1.8	3.3	3.0	2.2	3.3	1.5
Annual Net Benefit	$1,325.8	$1,155.5	$1,105.5	$1,081.3	$1,672.3	$1,665.8	$1,384.7	$1,726.2	$1,004.5
Pool Elevation	905 feet	905 feet	905 feet	905 feet	895 feet	895 feet	895 feet	895 feet	895 feet
Estimated Detention Event	10- to 25-year	25- to 50-year	50- to 100-year	100- to 250-year	25- to 50-year	25- to 50-year	100- to 250-year	25- to 50-year	-
Estimated Detention Volume	240 acre-feet	400 acre-feet	520 acre-feet	650 acre-feet	370 acre-feet	440 acre-feet	660 acre-feet	440 acre-feet	-
Residential Properties Impacted	24	24	24	24	21	21	21	21	Acquisition 146 Residential and Commercial
Non Residential Properties Impacted	6	6	6	6	6	6	6	6	
Detention Basin Excavation Volume	0 cubic yards	250,000 cubic yards	465,000 cubic yards	589,000 cubic yards	539,000 cubic yards	660,000 cubic yards	1,060,000 cubic yards	660,000 cubic yards	-
Levee	Yes	Yes	Yes	Yes	No	No	No	No	No
Levee Interior Drainage Issues	Yes	Yes	Yes	Yes	No	No	No	No	No
Long-term Levee Maintenance	Yes	Yes	Yes	Yes	No	No	No	No	No
Detention Dam	Yes	Yes	Yes	Yes	No	No	No	No	No

Long-term Dam Maintenance	Yes	Yes	Yes	Yes	No	No	No	No	No
Floodwall	Yes	Yes	Yes	Yes	No	No	No	No	No
Concrete Culvert under Karnes Road	No	No	No	No	No	Yes	Yes	No	No
Emergency Spillway	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Demolition and/or Relocation of Sanitary Sewer Lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Demolition and/or Relocation of Potable Water Lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Demolition and/or Relocation of Electrical Lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Demolition and/or Relocation of Natural Gas Lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Demolition and/or Relocation of Communications Lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Modification to Culvert and Sewer	No	No	No	No	No	No	No	No	No

Raise Karnes Road	Yes	Yes	Yes	No	No	No	No	No	No
Raise Maxwell Road Extension	Yes	Yes	Yes	Yes	No	No	No	No	No
Impact to Recreational Facilities	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Notes:

[1] Cost estimates were prepared using the Micro Computer Aided Cost Engineering System, MII software. Costs presented are considered Class 5 (Concept Screening) with an accuracy range of +100/-50 according to the American Society for Testing and Materials designation E 2516–06 Standard Classification for Cost Estimate Classification System.

Costs include contingency and are rounded to nearest hundred.

Costs are considered 2011 costs. Costs were not escalated to mid-point of construction because costs are for screening comparison only.

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Section 3
Recommended Plan

The results of the alternative plan screening analysis were presented to the project sponsor for consideration. The sponsor weighed the cost and performance of each alternative and selected the NED plan, Alternative 8. Alternative 8 is identified as the NED plan based on the economic benefits analysis.

3.1 Economics

3.1.1 NED Plan Costs

A new and more detailed cost estimate for the NED plan was developed in late 2013. The estimate was revised and updated with current pricing in January 2016 and underwent review and approval/certification by the center of expertise in Walla Walla in February 2016. The estimated TPC in FY 2016 dollars, as summarized by accounts in Table 3-1, is $14,761,000. This total includes preconstruction engineering and design, real estate requirements, construction and construction management and contingencies.

Table 3-1 Total Project Cost

TPC	
FY16 prices; $1000s	
Planning, Engineering & Design (PED)	$1,829.0
Lands & Damages	$1,290.0
Construction Management (S&A)	$467.0
Construction	
Relocations	
Compensable	$411.0
Non-compensable	$1,008.0
Total	$1,419.0
Fish & Wildlife Facilities	$381.0
Floodway Control & Diversion Structures	$9,375.0
TPC	**$14,761.0**
Fully Funded Cost	$14,985.0

Annual cost calculations for the NED plan are summarized in Table 3-2. Annual costs were calculated at the current FY 2016 federal water resources interest rate of 3.125 percent. A 50-year period of analysis is assumed. Interest during construction computations assumes project completion in FY 2020. A new estimate of OMRR&R costs also was prepared for the NED plan in early 2014 (updated to FY 2016 dollars subsequently). The tasks assumed for the new estimate include routine annual costs of $28,300 as well as replacement costs at longer intervals, particularly the replacement of riprap every 20 years at $19,400. The discounted present-worth of the OMRR&R costs in FY 2016 dollars is $29,300 at 3.125 percent, somewhat more than

but comparable to the 2011 screening-level estimate of $23,000. Annual costs at 3.125 percent total $641,700.

Table 3-2 Annual Costs

Annual Costs	
FY16 prices; 3.125% interest rate; $1000s	
First Costs	$14,761.0
IDC	$628.2
Total Investment Cost	$15,389.2
I&A factor (50 years)	0.03979
Annual Cost subtotal	$612.4
Annual OMRR&R Cost	$29.3
Total Annual Cost	$641.7
Rounded	$642.0

3.1.2 NED Plan Benefits

Benefits for the NED plan were recalculated most recently in early 2016 to account for price level changes in structure inventory values and other adjustments (such as adding emergency costs). Summarized in Table 3-3, annual benefits total $3,051,800 in FY 2016 dollars. (This total is not affected by interest rate changes.) The without-project EAD of $3,483,000 is reduced by about 86 percent with the NED plan in place. Reach 1 accounts for 77 percent of the benefits, while Reach 2 contributes the remaining 23 percent.

Table 3-3 Annual Benefits

Annual Benefits			
FY16 prices; $1000s			
BENEFITS	Reach 1	Reach 2	Total
Future without-project EAD	$2,719.4	$763.5	$3,482.9
Residual with-project EAD	$368.9	$62.2	$431.2
Damage reduction EAD	$2,350.5	$701.3	$3,051.8
Rounded	$2,351.0	$701.0	$3,052.0
Percentage	77%	23%	100%

3.1.3 Benefit-Cost Ratio for the NED Plan

As seen in Table 3-4, at the 3.125 percent interest rate and the FY 2016 price level, the NED plan for Blacksnake Creek has a very strong benefit-cost ratio of 4.8. Annual benefits total $3,052,000, annual costs are estimated at $642,000, and annual net benefits total $2,410,000.

Table 3-4 Benefit-Cost Data

Benefit Cost Data	
FY16 prices; 3.125% interest rate; $1000s	
Annual Benefits	$3,052.0
Annual Costs	$642.0
Benefit-Cost Ratio	4.8
Net Benefits	$2,410.0

3.1.4 Residual Risk

No structural project that conceivably could be constructed would successfully contain every possible flood. Significant flood risk will continue after the Blacksnake project is implemented. The chances that a damaging flood will occur in the project area even with the project in place are not reduced significantly except in the smaller, more frequent floods. As can be seen in Table 3-5, the annual exceedance probability for the NED plan design (the probability of flooding in any given year with a project in place) is 4.8 percent, reduced from 25.8 percent in the without-project condition. Residual risk also can be expressed as the long-term probability of a project's capacity being exceeded over a certain number of years under conditions of risk and uncertainty. The evaluation of residual risk indicates that over a 10-year period the probability of project capacity being exceeded is approximately 38.5 percent. Over a 30-year period, the long-term risk is 76.8 percent, and over 50 years, it is 91.2 percent.

Exceedance probability (the chances of flood damage) in a four percent ACE event, which is 100 percent under without-project conditions, is reduced significantly to 61 percent by the project, but it exceeds 95 percent for events larger than the 2 percent ACE event with the project in place. A total of $431,000 in residual EAD is estimated by the HEC-FDA model. The high continuing probability that damaging flood events will occur in the project area does not mean that the project is ineffective. As can be seen in the discussion of benefits above, the project very substantially reduces potential economic damage over the long term. But it accomplishes this not by completely preventing floods from occurring, but by alleviating depths of flooding to much less dangerous and harmful levels when floods do occur. There will be a continuing need, even after project implementation, to monitor potential flood events diligently and take appropriate precautions.

Table 3-5 Project Performance (Assurance)

Project Performance (Assurance)						
HEC-FDA ESTIMATES						
	REACH 1 (DOWNSTREAM)		REACH 2 (UPSTREAM)		TOTAL PROJECT AREA	
	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT
ANNUAL EXCEEDANCE PROBABILITY*						
Median	26.0%	4.6%	26.6%	1.0%	26.0%	4.6%
Expected	25.8%	4.8%	26.6%	1.1%	25.8%	4.8%
LONG-TERM RISK* (chance of flooding during period)						
over 10 years	94.9%	38.5%	95.4%	10.0%	94.9%	38.5%
over 30 years	100.0%	76.8%	100.0%	27.1%	100.0%	76.8%
over 50 years	100.0%	91.2%	100.0%	40.9%	100.0%	91.2%
CONDITIONAL EXCEEDANCE PROBABILITY PER EVENT (in %)						
10.0%	100.0%	1.6%	100.0%	0.0%	100.0%	61.2%
4.0%	100.0%	61.2%	100.0%	0.0%	100.0%	61.2%
2.0%	100.0%	88.4%	100.0%	5.7%	100.0%	88.4%
1.0%	100.0%	96.8%	100.0%	51.9%	100.0%	96.8%
0.4%	100.0%	99.8%	100.0%	77.2%	100.0%	99.8%
0.2%	100.0%	100.0%	100.0%	86.9%	100.0%	100.0%
CONDITIONAL NON-EXCEEDANCE PROBABILITY PER EVENT (in %)						
10.0%	0.0%	98.4%	0.0%	100.0%	0.0%	98.4%
4.0%	0.0%	38.8%	0.0%	100.0%	0.0%	38.8%
2.0%	0.0%	11.6%	0.0%	94.3%	0.0%	11.6%
1.0%	0.0%	3.2%	0.0%	48.1%	0.0%	3.2%
0.4%	0.0%	0.2%	0.0%	22.9%	0.0%	0.2%
0.2%	0.0%	0.0%	0.0%	13.1%	0.0%	0.0%

* Annual exceedance probability is the chance of a damaging flood in any year. The statistic implies nothing about the magnitude of the flood except that it would be large enough to exceed the system's capacity. The same is true of the long-term risk of flooding; it is based on the probability of a damaging flood of any magnitude.

3.2 Plan Components

3.2.1 Detention Basin

The Recommended Plan uses the natural topography and excavation within the Blacksnake Creek floodplain north of Northwest Parkway to create the detention basin. The basin would be a dry pond with a low flow channel and would not store water during non-storm events. Based on refinement of the hydrologic model, the elevation of the overflow spillway was raised from elevation of 895 to 897 NAVD to contain the 4 percent ACE event. With the higher pool elevation the basin would provide a detention capacity of 440 acre-feet. The basin footprint is shown in Figure 3-1.

The estimated maximum water surface elevation for the 1 percent ACE event for the existing (without-project) conditions at Karnes Road, based the June 2012 HEC Hydrologic Modeling System (HMS) model, is 898.9 NAVD. Modification of the model to incorporate the detention basin results in an estimated maximum water surface elevation for the 1 percent ACE event at Karnes Road of 898.7 NAVD, indicating that construction of the basin will not increase the 1percent ACE flood elevation over existing conditions. The effective Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (effective September 1984) shows a maximum water surface elevation for the 1 percent ACE event at Karnes Road of 895 NAVD. The City would need to prepare a Letter of Map Amendment (LOMA) for FEMA to request a revision to the effective floodplain map to show changes to floodplains, floodways, and flood elevations.

The HEC-HMS model indicates that the proposed detention basin will drain within 24 hours from the time of peak water surface elevation to full dewatering for storm events up to the 1 percent ACE event. The estimated times to drain based on the modified model are shown in Table 3-6.

Table 3-6 Times to Drain Detention Basin by Storm Event

ACE Event	Estimated Hours
50 %	14
10 %	13
4 %	15
2 %	17
1 %	18

Figure 3-1 Recommended Plan Detention Basin Footprint

3.2.2 Spillway

During events larger than the rated level of protection, the primary spillway would deliver excess runoff over the top of Northwest Parkway and into a nearby parking lot in the vicinity of the existing community pool. The overflow section would consist of a concrete paved roadway section with a minimum thickness of 12 inches. A toe-wall at the downstream edge of the pavement is recommended to protect against undermining of the pavement structure. Riprap protection would be installed on the downstream and upstream slope of the overflow section. The secondary spill at the southeast corner of the basin will deliver excess runoff over to the abandoned railroad right-of-way and will be protected with riprap. The location of the overflow spillways are shown in Figure 3-1. The spillway riprap sizing is discussed in the geotechnical engineering analysis provided in Appendix D.

Based on the June 2012 HEC-HMS model and 2012 site topographic survey[5], the overflow spillway at Northwest Parkway would need to be constructed at elevation 897 NAVD to contain the 4 percent ACE event. The secondary spill would be set at elevation 898 NAVD.

3.2.3 Roads

Roads located within and adjacent to the project area include Savannah Road, Cook Road, Maxwell Road Extension, Karnes Road, Northwest Parkway, and St. Joseph Avenue (see Figure 3-2). Cook Road, Maxwell Road Extension, Karnes Road, and Northwest Parkway are east west thoroughfares that cross the project area from north to south respectively. Savannah Road and St. Joseph Avenue are north south thoroughfares.

3.2.3.1 Project Impacted Roads

Northwest Parkway forms the southern boundary of the basin and would be the point of overtopping when the capacity of the basin is exceeded. The road will be armored as the primary overflow spillway.

Maxwell Road Extension – a private drive, that crosses near the mid-point of the proposed detention basin and provides access to a single residence on the east side will be removed. The drive will be replaced with access to the single residence via a new access road on the east side of the project.

3.2.3.2 City Road Improvements

Two City road improvements projects are underway and will be completed prior to the start of construction of the proposed project. These improvements are not a part of the federal project, however, were taken into consideration in the feasibility level design analysis for the proposed detention basin.

The City is planning to reduce the number of connectors to St. Joseph Avenue in the vicinity of the project. As a result the segment of Karnes Road from Ferndale Avenue to St. Joseph Avenue will be closed thus routing traffic to Northwest Parkway. The

[5] Survey Report, Blacksnake Creek Section 205 Feasibility Study, CDM Smith, May 2012.

City will install barricades and strip the road of asphalt from St. Joseph Avenue to approximately the detention boundary but leave the asphalt from the detention boundary to Ferndale Avenue to allow access to a single resident.

Also in attempt to reduce the number of connectors to St. Joseph Avenue the City has abandoned the connection at Savannah Road. A segment of Savannah Road will be closed by installing barricades, stripping the roads of asphalt, and covering the area with top soil.

3.2.3.3 Access Roads

Two new access roads will be constructed along the east side of the basin. The southern road will extend north from Karnes Road to provide maintenance access to a power pole supporting 161 KV power lines. The northern road will extend south from Cook Road to the residence located on the east side of the proposed project. This residence is currently accessed by way of a private drive that crosses the basin (from near the St. Joseph Avenue and Maxwell Road intersection) referred to as the Maxwell Road Extension. The new access road will also provide maintenance access to three 161 KV power poles. The access roads will be 20 feet wide with six inches of base gravel. The approximate total length of these access roads is 2,400 feet. These access roads would be constructed as part of the federal project.

Figure 3-2 Roads Located Within the Footprint of the Proposed Detention Basin

3.2.4 Utilities

Utilities located in close proximity to or within the footprint of the proposed detention basin include sanitary, natural gas, water, electric, and communications. The utilities to be relocated that have been determined to be compensable will be relocated and the costs for those relocations will be applied as a part of the LERRD credit for the sponsor cost-share match. The utilities that are identified as non-compensable will be relocated but costs will not be applied to the cost-share match. Tables 3-7 is a listing of the compensable utilities and Table 3-8 lists the non-compensable utilities. Utility relocations will be undertaken in advance of the construction of the basin.

Table 3-7 Utilities Impacted by Construction (compensable)

Type	Owner	Note
Natural Gas Line	Missouri Gas and Energy	Relocate 1,292 feet of line
Electric Transmission Line	Kansas City Power & Light	Electric transmission line is not anticipated to be relocated
Communication Line	Suddenlink	Remove one pole and 400’ of line
Electric Line	Kansas City Power & Light	Remove one pole and 100’ of line. Add 50’ new line
Utility Easements		Utility Easement have been platted, however, no utilities currently exist within the easement area

3.2.4.1 Natural Gas

Natural gas lines are operated by Missouri Gas Energy. An existing 12-inch coated steel natural gas line runs north from Northwest Parkway, turns east to follow Karnes Road, and then diverts to the north as shown in Figure 3-4. This portion of gas line is 2,100 feet long. Communications with Missouri Gas Energy indicate that the line was diverted north of Karnes Road east of the abandoned railroad right-of-way due to shallow limestone rock along this section of the road. As a result, it is proposed to remove the existing gas line which conflicts with the proposed detention basin and will be replaced back into its current alignment at a sufficient depth to provide a minimum of three feet of cover.

3.2.4.2 Electric Transmission Line

Three-phase 161 KV power lines run from north to south in an electrical transmission easement located along an abandoned railroad embankment as shown in Figure 3-6. The lines are owned by Kansas City Power & Light (KCP&L) and there are five poles supporting these lines. There are no proposed changes to these poles and these lines

will not be directly impacted by the proposed project. Level pads at the existing ground elevation of each pole will be constructed. These pads will extend 50 feet in all directions from the poles and will extend to the basin bottom at no greater than three feet horizontal (H) to one foot vertical (V) [3H:1V] slopes. Access roads from Karnes Road on the south and Cook Road on the north will provide access to the existing poles in the detention basin per discussions with KCP&L. The pads and access roads will be constructed as part of the project.

3.2.4.3 Communications Line and Electric Distribution Line

There is a communication line at Maxwell Road as well as an electric distribution line at Maxwell Road that are not in the City right of way. These lines will need to be removed and relocated. The communication line is approximately 400 feet of line to be relocated. The electric line relocation will require removal of one power pole and approximately 100' of line and the addition of approximately 50' of new line. These relocations will be completed for before construction of the proposed detention basin.

3.2.4.4 Utility Easement Eastern Side

There is an undeveloped property to the east side of the proposed detention basin. The landowner has obtained utility easements, however no utilities have been constructed on the property so no utility relocations will be required.

Table 3-8 Utilities Impacted by Construction (non-compensable)

Type	Owner	Note
Sanitary Sewer	City of St. Joseph	Removal of line
Sanitary Sewer	City of St. Joseph	Installation of line
Natural Gas Line	Missouri Gas and Energy	In Karnes Road ROW
Water Line 8"	American Water	In Karnes Road ROW
Water Line 12"	American Water	In Karnes Road ROW
Electric Line	Kansas City Power & Light	Removal- In Karnes Road ROW
Communication Line	AT&T	Removal- In Karnes Road ROW
Communication Line	AT&T	Relocate- In Karnes Road ROW
Communication Line	Suddenlink	Bury Line- In Karnes Road ROW

3.2.4.5 Sanitary Sewer

There are two sanitary sewer lines which are owned by the City. These lines will be relocated by the City prior to construction of the proposed detention basin.

The first is the main sewer line that conveys flow from the north end of the project site south, and runs approximately through the middle of the basin. This line is referred to as the West Line. Another sanitary sewer, termed the East Line, conveys flow from the east boundary of the basin to the west, where it ties into the West Line, as shown in Figure 3-3.

The existing east branch of sanitary sewer is made of 12-inch vitrified clay pipe. It is anticipated that the City will replace this line with a sanitary sewer which runs along the eastern boundary of the proposed detention project, as shown in Figure 3-3. There is one residence located on the east side of the basin that may currently be on a septic system. This residence will be connected to the new East Line sewer.

The West Line will be relocated along the western boundary of the proposed detention project.

Depending on final design, portions of these relocated lines may fall within the area of inundation and require riprap and or slope protection.

3.2.4.6 Hydraulic Structures

The combined sewer inlet is a 12-foot by 12-foot reinforced concrete double box culvert. The inlet serves as transition from open channel flow in Blacksnake Creek upstream of Karnes Road to piped flow for the remainder of the creek. The double box inlet is aligned in an east-to-west direction for approximately 90 feet at which point it transitions into a single 12-foot diameter concrete pipe culvert that flows south. A 36-inch reinforced concrete pipe sewer line enters the box culvert from the north, downstream of the box culvert inlet. The 36-inch sewer line will be relocated to tie into the sewer at Northwest Parkway. The double box structure will not be modified as part of the Recommended Plan. The design and construction of a new inlet may be conducted by the City as part of the combined sewer improvements, but is not part of the federal project.

3.2.4.7 Drinking Water

Existing eight and 12-inch water lines run under the south side of Karnes Road as shown on Figure 3-5. The water lines are owned by American Water. The removal of Karnes Road and construction of the basin will impact approximately 600 feet of both lines. It is proposed to remove the affected portions of the existing lines and bury them beneath the detention basin bottom along their current alignment.

3.2.4.8 Electric Transmission

Three-phase 161 KV power lines run from north to south in an electrical transmission easement located along an abandoned railroad embankment as shown in Figure 3-6. The lines are owned by KCP&L and there are five poles supporting these lines. There are no proposed changes to these poles and these lines will not be directly impacted

by the proposed project. Level pads at the existing ground elevation of each pole will be constructed. These pads will extend 50 feet in all directions from the poles and will extend to the basin bottom at no greater than three feet horizontal to one foot vertical [3H:1V] slopes. Access roads from Karnes Road on the south and Cook Road on the north will provide access to the existing poles in the detention basin per discussions with KCP&L. The pads and access roads will be constructed as part of the project.

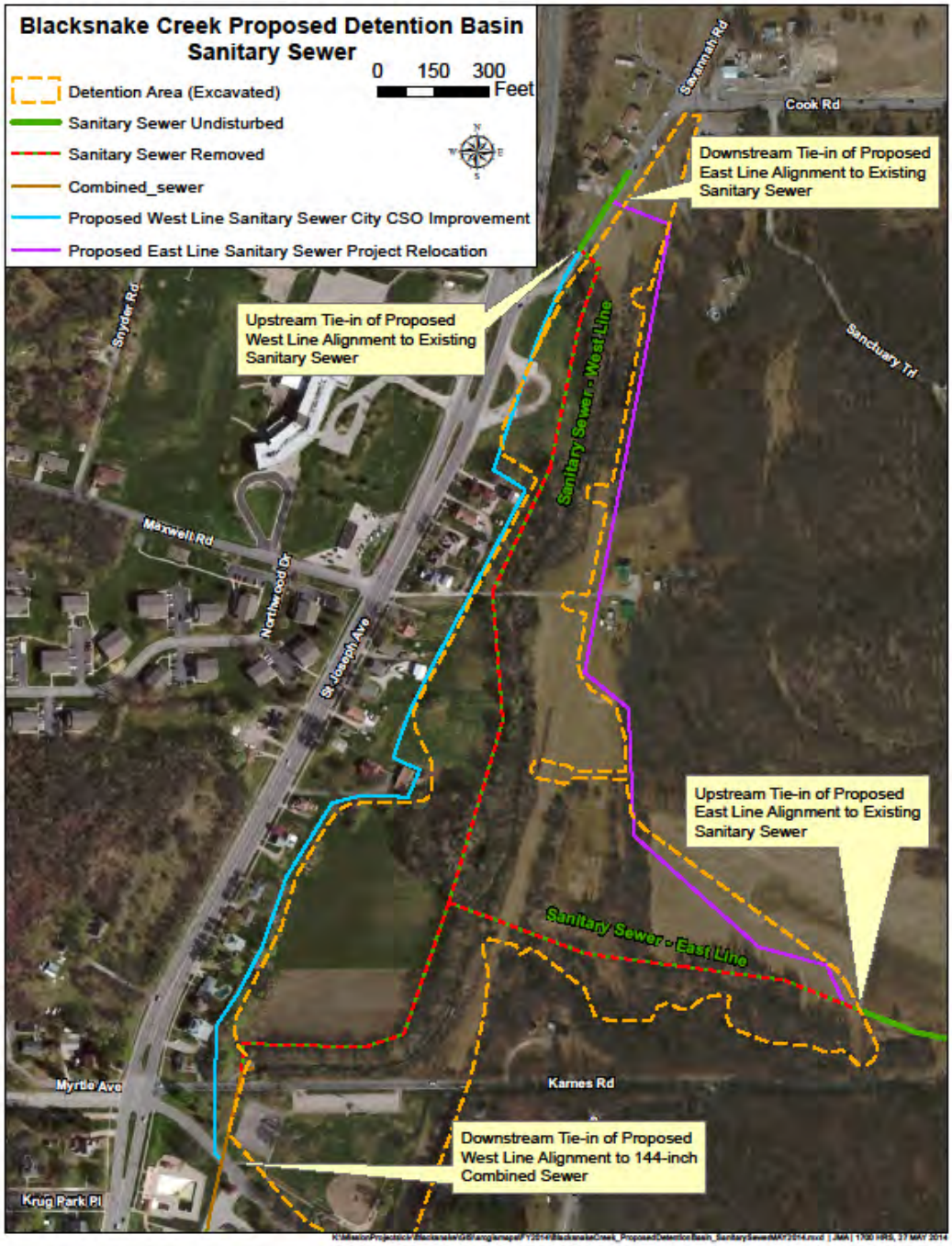


Figure 3-3 Sanitary Sewer Alignments.

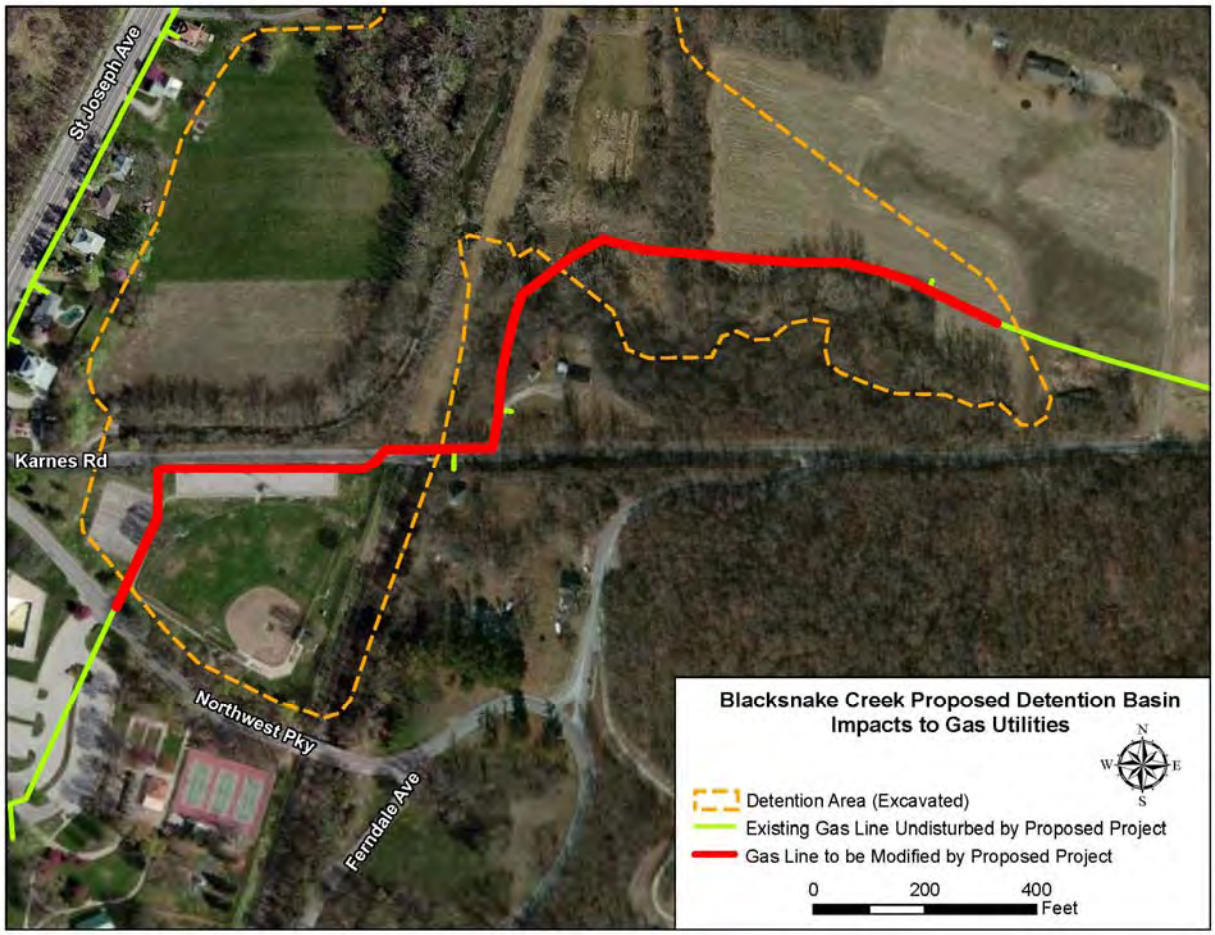


Figure 3-4 Gas Utility Impacted by the Construction of the Detention Basin

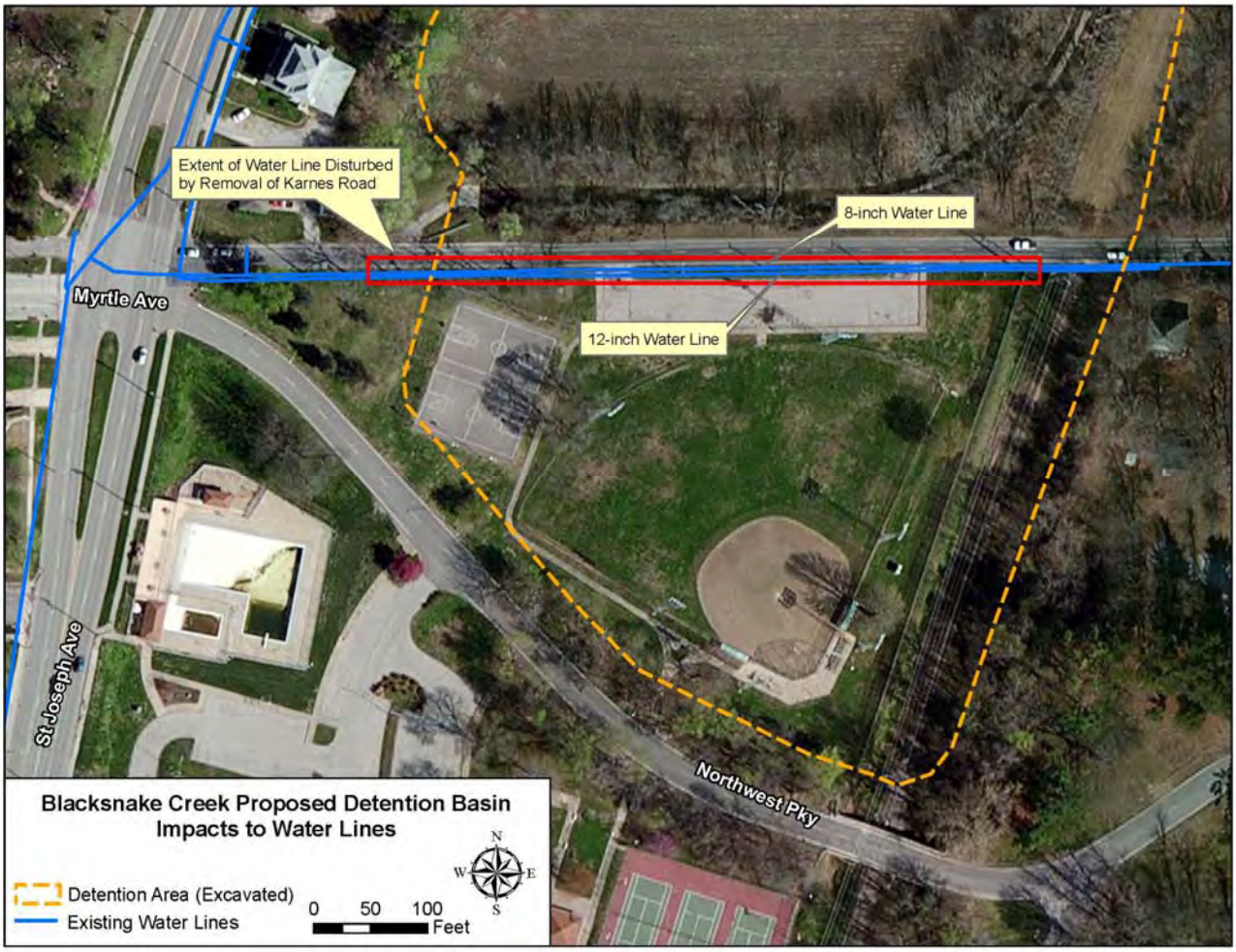


Figure 3-5 Water Lines Impacted by the Construction of the Detention Basin

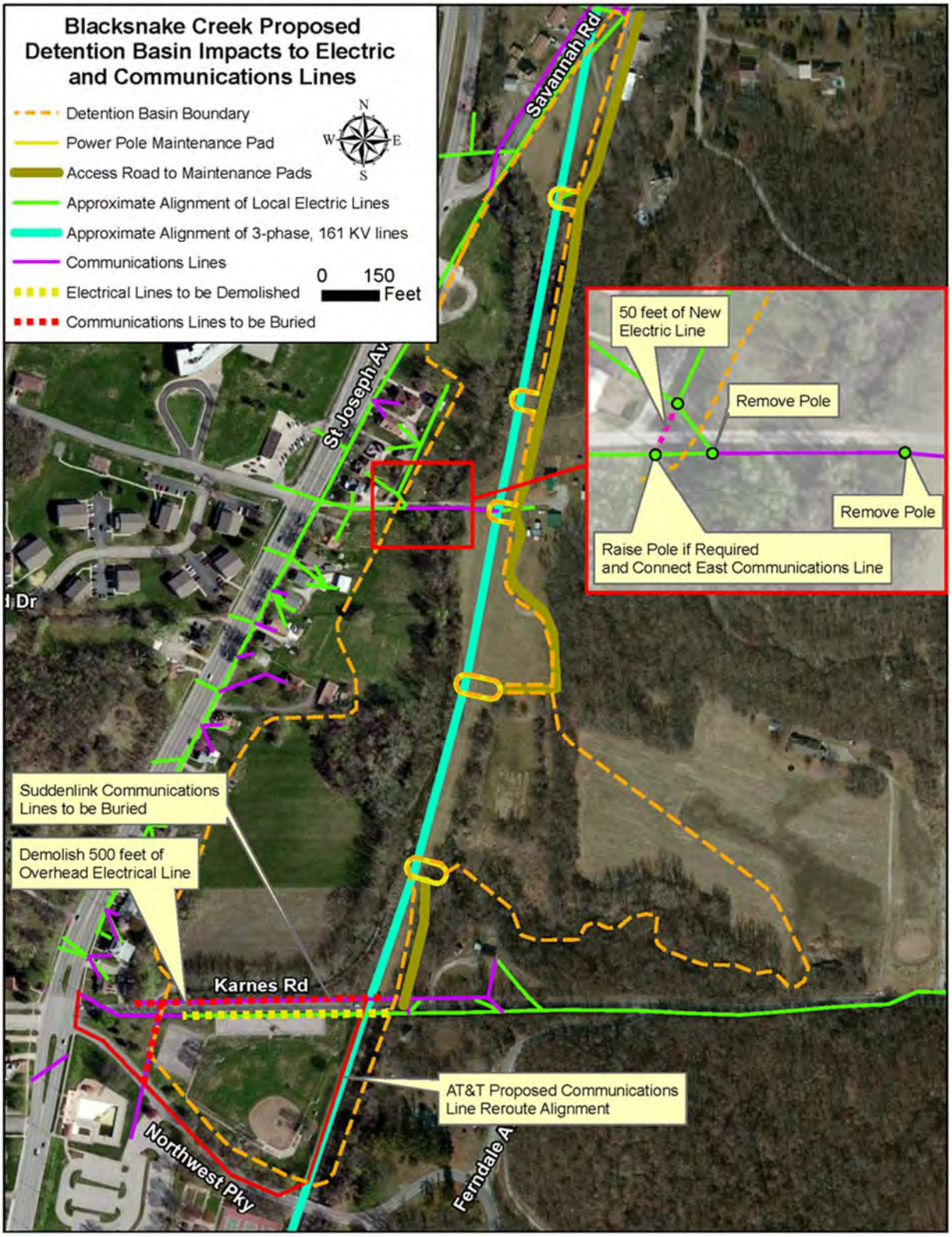


Figure 3-6 Electrical and Communications Lines Impacted by the Construction of the Detention Basin

The electric utility is proposed to be modified east of the intersection of Maxwell Road and St. Joseph Avenue where two utility poles are planned to be removed as shown in Figure 3-6. The lines are proposed to be routed using the remaining pole to the west, which is in line with the back edge of the properties to the north, adding additional height to it if necessary. KCP&L has agreed to the improvement per the email dated May 18, 2012. In addition, the 500 feet of electrical line which currently runs along the south side of Karnes Road is also proposed to be removed. Demolition of this line was discussed, and KCP&L agreed to its removal per the email dated May 18, 2012.

3.2.4.9 Communications

Approximately 900 feet of communication lines owned by AT&T and Suddenlink run along Karnes Road in the public right-of-way. Both communications companies have agreed that they will re-route the communications lines at no cost to the project. AT&T has proposed to re-route their communications lines south from Karnes Road along the railroad embankment and north-west along Northwest Parkway to St. Joseph Avenue, as shown in Figure 3-6 and per the telephone report dated May 15, 2012. The new alignment will run approximately 1,400 feet in length. Suddenlink has agreed to bury its communication line beneath the detention basin along its current 900 foot long alignment per the telephone report dated May 17, 2012.

The communication lines that traverse the basin in the north area of the proposed detention basin will remain in place. If required, the pole that runs the communications lines from the west side to the east side of the proposed basin will be raised. The pole that is in the center of the north side of the proposed detention basin will be removed.

3.2.5 Conservation Easement

An additional easement, setting aside land for outdoor recreation is also located in the project footprint. The area is inclusive of the ball field and courts located to the south of Karnes Road. The City is responsible for filing a significant change in use proposal through MDNR and seeking approval from the National Park Service and bears responsibility for the costs to replace the recreation facilities that will need to be relocated before construction of the project. The easement and recreation improvements were constructed with federal grant funds from the Land and Water Conservation Fund project. This action is a City requirement and is not eligible for LERRD credit.

3.3 Design and Construction Considerations

3.3.1 Earthwork

Approximately 660,000 cubic yards of material would need to be excavated to create the detention basin. The side slope of the excavation would be 3H:1V. The minimum slope of the detention basin bottom would be 1 percent to provide positive drainage to Blacksnake Creek. A preliminary grading plan for the basin is shown in Figure 3-7. Cross section through the primary and secondary overflow spillways are shown in Figures 3-8 and 3-9.

Within the detention basin footprint, the existing open channel is approximately 2,700 feet long, has a typical bottom width of 15 feet, and side slopes that vary between one

and two feet horizontal to one foot vertical. The existing open channel will be modified in cross-sectional geometry and alignment. The proposed channel will have an approximate length of 2,800 feet and an average slope of 0.6 percent through the project site. It will have a side slope of 3H:1V on the left bank and a side slope of 5H:1V on the right bank.

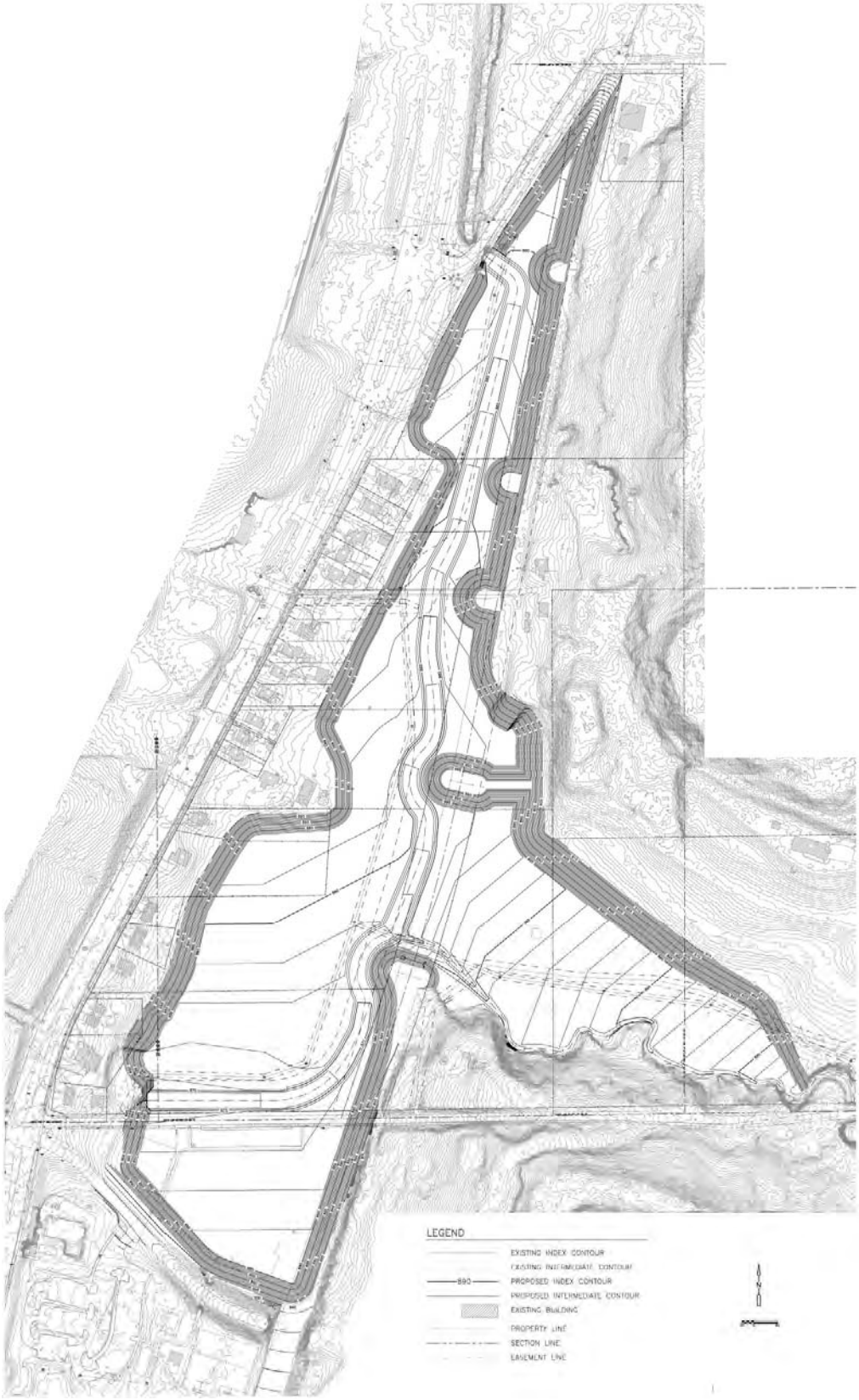


Figure 3-7 Preliminary Detention Basin Grading Plan

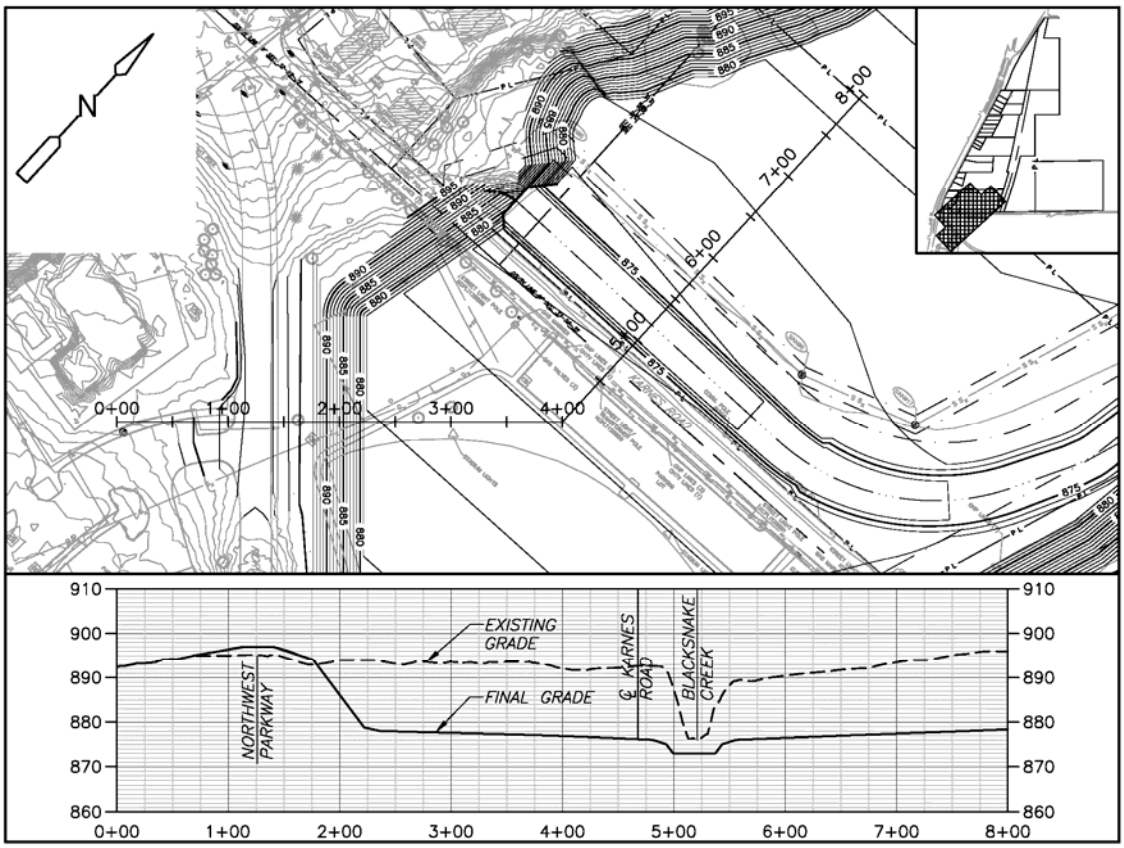


Figure 3-8 Cross Section through the Primary Spillway

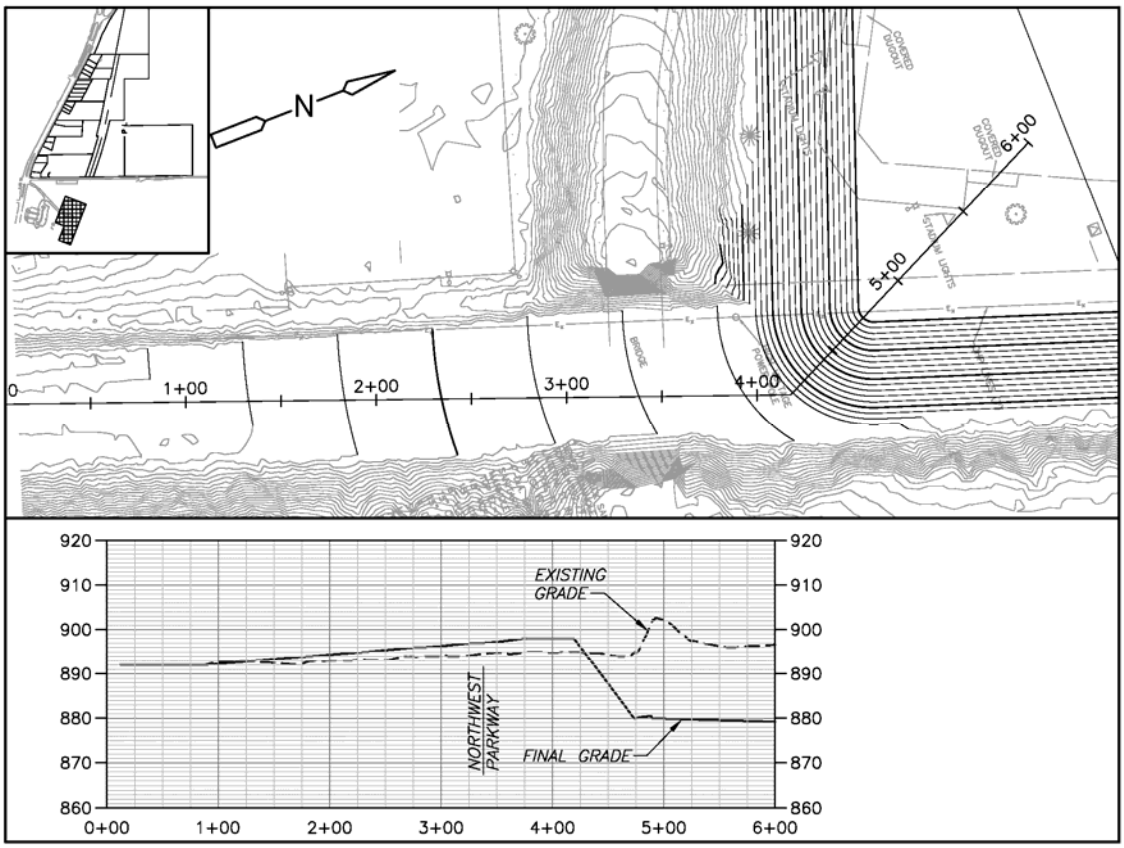


Figure 3-9 Cross Section through the Secondary Spillway

The final slopes would be seeded to provide erosion protection. Riprap protection would be added to areas of the stream channel and basin slopes susceptible to erosion during flood events. The slope stability analysis and riprap sizing for the basin are provided in the geotechnical engineering analysis provided in Appendix D.

3.3.2 Clearing and Grubbing

Clearing and grubbing of trees and vegetation will be required for approximately 13.4 acres, as shown in Figure 3-10. Throughout the rest of the 23 acres within the detention basin, clearing of turf will be required.

3.3.3 Storm water Management

The base flow for Blacksnake Creek is two million gallons per day[6]. A large temporary diversion channel capable of accommodating this flow will need to be created during construction. The diversion channel is anticipated to be located within the construction footprint, the exact location of the diversion channel will be determined in design. Development and adherence to a water control plan will be required for construction.

[6] Technical Memorandum No. TM-CSO-5, Storm water Separation Conduits, Black & Veatch, January 15, 2010.

A preliminary water control plan is discussed in the geotechnical engineering analysis provided in Appendix D.

Implementation and maintenance of erosion control measures would be necessary during construction. Storm water pollution prevention best management practices (BMP) will need to be utilized for all aspects of the project. Development and adherence to the storm water pollution prevention plan is critical.

3.3.4 Construction Sequencing

Construction activities will be greatly influenced by the time of year, proposed alignment, and conditions for erosion control stabilization. A preliminary construction sequence illustrating assumptions and challenges of construction, while accommodating Blacksnake Creek flows, is presented in the geotechnical engineering analysis provided in Appendix D.

3.3.5 Schedule

Table 3-9 presents the schedule for the major tasks for the design and construction of the detention basin. A more detailed schedule is provided with the cost estimate in Appendix E.

Table 3-9 Design and Construction Schedule

Task	Duration (calendar days)
35 % Design	120
65 % Design	120
95 % Design	60
100 % Design and Construction Contract Documents	45
Construction	325
Real Estate Acquisition	420

Figure 3-10 Clearing and Grubbing Required for Construction of the Detention Basin

3.3.6 Recommendations for Additional Investigation

An additional geotechnical investigation and laboratory testing program should be conducted to verify the soil stratigraphy and shear strength parameters determined as part of this preliminary feasibility study.

The investigation should consist of hollow-stem auger borings, each with a depth of 50 feet, or refusal, whichever occurs first. Soil boring locations should be selected based on critical components of the project. For example, transmission tower pads, inlet and outlet locations, overflow embankments, and tall or otherwise critical embankment slopes. Additionally, soil borings should be appropriately spaced around the perimeter of the project to provide adequate information about depth to bedrock and stratigraphic changes from one end of the project to the other.

The soil borings should include shelby-tube (for cohesive materials) and split-spoon (for granular materials) sampling at five-foot intervals for the full depth of the soil borings. A laboratory testing program would then be developed including moisture content testing, Atterberg limit testing, unconfined compression testing, unconsolidated undrained, and consolidated undrained with pore water pressure triaxial compression testing. The tests should be well-distributed throughout the soil boring depth to provide sufficient testing within each encountered stratum.

3.4 Lands, Easements, Rights-of-Way, Relocations, or Disposal Areas Considerations

3.4.1 Lands, Easements, Rights-of-Way

There are 24 parcels of land with a total acreage of approximately 42.17 that will be affected by the detention project. The type of interest to be acquired includes Fee Simple and Easements. The majority of the land (34.85 acres) will be acquired in fee simple. Approximately 7.19 acres of land will be acquired in the form of utility easements and approximately 20 acres of land will be acquired for a Temporary Work Area Easement. An additional 14.17 acres would be acquired for mitigation. There are 47 parcels that have been identified for potential mitigation locations. Specific locations will be determined during design.

3.4.2 Relocations

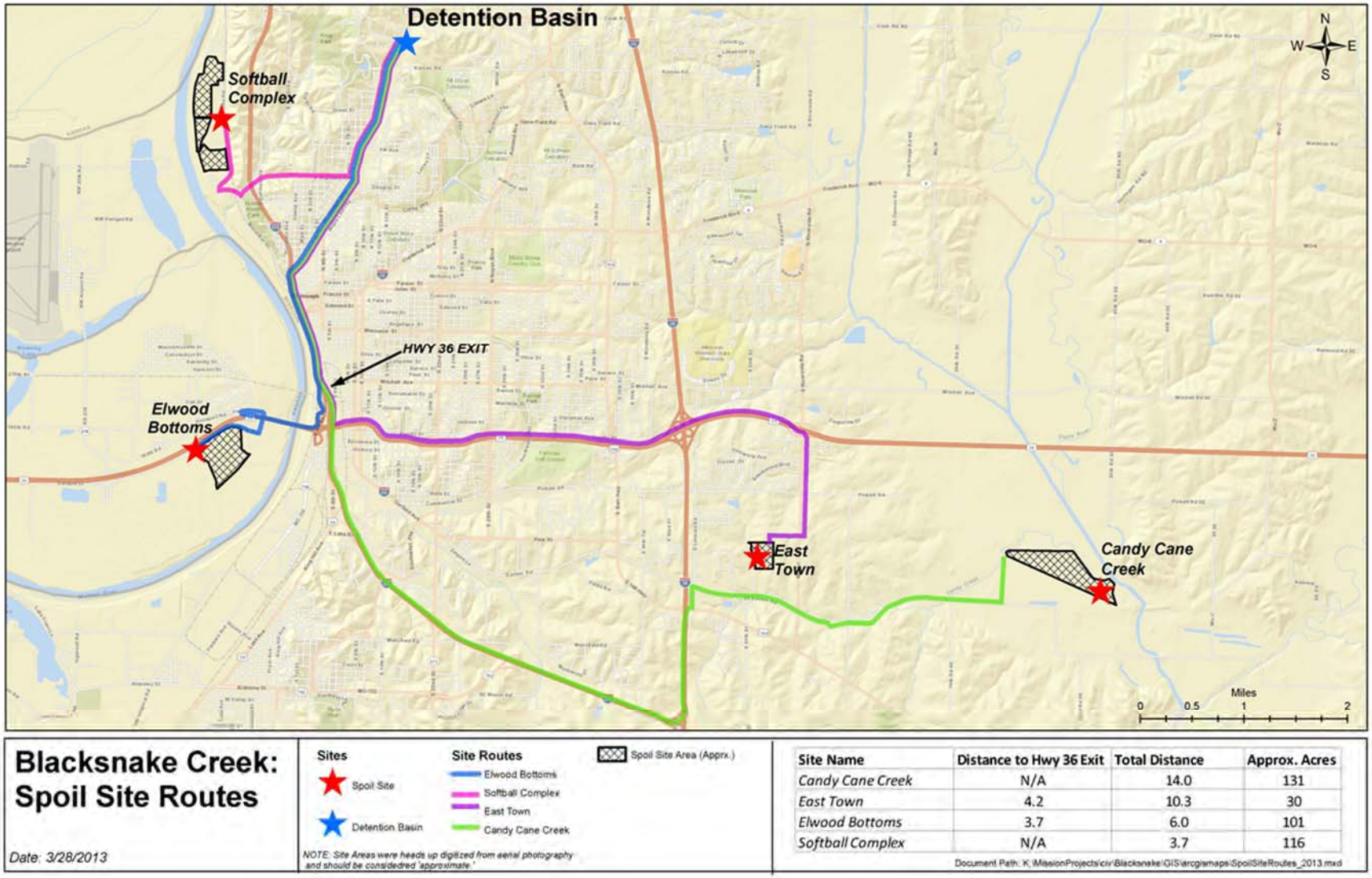
The utilities located in close proximity to or within the footprint of the project include natural gas, water, electric, sanitary sewer and communications lines. Although a significant effort was made to identify all required relocations, there is a possibility the project will require additional unknown relocations which will be addressed in the Engineering and Design phase of the project.

3.4.3 Disposal Areas

Four spoil sites were identified for disposal of the excavated soil. The locations of spoils sites, haul distance from the project site, and approximate acres of each are show on Figure 3-11. Of the four sites, the preferred locations are the Heritage Park Softball Complex and the Elwood Bottoms. The Heritage Park Softball Complex is the preferred spoil site for soil separation as it is owned by the City and is the largest site

and located closest to the Elwood Bottoms location. Elwood Bottoms consists of federally owned land acquired under the Missouri River Recovery Program. The lands are managed as agricultural land by the Kansas Department of Wildlife, Parks and Tourism. Excavated soils that are suitable for use in levee construction will be stockpiled at Elwood Bottoms and used for the adjacent MRLS R471-460 and L455 levee raise. If the Blacksnake Creek Project and levee raise are constructed within the same timeframe, material can be hauled directly to the levee from the Heritage Park Softball Complex instead of being stockpiled at Elwood Bottoms. Material that is not suitable for levee construction would be stockpiled at the Heritage Park Softball Complex. Unsuitable soil would be distributed within the Heritage Park Softball Complex and compacted, and some material such as large stones and debris may be disposed off-site.

3.5 Cost Estimate



Site Name	Distance to Hwy 36 Exit	Total Distance	Approx. Acres
Candy Cane Creek	N/A	14.0	131
East Town	4.2	10.3	30
Elwood Bottoms	3.7	6.0	101
Softball Complex	N/A	3.7	116

Figure 3-11 Disposal Areas

3.5.1 Cost Estimate

The cost estimate for the Recommended Plan provided in Appendix E was prepared using the Micro Computer Aided Cost Engineering System Second Generation (MII) software version 4.1, build 2 and using the latest available/supported MII databases: 2012 English Cost Book, 2014 MII Equipment Region 5 Library, and labor cost using local Davis-Bacon prevailing wage rates and professional labor rates. Material costs from the 2012 English Cost Book were updated using vendor quotes or adjusted to 2015 material costs. The 2014 Region 5 equipment library area factors were adjusted to account for current cost-of-money, state sales tax and fuel costs (gasoline and on- and off-highway diesel) at the time of estimate preparation.

The quantities used in the estimate preparation were determined from preliminary concepts for the work and calculations made by the project engineers. Quantity assumptions were used for concept components not shown or otherwise quantified. The structure of the estimate is based on the civil works breakdown structure and the tasks that would likely be required to complete the project.

The costs presented in the estimates are considered Class 5 according to the American Society for Testing and Materials Standard Classification for Cost Estimate Classification System (Designation E 2516-06). This cost estimate is an opinion of probable construction cost only, as defined by the documents provided at the level of design indicated.'

The sponsor's operations and maintenance tasks were included in the estimating process and include anticipated mowing and general cleanup, riprap inspection and replacement, debris removal in the channel and combined sewer inlet, and spillway inspection and maintenance.

3.5.2 Cost Risk Analysis

The current USACE guidance requires a formal cost risk analysis on all projects where the estimated TPC exceeds $40 million. However, USACE has established an Abbreviated Risk Analysis process as an acceptable method in addressing the regulations for risk based analysis for TPC under $40 million. A cost risk analysis was provided on the TPC.

Cost risk analysis process identified and measured the cost impact of project uncertainties on the estimated TPC. The overall cost risk analysis process for the project involved (1) identifying risk factors, (2) analyzing and quantifying the properties of those risk factors, (3) mitigating the impact of the factors on planned project performance, and (4) developing and implementing a risk management plan.

Key risks were identified by the project team and risk management strategies were identified as the risk analysis was conducted. In cases where the team identified quantity adjustments were needed, the adjustments were made to the project estimate. Where project costs remain unquantified due to the preliminary nature of the feasibility design analysis and lack of design data, the cost risk is managed by adding

contingency to the TPC for implementation. Based on the cost risk analysis, the overall contingency for the project is approximately 24 percent.

3.6 Environmental Impacts

Overview of alternative screening and selection of action alternatives:

KCD prepared a preliminary hydraulic analysis and identified four dry detention plans with the feasibility of meeting the designated levels of protection (CDM, 2009). These initially formulated alternatives (Alternatives 1 through 4) all included the construction of a detention dam, levee, and floodwall with different detention capacities. These alternatives were essentially screened out early in the feasibility phase due to a variety of issues. It was determined through economic and engineering analysis that the initial four structural alternatives were cost prohibitive from both the construction and operation standpoint, and would result in drainage issues as the construction of a levee would result in trapping water runoff within the yards of the homes bordering St. Joseph Avenue to the east, between Karnes Road and Savannah Boulevard. The levee itself would measure between five and 13 feet high with a base width of 50 feet to 100 feet, crest width of 10 feet, and a total length of 2500 feet. Opposition to structural alternatives was expressed at the April 2005 public meeting.

The *Blacksnake Creek Section 205 Feasibility Study Non-Structural Flood Mitigation Alternatives Analysis* (CDM Smith, 2012) was completed for this feasibility study. Non-structural measures considered include structure acquisition, demolition/relocation, structure elevation, and flood proofing. Nonstructural flood risk management measures were generally considered ineffective to meet project objectives due to technical and economic feasibility, quantity and distribution of structures in the downstream reach, local acceptability and other factors. Consequently, most of the potential nonstructural measures were eliminated from further consideration in the early stages of plan formulation. An acquisitions alternative – Alternative 9, however, was carried into the economic screening analysis but did not compete effectively against the NED plan in terms of economic efficiency.

Four dry detention plan alternatives with levels of protection in the range of a 25 to 250-year flood event were subsequently added as Alternatives 5 through 8. The alternative plan with highest net benefits is the NED plan. The NED plan is considered the most economically efficient alternative and is the Recommended Plan as a result of economic analysis. The Recommended Plan is described in detail in Section 3 Recommended Plan. Alternatives 5, 6 and 8 are very similar, with the primary exceptions of the excavation of Karnes Road and not relocating the 161 KV power poles, which are included in Alternative 8. Alternative 7 is similar to 5, 6 and 8, but has an additional difference in that it would also involve 21 relocations. Figure 2-6 provides a graphic of the alternatives with an overlay of Alternatives 5, 6, 7, and 8. Construction footprint acreages are included below in the alternatives descriptions. The maximum excavation depth is estimated at five feet to 15 feet for all of the action alternatives proposed.

Alternative 5: Detention Basin with lower pool height, no levee, flood wall or dam; excavation without impacting structures; overflow spillway on Karnes

Road: The Blacksnake Creek floodplain north of Karnes Road between St. Joseph Avenue and an abandoned railroad right-of-way would be excavated to increase detention capacity. The abandoned railroad right-of-way along the east side of the basin would be removed to access additional detention volume to the east. An overflow spillway would be constructed at an elevation of 895 NAVD on Karnes Road. In this alternative, an overflow spillway at Karnes Road would be the point of overtopping. Alternative 5 includes a construction footprint of approximately 23 acres.

Alternative 6: Similar to 5, but more storage by excavating between Karnes Road and Northwest Parkway: Alternative 6 would increase the detention capacity of Alternative 5 by excavating the area between Karnes Road and Northwest Parkway. Culverts would be constructed to provide a connection between the areas north and south of Karnes Road. In this alternative, an overflow spillway constructed at Northwest Parkway would be the point of overtopping. Alternative 6 includes a construction footprint of approximately 28.3 acres.

Alternative 7: Similar to 6, but expanded storage located north of Karnes Road; requires acquisition and removal of homes west of St. Joseph Avenue: Alternative 7 would increase the detention capacity of Alternative 6 by expanding the basin north of Karnes Road to the west. This alternative would require the purchase and demolition of the residences on the west side of the basin along St. Joseph Avenue. In this alternative, an overflow spillway constructed at Northwest Parkway would be the point of overtopping. Alternative 7 includes a construction footprint of approximately 37 acres.

Alternative 8 (NED Plan and Recommended Plan): Similar to Alternative 6, but excavates abandoned Karnes Road and uses the volume gained to construct utility pads around three 161 KV power poles that were to be relocated: Alternative 8 is similar to Alternative 6, but takes into account the City's plan to abandon the section of Karnes Road crossing the basin as part of its approved area transportation plan. The abandonment of Karnes Roads allows a reduction in cost by eliminating the need to raise, reconstruct, and armor the road, and for the installation of culverts to provide a hydraulic connection between the basin areas north and south of the road. The point of overtopping is similar to Alternative 6 and includes an assumed primary overflow spillway at Northwest Parkway with a crest elevation of 897 NGVD and a secondary spillway at 898 NGVD as shown on Figure 3-2. These overflow spillways would inundate the park location downstream of Northwest Parkway similarly to the existing condition and accommodate the City's planned road modifications. The volume gained by the removal of Karnes Road is used to construct pads around three 161 KV power poles that were to be relocated under Alternative 6 while maintaining the same detention volume. The cost savings associated with removing Karnes Road and not relocating the 161 KV power poles out of the basin is approximately $1 million. Alternative 8 includes a construction footprint of approximately 35.6 acres.

Environmental impacts resulting from the no-action alternative and dry detention Alternatives 5 through 8 brought forth through feasibility are discussed below. Unlike Alternatives 1 through 4, Alternatives 5 through 8 use the natural topography and a lower pool height to avoid the need for the Karnes Road dam and levee/floodwall

combination upstream. “Construction” refers to all activities required to complete the proposed project including clearing and grubbing, excavation of spoil, hauling and placement, utility relocations, and all other related construction activities. As described above, Alternative 8 is the Recommended Plan. The terms “Alternative 8” and “Recommended Plan” are used interchangeably below.

3.6.1 Air Quality

Air quality impacts as a result of the action alternatives proposed including the Recommended Plan are anticipated to be minor, short-term adverse impacts primarily due to clearing and grubbing, excavation, hauling, separation and the placement of soil and stone. These activities would result in the generation of common air quality pollutants including nitrogen oxides, ground level ozone, dust and windblown particulate matter.

Alternatives 5, 6, and 7 would each result in clearing 12.4 acres of trees and excavating soil volumes of 539,000 cubic yards, 660,000 cubic yards, and 1,060,000 cubic yards, respectively. Therefore, Alternative 5 would likely result in the least air quality impacts, with Alternatives 6 and 8 resulting in similar air quality impacts. Alternative 7 would be anticipated to result in the most air quality impacts due to the largest volume of soil excavated among the proposed action alternatives. The Recommended Plan results in clearing 13.4 acres of trees and excavating 660,000 cubic yards of soil, one acre of trees more than the other alternatives proposed, but less soil excavated compared to Alternative 7.

Construction-related air quality impacts are expected to be short-term and minor. During construction, BMPs such as watering roads and construction sites could be implemented to minimize fugitive dust emissions. Spoil locations would be seeded after placement to prevent additional dust and windblown particulates. Construction of any of the action alternatives is anticipated to conform to National Ambient Air Quality Standards.

Post-construction air quality impacts are anticipated to be short-term and minor. Clearing 12.4 acres of trees would reduce the number of trees within the project area available to reduce evaporative emissions from vehicles and other fuel storage. Tree clearing also reduces the surface area of leaves that can allow for removal (deposition) of ozone, nitrogen dioxide, and to a lesser extent particulate matter. Several different factors affect pollutant removal. These factors include how long a parcel of air is in contact with the leaf, the amount of leaf area, as well as the specific pollutant of interest. Air quality would also be impacted by future maintenance as it would include mowing and debris removal from the channel, combined sewer inlet, and spillway. Minor earthwork and reseeding may be required in erosion prone areas and rip-rap may need to be moved or replaced due to the settling process or high flows. Air quality impacts would be mitigated by tree replacement as discussed in Section 3.6.12. There are also relatively large acreages of trees located adjacent to the project area that would continue to provide air quality benefits (Figure 1-1).

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would likely result in

increased adverse air quality impacts over the action alternatives proposed as long-term, repeated, minor adverse impacts to air quality due to future flood events in the five-year range as these would result in the continued mobilization and operation of emergency vehicles, generators, and associated equipment in the absence of a federal project that provides increased flood risk management. Due to the apparent age of the riparian corridor, which appears to be between approximately 10 and 20 years, selective clearing would continue to adversely impact portions of the riparian corridor that provide air quality benefits, but would not be anticipated to totally clear the riparian corridor.

3.6.2 Water Quality

Short-term, minor impacts to water quality would be anticipated as a result of implementing any of the action alternatives proposed. Construction would include the removal of riparian vegetation, excavation, grading, and hauling of soil, timber, and stone. Alternative 5 would likely result in the least potential for adverse water quality impacts as it requires less excavation area and volume than the other action alternatives proposed. Alternatives 6 and 8 would be expected to result in similar potential impacts to water quality as they require the same excavation volume, although the excavation area of Alternative 8 (Recommended Plan) is 7.3 acres larger than the excavation area of Alternative 6. Alternative 7 would likely result in the largest potential impacts to water quality as the largest area and volume of soil would be excavated compared to the other action alternatives (Figure 2-6). In addition to basin excavation, a temporary diversion channel capable of accommodating the Blacksnake Creek base flow will need to be excavated for construction for all of the action alternatives proposed. The diversion channel is anticipated to be located within the construction footprint. The location of the diversion channel will be determined in design.

All of the action alternatives would be anticipated to result in a short-term, minor increase in suspended solids and turbidity in the vicinity of the Missouri River outfall. These impacts would decrease as the construction area stabilizes following construction and the detention of floodwater would provide a positive impact to downstream water quality due to the settling of suspended solids and organics. Potential impacts to downstream Blacksnake Creek and the Missouri River water quality are not anticipated to be significant as BMPs, a storm water pollution prevention plan, and a water control plan would be implemented during construction to prevent potential water quality impacts. A preliminary water control plan is discussed in the geotechnical engineering analysis provided in Appendix D. A national pollutant discharge elimination system (NPDES) permit and Section 401 water quality certification would be obtained prior to construction.

BMPs would be designed to minimize the incidental fallback of material into the waterway during construction and to minimize the introduction of fuel, petroleum products, or other deleterious material from entering the waterway. Such measures could include the use of erosion control fences; storing equipment, solid waste, and petroleum products above the ordinary high water mark and away from areas prone to runoff; and requiring that all equipment be clean and free of leaks. To prevent spoil from reaching water sources by wind or runoff, spoil would be covered, stabilized or

mulched, and silt fences would be used as required. Potential impacts would be avoided and/or minimized to the greatest extent possible by the implementation of BMPs and measures required under the NPDES permit. Disturbed areas and spoil areas would be seeded concurrently with construction or as soon as practicable following construction. Post-construction water quality impacts are anticipated to be short-term and minor as maintenance would include mowing and debris removal from the channel, combined sewer inlet, and spillway. Minor earthwork and reseeding may be required in erosion prone areas and rip-rap may need to be moved or replaced due to the settling process or high flows.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would result in major, short- and long-term impacts to water quality as periodic flooding would introduce waste and contaminants from the City's CSS and overland flow into flood prone areas. Adverse post-construction water quality impacts from the Recommended Plan would be minimized compared to the no-action alternative as the proposed project is designed to provide flood risk management for the 4 percent to 2 percent ACE event.

3.6.3 Noise

No significant noise impacts are anticipated due to the construction of any of the build alternatives proposed. All of the proposed build alternatives would result in a short-term, relatively minor adverse noise increase over existing conditions due to construction. Project noise impacts would result from the operation of construction equipment including excavators, graders, and haulers, and increased construction traffic on area roads. The difference between noises generated as a result of the construction of the action alternatives is primarily due to the cubic yards excavated and the acreage of clearing and grubbing. Alternative 5 would result in the least construction noise compared to the other action alternatives as it requires less clearing and grubbing and less excavation compared to the other action alternatives proposed. Alternatives 6 and 8 require the same detention basin excavation, with Alternative 8 requiring more clearing and grubbing (7.3 acres) of woody vegetation. Alternative 7 requires more clearing and grubbing and more excavation than the other action alternatives proposed and would therefore likely result in the most construction noise of the alternatives proposed.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would result in recurring flood events and increased short and long-term noise over the action alternatives proposed as no action would provide existing 20 percent ACE flood risk management protection compared to the 4 to 0.4 percent ACE event protection that the action alternatives provide. Increased noise would result from the recurring mobilization of emergency vehicles, generators, and associated equipment to clean and repair flood damaged areas.

The Recommended Plan provides flood risk management protection in the 4 to 2 percent ACE range. Noise associated with the operation of the action alternatives includes the periodic mowing, removal of woody vegetation from the detention basin, and other maintenance activities. Noise generated within the project area may travel

farther as a result of riparian corridor removal as fewer trees would be available to buffer sound. The City plans to replant trees to lessen the impact of riparian corridor removal. Minor, short-term adverse post-construction noise impacts anticipated include mowing, debris removal, and rip rap adjustment or replacement.

To lessen the impact of noise during construction, the public would be made aware of pending construction. Source control, site noise emissions, and work hours may be coordinated with sensitive noise receptors to manage the impact of construction noise.

3.6.4 Aesthetics

All of the action alternatives proposed would result in moderate, long-term adverse impacts to aesthetics within the project area. The impact of the Blacksnake Creek riparian corridor removal would be anticipated to be more prevalent to the residents along St. Joseph Avenue whose property faces the creek, and those who drive along the roads in the vicinity of Blacksnake Creek. Alternatives 5, 6, and 7 would impact 12.4 acres of trees with a progression in clearing and grubbing of approximately 23.0 acres, 28.3 acres, and 37.0 acres. Alternative 8 impacts approximately 13.4 acres of riparian vegetation with a total cleared and grubbed area of 35.6 acres. Alternative 7 would result in a major, long-term impact to aesthetics compared to the other action alternatives proposed as 21 homes and associated structures located west of Karnes Road would be removed for detention.

The conversion of the baseball field, basketball courts, and parking lot located south of Karnes Road to detention basin as a result of Alternatives 6 through 8 is considered a moderate, long-term adverse aesthetic impact as conversion to detention is different than existing conditions. However, the baseball field, basketball courts, and parking area are aged, only periodically maintained and show visible wear from use and their existing aesthetic value is considered relatively low. The recreational facilities will be replaced by the City in accordance with the City's obligation under Section 6(f)(3) of the Land and Water Conservation Fund Act. A portion of Northwest Parkway is a designated scenic drive and is lined with trees, which will lessen the aesthetic impact of tree removal adjacent to Karnes Road. The detention basin would eventually be colonized by herbaceous and woody vegetation, which would likely be periodically cleared to convey flow.

The City has developed a tree mitigation plan so that trees cleared for detention basin excavation would be replaced by the construction contractor and therefore lessens the aesthetic impact associated with tree impacts due to the action alternatives proposed, including the Recommended Plan. Additionally, Blacksnake Creek upstream of the project area would retain its riparian corridor and there are hundreds of acres of trees within the vicinity of the project area with similar species as those to be removed (Figure 2-1). The aesthetic impact is as a result of tree and recreational facility removal, and the excavation of a detention basin are considered moderate, long-term and less than significant.

The storage of soil at the Heritage Park Softball Complex and Elwood Bottoms is anticipated to result in a short-term, minor adverse impact to aesthetics. Soil separation is anticipated to occur within the winter timeframe, which is typically when

construction occurs and softball season has ended. Separated soil is expected to be graded concurrently with construction. Some soil may need to be stockpiled temporarily within the Heritage Park Softball Complex, and would be graded into the existing grade of the Heritage Park Softball Complex prior to spring. Tree clearing, excavation and earth moving have recently occurred within the Elwood Bottoms. Soils may be stockpiled for approximately two years, which would result in a short-term, minor adverse aesthetic impact considering the amount of disturbance and altering of aesthetics that has already occurred within the Elwood Bottoms.

Post-construction aesthetics would not be anticipated to appreciably change with regular maintenance of the project. The City's operations and maintenance considerations will include periodic inspections of the project, occasional mowing and debris removal to maintain flow conveyance. Increased aesthetic impacts would occur if a lack of maintenance allows woody vegetation to grow to an appreciable size prior to clearing to maintain conveyance.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would result in major, long-term adverse aesthetic impacts as periodic flooding of the corridor, residences, and businesses would occur more frequently than implementing an action alternative. Due to the apparent age of the overall riparian corridor, which is estimated to be between approximately 10 and 20 years, selective clearing would continue to impact portions of the riparian corridor, but would not be anticipated to totally clear the riparian corridor. Existing riparian corridor located upstream of the project area would be expected to remain intact in the short-term, although increasing urbanization may result in additional impacts to the riparian corridor. The baseball field, basketball courts, and parking lot located south of Karnes Road would continue to require periodic maintenance such us painting, repaving, mowing, weed control, seeding, and cleaning after flood events to maintain or improve existing aesthetics.

3.6.5 Climate

Climate change is generally attributed to extreme weather events such as El Nino and global warming due to the deterioration of the Ozone layer. The action alternatives proposed including the Recommended Plan would result in a minor, short-term impact to air quality due to construction emissions and a minor, relatively long-term impact due to the removal of vegetation as replacement vegetation would take a few years to get established and provide environmental benefits. The construction activities proposed for all of the action alternatives are similar to construction that occurs periodically within the vicinity of the project area and throughout parts of the City, but would occur on a larger scale in a single timeframe. Construction and post-construction impacts are anticipated to have a negligible impact on climate change as maintenance would include occasional mowing, debris removal, and/or rock adjustment or replacement.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would result in a continued minor, long-term adverse impact to air quality due to the mobilization of emergency vehicles and construction equipment during and following a flood event. The no-action

alternative and the action alternatives proposed are not anticipated to appreciably affect extreme climate and weather events, drought, or climate change in general.

3.6.6 Recreation

The extent of recreation associated with Blacksnake Creek is unknown, but likely minimal as the creek is relatively narrow and shallow with intermittent flow, deeply incised banks and a limited fishery. Private residences and associated privately owned properties adjoin the creek and to some extent contribute to limited public access. All of the action alternatives proposed would result in minor, short-term impacts to Blacksnake Creek recreation as creek recreation would not be available during construction. Creek recreation would be available post construction, although the creek recreation opportunities within the project area would differ in the long-term due to the removal of the riparian corridor, flattening and armoring of the stream banks.

Alternative 5 would result in no impacts to the Northside Recreational Complex and associated parking south of Karnes Road. Alternatives 6, 7, and 8 would result in long-term, minor impacts to recreation as the ball field, basketball courts, and associated parking just south of Karnes Road would be excavated for detention.

The sports fields (ball park and basketball courts) were constructed by the City using grant funds from the Land and Water Conservation Fund. The lands underlying these facilities are part of a permanent conservation easement that sets aside the land for outdoor recreational use. The City is responsible for replacing the impacted facilities and for maintaining the conservation easement on the set aside lands. The land may be converted to passive recreational opportunities via an application to be prepared by the City and upon approval by the agencies overseeing the conservation easement. The City has plans to replace the ball field and basketball courts within the area, however specific locations have not been identified. Similar facilities are available within the general vicinity that can accommodate additional recreational activities in the interim. The nearest locations of additional public basketball courts include Humboldt Elementary, 1520 N 2nd St.; Robidoux Middle School, 4212 St. Joseph Ave; Lindbergh Elementary, 2812 St. Joseph Ave; and Field Elementary, 2602 Gene Field Rd. Additional ball fields are available at the Heritage Park Softball Complex located to the southwest of the project area,

An overall minor, long-term adverse impact to local recreation as addressed above would occur due to the implementation of Alternatives 6, 7, or 8. However, the City has plans to provide recreation amenities similar to those that are currently available within the local area and region.

The Recommended Plan would reduce flood risk from the 26 percent pre-project annual exceedance probability to about 5 percent with the project in place.

Post-construction maintenance including the mowing and clearing of vegetation and debris within the channel, combined sewer inlet, and spillway would not be anticipated to impact recreation. Minor earthwork and reseeding may be required in erosion prone

areas and rip-rap may need to be moved or replaced due to the settling process or high flows.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would result in minor, short-term impacts to recreation as the creek and recreational amenities south of Karnes Road including the Northside Recreational Complex would be unavailable during, and for an undetermined timeframe following flood events.

3.6.7 Geology and Soils

Long-term, minor adverse impacts to soils and geology would be anticipated from all of the action alternatives proposed due to the excavation of approximately 660,000 cubic yards of alluvium, soil mapped as prime farmland and hydric soil, and its removal from the project area, separation and storage of soil within proposed disposal areas and the removal of rock from a local quarry. Alternative 5 would result in the least amount of soil removed (estimated 539,000 cubic yards) as it requires less excavation than the other action alternatives proposed. Alternatives 6 and 8 would be expected to result in similar impacts to soils as they require the same volume of excavation (estimated 660,000 cubic yards). Alternative 7 would result in the largest impact to soils as this alternative requires the largest volume of soil to be excavated compared to the other action alternatives (estimated 1,060,000 cubic yards). All action alternatives would use similar amounts of rip rap to armor areas of potential erosion along Blacksnake Creek and aggregate to construct access roads.

Prime farmland soils, prime farmland if drained, and prime farmland of statewide importance removed from the project area would be separated and placed on existing mapped prime farmland soils and hydric soil located in the proposed disposal areas. Stockpiled soil is anticipated to be used for the MRLS R471-460 and L455 levee projects. No spoil would be placed in wetlands or within riparian areas. Rock would be avoided during detention basin excavation and not excavated if encountered. Rock used to armor the stream banks would be obtained from an existing quarry located in Missouri or Kansas and would meet the criteria specified in Engineering Manual 1110-2-1601, Engineering and Design - Hydraulic Design of Flood Control Channels. This impact to soils is considered minor as there is a very large amount of loess and alluvium, prime farmland and hydric soils mapped within Buchanan County, the vicinity of the project area and disposal areas.

Post-construction impacts to geology and soils would be anticipated to be negligible. Some minor, short-term geology and soil impacts could occur due to soil and rock replacement with the operation of the project.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would be anticipated to result in the continued erosion and deposition of alluvium within the floodplain due to periodic high flows. Geology, prime farmland and hydric soils within the vicinity of the project area would be anticipated to be adversely impacted by future maintenance and construction activities.

The no-action alternative would result in no soil separation at the Heritage Park Softball Complex and no stockpiling of soil at Elwood Bottoms. The soils within the Heritage Park Softball Complex are highly disturbed due to the construction of ball fields and associated amenities. No spoil would be placed and/or graded into existing ground. Elwood Bottoms soils are disturbed due to tree removal and grading, and would be anticipated to continue to be leased for agriculture and seasonally tilled. Geology would not be anticipated to be adversely impacted as a result of the no-action alternative as subsurface activities would not be anticipated to occur within the Heritage Park Softball Complex or Elwood Bottoms areas as a result of their current and anticipated future use. Spoil from detention basin excavation would not be temporarily stored within Elwood Bottoms in the absence of a Federal project.

3.6.8 Disposal Areas

The disposal areas designated for construction would be anticipated to receive relatively short-term, minor impacts as a result of the action alternatives proposed including the Recommended Plan. Spoil excavated from the proposed project area would be separated at the Heritage Park Softball Complex. Impervious material would be transported to the Elwood Bottoms spoil area. Separated material located at the Heritage Park Softball Complex would be stockpiled for future use, or graded into the existing open areas of the Heritage Park Softball Complex. Impervious material would be stockpiled in the Elwood Bottoms for up to approximately two years and is planned to be used to raise MRLS Units L455 and R 471-460. The long-term existing land use of the disposal areas is not expected to change and is anticipated to resume post construction.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would result in no soil separation at the Heritage Park Softball Complex and no stockpiling of soil at Elwood Bottoms. The soils within the Heritage Park Softball Complex are highly disturbed due to the construction of ball fields and associated amenities. No spoil would be placed and/or graded into existing ground. Elwood Bottoms soils are disturbed due to tree removal and grading, and would be anticipated to continue to be leased for agriculture and seasonally tilled. Geology would not be anticipated to be adversely impacted as a result of the no-action alternative as subsurface activities would not be anticipated to occur within the Heritage Park Softball Complex or Elwood Bottoms areas as a result of their current and anticipated future use. Spoil from detention basin excavation would not be temporarily stored within Elwood Bottoms in the absence of a federal project.

3.6.9 Land Use

Land use within the watershed is not expected to change appreciably within the short-term. The lower basin is already predominantly urban. Existing agricultural land within the upper basin would be expected to convert to urban land uses in the long-term as this seems to be the trend in similar watersheds.

Land use within the vicinity of the proposed project area would be anticipated to remain primarily urban and would not be anticipated to appreciably change as a result of any of the action alternatives proposed, including the Recommended Plan.

Implementation of any of the action alternatives proposed would result in increased flood risk management within the estimated 4 percent to 0.4 percent ACE event range. Alternative 7 would result in a major, long-term impact to land use compared to the other action alternatives proposed as 21 homes and associated structures located west of Karnes Road would be removed for detention. The Recommended Plan is anticipated to provide flood risk management in the range of the 4 percent to 2 percent ACE flood event, which would provide a long-term, positive impact to existing land use. Although existing residences and businesses would gain increased flood risk management, severe precipitation events would likely result in some flooding within the areas currently impacted by flooding. Post-construction maintenance activities such as reseeding and riprap replacement, mowing, debris removal from the channel, combined sewer inlet, and spillway is not anticipated to change land use.
In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would not be anticipated to appreciably change the existing land use within the basin or project area as it is highly urbanized, but would continue to result in major, periodic adverse impacts to the business and residences impacted by flooding, contributing a general economic decline in the area. Some businesses and/or residents may choose to relocate to higher ground to avoid flooding or choose to relocate out of the floodplain; however, such relocations are not assured and cannot be quantified.

The land use of the proposed spoil areas would not be anticipated to change in the long-term as a result of any of the action alternatives proposed, or the no-action alternative. The Heritage Park Softball Complex would continue to provide the same recreational benefits whether or not soil separation occurs with or without a federal project due to the amount of acreage available for stockpiling soil and per the City, the soil would not be stockpiled and graded into existing areas used to play softball or softball spectating. Heritage Park Softball Complex recreation during construction and post construction would be no different than current conditions, although access may be encumbered if construction would occur during active use of the Heritage Park Softball Complex. Stockpiling of soil at Elwood Bottoms would result in a minor, short-term change in land use as a portion of the existing agricultural land within the Elwood Bottoms would not be farmed for a couple of years due to stockpiling soils. Agriculture within the stockpiled area is expected to resume once the stockpiled soil is removed and the area graded to the surrounding elevation. In the absence of a federal project, no soil separation would occur at the Heritage Park Softball Complex and no soil stockpiling would occur within Elwood Bottoms.

3.6.10 Hazardous, Toxic, and Radioactive Waste (HTRW)

The Phase I Site Assessment concluded that there was little evidence of HTRW within the vicinity of the project area (Appendix A). The Assessment provided the following recommendations to avoid adverse HTRW impacts:

1) "*It is recommended that the abandoned railroad embankment not be used for borrow to construct any features of the proposed project, although the risk of significant contamination is small. If it is required that this material be used, soil testing should be performed to verify the presence or lack of contamination.*"

2) "*There are two upright 55 gallon drums located on adjacent private property within the limits of the proposed retention pond. Prior to removal, the contents of the drums (if any) should be identified so proper disposal measures can be taken.*"

There is no history of development or disposal of HTRW in the areas proposed for spoil separation and stockpiling, and no physical features that would indicate the past or present storage or use of HTRW. The portion of Elwood Bottoms that would be used for stockpiling has recently been cleared and graded and is partially actively used for agriculture. The Heritage Park Softball Complex is actively used for athletics, primarily softball. No HTRW was identified in the proposed disposal areas.

The railroad embankment would not be used for borrow. Any HTRW encountered including the two 55 gallon drums mentioned above would be removed and properly disposed prior to construction of any of the action alternatives proposed, including the Recommended Plan. HTRW removal is the responsibility of the project sponsor. Operation and maintenance of the detention basin following construction may include the localized use of herbicides and/or pesticides. However, operation and maintenance is not anticipated to result in any appreciable change regarding existing or new HTRW within the vicinity of the project area.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would be anticipated to result in no appreciable change in HTRW within the project area. Any existing HTRW would be expected to remain in place. No new sources of HTRW would be anticipated as a result of the no-action alternative as the history of the area includes minimal use and/or storage of HTRW within the vicinity of the project area and the land use is not anticipated to change in the absence of a flood risk management project.

3.6.11 Aquatic Habitat

Blacksnake Creek aquatic habitat quality is low as the creek is channelized, incised and highly disturbed due to selective clearing of the riparian corridor, channelization, the lining of concrete, and the dumping of asphalt, concrete, and litter into and adjacent to the creek. The existing riparian corridor provides shade and the removal of the tree canopy and rock armoring power pole foundations and potential areas of erosion would result in disturbance of the existing aquatic habitat, less stream shading and more impervious surface that would be anticipated to result in localized increased water temperatures and lower dissolved oxygen. Removal of the trees along the riparian corridor would be anticipated to result in minor change of the aquatic community that is currently present within the project area. Water temperature would be anticipated to cool down after flowing underground from the project area to the Missouri River and movement of water out of an outfall and into the Missouri River would compensate and increase dissolved oxygen content due to the mixing of water and air at the outfall. Therefore, less shading and rock placement is not anticipated to increase runoff pollution and adversely impact the dissolved oxygen content in the Missouri River. The settling of floodwater in detention would allow for particulate matter and organics to settle out prior to outfall to the Missouri River and the aquatic community would become reestablished within the project area following construction and stabilization of the project.

To determine the amount of fill that would be placed in jurisdictional waters of the U.S., a 404(b)(1) evaluation was conducted by the KCD Regulatory Office (Appendix J). Impacts to the perennial stream (Blacksnake Creek) and the adjacent ephemeral stream are based on the Missouri Stream Mitigation Method calculations provided by MDNR (Appendix B). Impacts to these resources are addressed separately below. Blacksnake Creek jurisdictional water measures a total of 2,650 total linear feet within project area, and 1,200 linear feet would be excavated three to four feet deeper than the existing creek substrate. The Creek bottom would also be widened an average of 20 feet along its length as it is currently incised and stream banks would be shaped. Areas that are realigned for power pole foundations would bump the channel out and function as small meanders. The estimated amount of material to be excavated below the ordinary high water mark totals 44,000 cubic yards and the estimated total amount of fill is approximately 2,700 cubic yards for a net excavation of 41,300 cubic yards. Excavated material will be reused as fill and would be moved around to shape the stream and stream banks. Remaining suitable material would be used to elevate power pole foundations.

Approximately 2,140 tons of riprap would be placed below the ordinary high water mark at river bends. Approximately 30,980 tons of rock would be placed above the ordinary high water mark. Placement of rock above the ordinary high water mark includes around power pole pads, at the primary and secondary spillways, and at river bends. Approximately 3,800 tons of aggregate will be used for permanent and temporary access roads. Therefore, a total of approximately 33,120 tons of riprap for erosion control and 3800 tons of aggregate surfacing would be placed.

The ephemeral stream to the east of Blacksnake Creek would be impacted similar to the creek. The total stream length is 1,380 linear feet. Trees would be removed to convey flow, 240 linear feet of stream would be realigned and 1,060 linear feet of stream would be shaped to convey flow more efficiently. The estimated amount of material to be excavated below the ordinary high water mark totals 284 cubic yards and the total estimated amount of fill required is 53 cubic yards. Excavation would not occur deeper than the existing streambed and excavated material would be moved around to shape the stream and stream banks. Sixty linear feet of the existing channel would be permanently filled. However, flow would be directed into the creek similar to existing conditions and mixing would occur at the Missouri River outfall. Therefore, no discernible change in Missouri River dissolved oxygen would be anticipated. The ephemeral stream aquatic community would become reestablished within the project area following construction and stabilization of the project.

The City’s future maintenance of the both the creek and the stream to convey flow is also considered a long-term, minor positive impact as they would remove litter and deleterious material that impedes flow. Post-construction operation and maintenance would primarily include periodic mowing and debris removal from the channel, combined sewer inlet, and spillway, riprap replacement, and reseeding of erosion prone areas. Therefore, operation and maintenance activities are not anticipated to result in appreciable post-construction adverse impacts to aquatic habitat as they would function to convey flow and prevent erosion.

3.6.12 Terrestrial Habitat

All of the proposed action alternatives including the Recommended Plan (Alternative 8) would result in a moderate, long-term impact to the riparian corridor of Blacksnake Creek. Alternatives 5 through 7 have a construction footprint of 23.0 acres, 28.3 acres, and 37.0 acres, respectively, and each of these alternatives result in clearing 12.4 acres of riparian corridor, with the remaining acreage comprised of turf. The Recommended Plan has a construction footprint of 35.6 acres and clears about 13.4 acres of riparian corridor and 22.2 acres of turf. Therefore, Alternative 5 would result in slightly less acreage impacted as the other action alternatives proposed as the detention basin would not extend south of Karnes Road. Alternative 7 would impact slightly more terrestrial habitat than the other action alternatives proposed as this alternative has a slightly larger construction footprint. Alternatives 6 and 8 have a similar construction footprint, with Alternative 8 impacting slightly more acreage.

There are hundreds of acres of terrestrial habitat comprised of similar species with similar ecosystem benefits as those impacted by the proposed project that are located within and adjacent to the area of proposed action and the Blacksnake Creek watershed, particularly to the east of the project area (Figure 2-1). The construction contractor would be required to plant tree species similar to those impacted. Seven separate tree replacement areas are proposed with a total usable area of about 95 acres and a minimum of 13.4 acres of impacted trees would planted within this available acreage (Appendix G). Tree spacing and the total number of trees to be planted would be determined in design and depend on species selected. No terrestrial habitat would be anticipated to be impacted by spoil placement at the Heritage Park Softball Complex or Elwood Bottoms as there is enough cleared area within the Heritage Park Softball Complex for spoil stockpiling and/or grading into existing ground, and the area of spoil placement within Elwood Bottoms consists mostly of land cleared of trees and some leased agricultural ground.

Post-construction terrestrial habitat impacts would include the occasional mowing and clearing of vegetation, particularly woody vegetation, from the creek channel and banks to maintain flow conveyance.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would result in no immediate short-term impacts to terrestrial habitat. Terrestrial habitat within the project area would be anticipated to receive occasional minor, adverse impacts in the long-term due to periodic flooding and maintenance within the vicinity of the corridor, which has resulted in past selective clearing.

3.6.13 Wetlands

No wetlands would be impacted by any of the action alternatives proposed as no wetlands are located within the vicinity of the proposed detention basin. Similarly, in the absence of a federal project, the project sponsor would not follow through with a flood risk management project and the no-action alternative would result in no adverse wetland impacts. The no-action alternative would not be anticipated to result in the restoration or creation of wetlands as continued periodic flooding up until this point in

time has not resulted in the restoration or creation of wetlands within the vicinity of the creek corridor or downstream of the proposed project area.

Although the detention basin design is for “dry” detention, vegetation that is found in riparian, wetland, and old field habitats would likely seasonally colonize shallow, localized depressions that may occur within or adjacent to the project area after construction.

Soil separation and placement within the proposed disposal areas would not impact existing wetlands within these areas. Although there are NWI-mapped wetlands in the two selected locations, impacts to any existing wetlands would be avoided as sufficient area is available within the proposed spoil sites to separate and stockpile soil without impacting wetland resources. Spoil areas would be surveyed again prior to construction and any existing wetlands would be cordoned off and not impacted by soil separation or stockpiling. Stockpiled soils would be contained to prevent runoff into adjacent habitat. The proposed action alternatives including the Recommended Plan would not result in the destruction or modification of wetlands and would not directly or indirectly support new construction in wetlands. Therefore, the proposed project is determined to be in compliance with Executive Order 11990, Protection of Wetlands.

3.6.14 Fish and Wildlife

The Blacksnake Creek fishery is not documented and is very limited based on field observations. Therefore, it is anticipated that a minor, long-term impact would occur to fish and associated aquatic organisms as a result of any of the action alternatives proposed. All of the action alternatives proposed would result in similar, long-term, minor adverse impacts to wildlife. Alternatives 5, 6, and 7 impact 12.4 acres of riparian corridor, whereas Alternative 8 impacts 13.4 acres of riparian corridor. The remaining terrestrial habitat impact for the action alternatives include the clearing and grubbing of up to an estimated maximum of 24.6 acres.

Long-term, minor adverse impacts to fish and wildlife are anticipated primarily due to the removal of the Blacksnake Creek riparian corridor. The impacts to wildlife resources would be related to noise, mechanical clearing and general disturbance of the riparian corridor, creek and ephemeral drainage substrates and banks. The removal of trees would result in the loss of connectivity between the large forested areas located to the east of the project area (Figure 2-1). However, wildlife known to occur within the project area are common species and include white-tailed deer, squirrel, opossum, and additional species that don’t require forested corridors to travel between habitats.

Fish and wildlife within the construction footprint would be anticipated to move away from the construction disturbance, likely upstream to available riparian areas and stream areas not disturbed by construction. Mortality would be expected for immobile and less mobile organisms. Although the substrate and banks of the creek and ephemeral drainage located within the eastern portion of the project area would be disturbed due to excavation and shaping, a long-term positive impact to fish would occur due to the removal of concrete and miscellaneous debris, and widening incised

channels. Bank armoring would provide some stream habitat as a form of structure for fish and invertebrates.

All of the proposed action alternatives would attenuate flood events within the 4 to 0.4 percent ACE range and reduce overland flooding impacts and combined sewer back-ups, which would benefit fish and wildlife in the long-term. There are no species within the project area that require associated flooding for viability. The impacts to fishery resources in addition to the tree clearing and creek disturbance mentioned above would be related to potential site runoff and increased suspended solids and turbidity. BMPs and a water control plan with a storm water pollution prevention plan would be implemented during construction and an NPDES permit and Section 401 water quality certification would be obtained prior to construction and adhered to throughout construction to minimize impacts to downstream water quality and aquatic life. Trees would be replaced by the construction contractor as part of the project in areas that would not impede creek flow, which would benefit wildlife after construction. Tree replacement would be conducted by the construction contractor, primarily south of the project within seven areas proposed by the City and would provide long-term benefits to wildlife. Tree replacement is discussed in Section 3.6.12, and tree replacement areas are shown in Appendix G.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would result in no immediate adverse impacts to fish and wildlife. Fish and wildlife would be subject to long-term adverse impacts as the project area would still be impacted by occasional flooding. The no-action alternative would still result in overbank flooding and backing up of the CSS, which results in adverse water quality impacts and impacts to fish and wildlife.

The separation of soil at the Heritage Park Softball Complex and placement of spoil in Elwood Bottoms is anticipated to have a short-term, minor impact to wildlife due the movement of construction equipment and associated dust and noise. The Heritage Park Softball Complex is primarily turf, dirt, and concrete with some adjacent trees and shrubs. Woodlands exist to the northeast and west along the Missouri River. The Elwood Bottoms spoil area is primarily agricultural land with the Missouri River located about 0.5 miles to the east.

3.6.15 Threatened and Endangered Species

There is no viable habitat for the piping plover, red knot and least tern within the vicinity of the project location. The pallid sturgeon may migrate within the Missouri River downstream of the project area. However, the Recommended Plan may result in a slight increase in turbidity and suspended particulates during construction, which would not adversely impact the pallid sturgeon because the species is adapted to turbid conditions. The project area contains viable habitat for the northern long-eared and Indiana bats and these species have similar habitat requirements. The riparian corridor of Blacksnake Creek is generally isolated by St. Joseph Avenue to the west and a utility corridor to the east. The riparian corridor is relatively narrow with a relatively low number of trees greater than 12 inches in diameter and a dense understory. However, trees greater than 12 inches in diameter with exfoliating bark do exist including cottonwoods, silver maple and sycamore. Additional viable habitat is

located within the basin upstream of Blacksnake Creek along its corridor and the corridors of the additional streams in the basin. The Missouri River is relatively close to the project area and also contains preferred northern long-eared bat and Indiana bat habitat and in larger quantities than provided by the proposed project area.

As discussed in Section 3.6.14, tree clearing would result in a loss of connectivity between large forested areas oriented north-south and located east of the project area (Figure 2-1). However, the loss of connectivity would result in no impacts to threatened and endangered species as the treed area that provides the connectivity is relatively narrow and there are no threatened and endangered species within the project area that require connectivity between these habitats.

All of the proposed action alternatives including the Recommended Plan would result in similar impacts to the riparian corridor and adjacent land. However, the Recommended Plan would result in clearing about one more acre of riparian acreage than the other action alternatives. In accordance with USFWS guidance, tree clearing would be scheduled between November 15 and March 31 to avoid adverse impacts to the Indiana bat and northern long-eared bat. Therefore, the Recommended Plan is not likely to adversely affect the Indiana or northern long-eared bat. USFWS has indicated that the project exceeds the acreage threshold of 10 acres of woodland habitat removal, and requires an Indiana bat habitat assessment. The bat habitat assessment would be conducted during the project design phase before completion of the Section 7 consultation for ESA. If it is not feasible to schedule tree removal within the prescribed timeframe, the USFWS would be contacted and an Indiana bat/northern long-eared bat acoustic survey and/or mist netting would be conducted per current USFWS guidelines by a qualified biologist to determine the presence/absence of these species. Although considered low risk, the cost risk analysis identified costs for potential unspecified ESA activities within the contingency budget.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. No tree clearing would occur with the exception of periodic selective clearing of the riparian corridor.

None of the sensitive habitats or species listed in the Natural Heritage Database would be anticipated to occur within or adjacent to the project area or spoil areas. Riverine, wetland, and grassland matrix are the preferred habitat of the vast majority of the animal and plant species listed. No wetlands or grasslands are located within or adjacent to the project area. Some relatively small NWI-mapped wetlands occur within the Heritage Park Softball Complex.

Field visits were conducted in August 29, 2003, June 19, 2008, June 7, 2013, and September 19, 2014. No violets or regal fritillary butterflies were observed during any of the field visits to the project area. Blacksnake Creek does not contain viable habitat for the brassy minnow and the project area does not contain viable habitat for tall agrimony. The eastern tiger salamander and long-tailed weasel have the potential to occur within the vicinity of the project area as they inhabit woodlands near water. However, no populations of these species are documented to occur within the vicinity of the project area or spoil areas. No adverse impacts to the sensitive habitats and

species recorded by the database to occur within Buchanan County would be anticipated to occur as a result of the no-action alternative, and action alternatives proposed including the Recommended Plan as they are either not located within the project area or spoil areas, or are highly unlikely to occur within the highly disturbed project area and spoil areas.

3.6.16 Roads

As a result of the action alternatives proposed, including the Recommended Plan, the Maxwell Road Extension which provides access to a single household residence, would be abandoned due to any of the action alternatives proposed as it is located within the approximate northern center of the proposed detention basin. Karnes Road to the south and Savannah Road to the north will be abandoned as part of the City's overall transportation plan for this area of the City and are not part of the federal project. Following construction, the single household residence that uses the Maxwell Connector to access roads to the west will be able to use the northern access road that would be constructed as part of the action alternatives proposed (Figure 3-2). Abandoning the Maxwell Connector would result in a longer commute for the single household residence to access the roads to the west and south of the proposed detention basin. The City's abandonment of Karnes Road is anticipated to slightly increase commuting times as most Karnes Road commuters will instead use Northwest Parkway to the south. Similarly, the City's abandonment of a portion of Savannah Road to the north will result in the use of alternative routes resulting in increased commuting times for the residences and businesses that use Savannah Road. Impacts to access as a result of detention basin construction are considered long-term and minor.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The Maxwell Road extension would not be abandoned. The Karnes Road and Savannah Road would still be abandoned by the City as part of the City's overall transportation plan.

3.6.17 Socioeconomic Conditions

The socioeconomic environment of the project area and vicinity would be anticipated to receive a major, long-term positive impact as a result of any of the action alternatives proposed, including the Recommended Plan. Periodic flooding occurs minimally due to the 20 percent ACE flood event and affects approximately 165 residential, commercial, and industrial structures resulting in total EADs estimated at $3.5 million in 2016 dollars (Appendix I). Flooding in this area has also resulted in fatalities.

The action alternatives proposed would result in attenuating the effects of floods between the 4 and 0.4 percent ACE events. The Recommended Plan would result in flood risk management from flood events up to the 2 percent ACE event and help to maintain, and perhaps improve, the socioeconomic conditions of the affected area and vicinity. With continued industrial and commercial stability enhanced by the increased reliability against flooding, existing neighborhoods and populations would be expected to remain relatively stable, barring impacts from other sources.

Alternative 7 would result in long-term, adverse impacts to residents located just east of St. Joseph Avenue as 21 homes would be removed due to the construction footprint of the proposed detention basin (Figure 2-2). The other action alternatives proposed, including the Recommended Plan, do not directly and adversely impact residences and/or businesses.

Construction of any of the action alternatives, including the Recommended Plan, would also be expected to temporarily increase employment in the region. In the short term, project construction may bring a temporary increase in demand for some services in the local area, and also a temporary increase in business, profits, and sales tax receipts at the local retail and service establishments. It is also expected, based on existing resources in the area, that the community service base is adequate to accommodate temporary construction workers. Public health and safety would also be enhanced by the action alternatives including the Recommended Plan and its increased reliability against flooding. The removal of approximately 70 acres of land from active agricultural within the Elwood Bottoms is considered a short-term, minor impact. Active agricultural occurs within the vicinity of the impacted agricultural area and the impacted area would be expected to resume agricultural activity within about a two-year timeframe when the stockpile is removed. Although there would be a short-term revenue loss, the use of this area for spoil results in a significant cost savings compared to multiple disposal site management with increased haul distances and/or acquiring land for disposal.

All required construction access would use public roadway and/or established access. Accessibility to individual businesses in the project area would not be expected to be significantly impacted by construction of the action alternatives or the Recommended Plan as access would still be available.

Implementation of any of the action alternatives proposed including the Recommended Plan is not anticipated to result in disproportionate impacts to minority or low income groups, or substantially disrupt the continuity and quality of life within a community. The proposed project provides equitable levels of protection for affected residences and businesses. Therefore, the project is determined to be compliant with Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would leave the affected area vulnerable minimally to the five-year event. It is unknown if residences and/or businesses would relocate due to periodic flooding, but based on historical response, it is likely that there would be continued occupation of the structures in the floodplain and that the area would face a gradual general economic decline if relocations of existing businesses were to occur, this would have a major, long-term adverse impact on the socioeconomic environment, particularly if businesses and/or residences relocated out of the affected area and were not replaced by viable businesses and additional residents.

3.6.18 Cultural Resources

Alternatives 1 through 4 and Alternative 9 (acquisitions) included in this Section 205 feasibility study were eliminated from consideration. The impacts to cultural resources for the alternatives still under consideration are presented below.

No-Action Alternative: In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative would not impact any cultural resources as the NRHP listed St. Joseph Park and Parkway System would not be impacted by a project and would remain in its present condition and no archeological sites were identified in the project area during the field survey or background research.

Alternative 5: Detention Basin with lower pool height, no levee, flood wall or dam; excavation without impacting structures; overflow spillway on Karnes Road: Alternative 5 would not impact any cultural resources as the NRHP listed St. Joseph Park and Parkway System would not be impacted by a project and would remain in its present condition and no archeological sites were identified in the project area during the field survey or background research.

Alternative 6: Similar to Alternative 5 but more storage by excavation between Karnes Road and Northwest Parkway: Alternative 6 would not impact any cultural resources as the NRHP listed St. Joseph Park and Parkway System would not be impacted by a project and would remain in its present condition and no archeological sites were identified in the project area during the field survey or background research.

Alternative 7: Similar to Alternative 6, but expanded storage in the area north of Karnes Road; requires acquisition and removal of homes west of St. Joseph Avenue: The St. Joseph Park and Parkway System property listed on the NRHP is situated within the project area. The removal of homes west of St. Joseph Avenue may impact the NRHP site. In addition, these homes would need to be evaluated as to their eligibility for the NRHP and if found eligible they would need to be mitigated or avoided by the project. No archeological sites were identified in the project area during the field survey or background research.

Alternative 8 (Recommended Plan): NED Plan, Similar to Alternative 6, but excavation of abandoned Karnes Road and uses the volume gained to construct utility pads around three 161 KV power poles that were to be relocated: Alternative 8 would not impact any cultural resources as the NRHP listed St. Joseph Park and Parkway System and no archeological sites were identified in the project area during the field survey or background research.

In compliance with the National Historic Preservation Act, USACE has coordinated a finding of “no adverse effect” for the proposed project with the Kansas and Missouri SHPO (Appendix B). Both SHPOs have concurred with this finding. The project was coordinated with affiliated federally recognized Native American tribes. The Missouri SHPO also stated that if plans change, information documenting the revisions should be submitted the SHPO for further review and comment, and that in the event that

cultural materials are encountered during project activities, all construction should be halted, and the SHPO notified as soon as possible in order to determine the appropriate course of action.

3.6.19 Floodplain

The Blacksnake Creek floodplain existing condition is highly urbanized and disturbed. The City's Floodplain Management Code and Land Use Plan minimizes losses related to periodic flood inundation, including loss of life and/or property, but does not mitigate damages to existing buildings. The construction of a detention basin is not anticipated to result in additional floodplain development as the remaining floodplain is vastly urbanized within the project area.

The Recommended Plan (NED Plan) uses the natural topography and excavation of approximately 660,000 bank cubic yards within the Blacksnake Creek floodplain north of Northwest Parkway to create a detention basin. The basin will be a dry detention basin with a low flow channel and would not store water during non-storm events.

Hydraulic analysis indicates no net increase for the base flood event; removal of 104 structures from the base floodplain; minimizes impact to an additional 74 structures; and does not induce development. Accordingly, floodplain impacts are considered to be short-term and minor.

A LOMA would need to be submitted to FEMA by the sponsor to request a revision to the existing floodplain map to show changes to floodplains, floodways, and flood elevations following the construction of the detention basin.

Factors such as impact of floods on human safety, the functional need for locating at this particular location, fish and wildlife habitat impacts, as well as aesthetics, socio-economic and economics have been considered and brought forth to the public. Public comments have been considered. Overall, the public is in favor of this project because of the reduction in flood risks. Therefore, the proposed NED Alternative is determined to be in compliance with Executive Order 11988, Floodplain Management.

3.6.20 Environmental Impacts Summary

The primary project environmental impact due to the action alternatives proposed, including the Recommended Plan, is the excavation of dry detention with a total construction footprint of approximately 35.6 acres and clearing up to 13.4 acres of the Blacksnake Creek riparian corridor. Although the creek has been channelized and portions are concrete lined, removal of the riparian corridor and daylighting the creek, and excavating detention around the creek is a change from existing conditions. Tree clearing and detention basin excavation result in moderate, long-term adverse impacts to terrestrial habitat, aesthetics, and aquatic habitat for both the creek and the ephemeral stream. Overall long-term, positive impacts to the creek and ephemeral stream includes channel widening, bank shaping and stabilizing the banks, which would prevent future incision and erosion. Hundreds of acres of trees that provide similar ecosystem benefits as the trees to be removed are located primarily to the east of the creek and riparian corridor upstream of the project area would not be removed

for the project. The City will also provide approximately 95 acres of land for tree planting and tree planting would be included in the construction contract. Ecosystem benefits provided by the Recommended Planted trees would be similar to the trees removed in about 10 years to 20 years based on the estimated age of the impacted trees

The project is anticipated to result in minor, long-term adverse impacts to wildlife. Although riparian corridor would be removed, similar vegetation available to wildlife is located within the vicinity of the project area and within the watershed. The adverse impact to aesthetics, terrestrial habitat and wildlife is anticipated to be lessened over time with the implementation of tree plantings conducted as part of the construction contract and the maturation of planted trees. A long-term, minor adverse impact would occur to geology and soils, and disposal areas due to construction and the stockpiling of soil, and a potential, minor, short-term adverse impact to water quality may occur as some soil may incidentally be introduced into the creek and potentially the Missouri River during construction. Long-term positive impacts to water quality would occur due to a reduction in flooding and combined sewer overflows. A minor, long-term impact to fish and aquatic life is anticipated due to implementing the Recommended Plan as the creek has been observed to have a very limited fishery. The project when combined with the City's project for a separate storm sewer will provide for both the flood benefits and a decrease of combined sewer overflows resulting in an overall improvement in downstream water quality. Floodwater detention and particulate settling prior to outfall would also result in benefits to downstream water quality and fisheries.

A long-term, minor impact to recreation is anticipated as the action alternatives result in the removal of two basketball courts and a baseball field. This impact is considered minor as the City would relocate or replace these facilities with similar recreation facilities in compliance with the requirements under the Land and Water Conservation Fund grant.

A long-term, positive socioeconomic impact would occur with the implementation of any of the action alternatives proposed as flooding and associated damage would occur within the 2 to 4 percent ACE range event instead of the 0.2 percent ACE range event. Construction of any of the action alternatives proposed would result in a short-term benefit to the local economy due to construction and a long-term socioeconomic benefit as a result of increased flood risk management.

No disproportionate adverse impacts would occur to minority or low-income populations as the project is designed to provide flood risk management benefits for affected properties within the project area. The proposed project provides equitable benefits to all residents and businesses impacted by Blacksnake Creek flooding. Similarly, a long-term positive impact to existing land use is anticipated due to increased flood risk management. As a result of this project, access within the project area will result in a long–term minor impact for a single residence due to abandonment of the Maxwell Connector. This residence will be able to use access roads constructed for the project instead of the Maxwell Connector, which will result in a slight increase in commute time.

Construction and operation of the proposed project would result in both minor, long-term and short-term adverse noise and air quality impacts within the project area due to the removal of trees during construction and the detention basin maintenance post construction. A relatively small, localized area of impact is not anticipated to affect extreme climate and weather events, drought, or climate change in general.

No impacts to wetlands, threatened and endangered species, or cultural resources are anticipated as none are known to exist within or adjacent to the project area. As recommended by the USFWS, tree clearing would occur between November 1 and March 31 to avoid potential impacts to the Indiana bat. In addition, an Indiana bat assessment would be conducted during design to avoid any potential impacts to the Indiana bat. It is the responsibility of the project sponsor to remove all HTRW prior to initiating construction of a federal project. Project construction and operation is not expected to result in HTRW storage and use above ambient conditions. Removal and proper disposal of HTRW is a positive impact.

Detention basin excavation would not be anticipated to result in additional floodplain development as the remaining floodplain is vastly urbanized within and downstream of the project area. A LOMA could be submitted to FEMA by the non-federal sponsor to request a revision to the existing floodplain map to show changes to floodplains, floodways, and flood elevations after construction of the project.

3.6.21 Cumulative Impacts

The CEQ Regulations defines cumulative impacts as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time” (CEQ, 1997). The cumulative impacts addressed in this document consist of the impacts of multiple actions that result in similar effects on the natural resources. The geographical area of consideration for actions includes the Blacksnake watershed and vicinity. The following past, present and reasonably foreseeable future actions were identified as having the potential to interact with or have impacts related to those of the Recommended Plan. The vast majority of the actions identified below are construction related and can be assumed to have generally resulted, or will result in adverse cumulative, construction-related impacts to air quality, water quality, terrestrial habitat, aquatic habitat, noise, aesthetics, geology and soils.

Past and Present Actions

In 1961, the City was mandated by the U.S. Government to construct and operate a wastewater treatment facility. Design work was completed early in 1964 and the primary treatment plant was operational in November 1965. Prior to that time, the City had no wastewater treatment of any kind and all sanitary/industrial waste was discharged directly to the Missouri River. In addition to the primary treatment plant, the Whitehead Pumping Station and Force Main, interceptor sewer along the Missouri River and Brown's Branch Pumping Station and Force Main were constructed. A secondary portion of the primary treatment plant came on line in April 1979. South St.

Joseph Pumping Station and Force Main, Easton Road Pumping Station and Force Main, and Faraon Street Pumping Station and Force Main were included in the secondary treatment project. A review of 1958 aerial photography shows that the location of the wastewater treatment plant and associated facilities primarily impacted existing agricultural land within the Missouri River floodplain. The Recommended Plan does not impact agricultural land. Therefore, there is no cumulative project impact to agricultural land.

In 2008, the City submitted a Long-Term Control Plan (LTCP) to reduce sewer overflows to MDNR. The LTCP details the City's commitment to controlling the amount of sewer overflows and the frequency of overflows that discharge into the Missouri River to comply with the Clean Water Act. In accordance with the Recommended Plan, the City conducted major maintenance to diversion structures, pump stations, and treatment plants in 2012. The City repaired 68 cave-ins (manhole replacements, storm sewer line repair, and related major maintenance), cleaned 2,434 inlets (remove vegetative growth, sand, rock, and additional accumulated deposits), and repaired or replaced 355 sewer inlets in addition to regular minor inspections and maintenance and response to emergency situations. These maintenance actions provided positive impacts to water quality and no discernible adverse impacts to natural resources as they were relatively small in scope and targeted existing infrastructure. The Recommended Plan will complement these actions. While the project's purpose is to reduce flooding impacts, it will also provide ancillary benefit toward the reduction of combined sewer overflows with the City's construction of a separate storm sewer which will result in a cumulative positive impact to downstream water quality.

Similar to the Blacksnake Creek Project, the City, as part of the LTCP, conducted an evaluation of design alternatives to address combined sewer overflow issues and potential improvements to the Roy's Branch Basin and the Whitehead Basin CSS.

Roy's Branch drainage basin is located in the northwest corner of the City of St. Joseph and is currently served by a CSS. Plans included the separation of storm water inlets from the sewer system by providing a separate storm water sewer system within the developed portion of the drainage basin. The construction project was divided into two phases and areas. Phase I includes the northern area of Dewey Avenue from Dolman north to the alley north of Highland Avenue and Highland from Main St. to Dewey. Phase I work was completed in 2008.

The second phase of the Roy's Branch sewer separation project includes the construction of a separate storm water system to capture runoff before it enters the sanitary sewer system. Phase II consists of the southern area of Elwood from Chestnut to Market, Bellevue from Chestnut to Market, Prospect from mid-block between Rosine and Cherry to Market, Chestnut from I-229 to Dewey Avenue, and A St. Phase II is anticipated to be completed in the near term.

The Whitehead Creek Storm water Separation project consists of a new large pipe that will transport a portion of the storm water runoff in the Whitehead Creek Basin directly to the Missouri River. Currently, storm water runoff that reaches Whitehead

Creek is piped along with wastewater (sewage) in a 16-foot diameter pipe known as the Whitehead Creek Combined Sewer. The existing pipe carries both storm water and sewage and overflows into the Missouri River during most rain storms. The project purpose is to construct a diversion structure and second pipe to intercept storm water runoff from the creek before it reaches a larger pipe to reduce sewer overflows as part of the City's LTCP. The design includes: 4,000 feet of 78 to 126-inch diameter conduit to convey storm water, 1,300 feet of eight-foot diameter tunnel, a nine-foot diameter railroad jack and bore, storm water diversion structure on Whitehead Creek, outfall structure and downstream channel improvements, modifications to the existing Whitehead combined sewer diversion structure, 2,000 feet of 36-inch diameter separated sanitary sewer piping, street and utility improvements in affected areas.

Roy's Branch is relatively small and experiences some of the fewest overflows of local steams that flow into the Missouri River (Reference: Roy's Branch Next Phase of Sewer Project) compared to other streams in the area. The Roy's Branch Project primarily impacted existing sewer line in residential areas and resulted in a relatively small gain of overflow protection, but has increased the longevity of the sewer system. The Whitehead Creek Project is estimated to reduce combined sewer overflows from 1.7 billion gallons per year to 580 million gallons per year and eliminate the cost of treating a maximum of about two million gallons of dry weather creek water per day (City of St. Joseph, Missouri 2014). LTCP projects including the Recommended Plan will continue to result in adverse cumulative impacts to aquatic and terrestrial habitat and aesthetics due to construction. However, these projects provide long-term positive impacts to water quality and socioeconomics as they separate storm water and wastewater and decrease overflows that cause flooding and adversely impact downstream water quality. Tree replacement is intended to mitigate impacted vegetation, although the full ecosystem benefits of tree replacement may not be achieved until tree maturation.

In 2012, the City completed a Green Project within the City's parkway system near the intersection of N. 22nd Street and Northeast Parkway about 1.3 miles south of the project area to refurbish a detention pond formerly used to hold water runoff. The project included hiking and biking paths and native vegetation was planted around the pond along with an explanation of how the detention pond can keep runoff out of the CSS. The pond includes a bypass pipe to drain the basin for maintenance. Construction of the Green Project occurred in areas already disturbed by the construction of Northwest Parkway and therefore did not adversely impact resources of concern and the project provided positive impacts to recreation and water quality. Although the Recommended Plan results in adverse impacts to basketball and baseball recreation, it provides cumulative positive impacts to flood risk management, land use, socioeconomics and downstream water quality.

The KCD Regulatory Office database was searched for regulatory actions that have occurred within the past 10 years within and adjacent to the Blacksnake Creek watershed. These actions occurred in a variety of locations and primarily included bridge replacement and repair, roadway repair and maintenance, residential and commercial construction, ditch work and box culvert extensions. Although there is no

specific information available regarding the impacts associated with these permitted actions, the nature of the work conducted and the nature of the work proposed by the Recommended Plan would be anticipated to result in some minor adverse cumulative impacts to terrestrial and aquatic habitat, aesthetics, air quality, noise, and water quality.

Continued commercial development on the East Side within St. Joseph has resulted in the need for new and upgraded water utilities. The Eastowne Business Park is an approximate 300-acre development located approximately 5.5 miles southeast of the Blacksnake Creek project area that consists of mixed office and industrial space. To provide the necessary water utilities needed for development, a new sanitary sewer pump station near Candy Creek, along with associated force mains and gravity sewer interceptors would be constructed. The new pump station replaces the existing Easton Road pump station, which is under capacity and not in the proper location to meet future service needs. The need to rehab the Faraon Street Pump Station and associated force main will also be evaluated. Adverse impacts associated with this development primarily include agricultural land, terrestrial and aquatic habitat and associated fish and wildlife as an unnamed intermittent stream and associated riparian corridor are located within the area to be developed. Positive socioeconomic impacts would occur due to increased businesses and available jobs within the St. Joseph area. Therefore, this development and the Recommended Plan result in minor cumulative adverse impacts to terrestrial and aquatic habitat, fish and wildlife, and aesthetics, and positive cumulative impacts to socioeconomics and water quality.

The following future actions are also anticipated to have adverse impacts to the resources they impact. Impacts due to future actions are generally dependent on the resources within and adjacent to their respective construction footprint, the existing condition of the resources and the degree of disturbance to resources due to construction.

Future Actions

In conjunction with the Eastowne Development, a new wastewater treatment plant would be constructed. The location of the Recommended Plant would occur following a future siting study and plant construction would occur in about 20 years (City of St. Joseph, Missouri 2014). Therefore, the adverse impacts associated with a new plant are unknown and are dependent on the existing condition of the resources within the proposed future site location. Similar to other projects conducted under the LTCP, the new plant would provide positive impacts to downstream water quality.

A proposal to construct a commercial subdivision at 3411 Ashland Avenue and 3137 Karnes Road, located approximately 1.4 miles east of the project area is under review by the City.

A proposal to construct a minor subdivision that includes the properties at 403 and 405 Woodbine Road is under review by the City.

The locations of these proposals are generally located adjacent to residential or commercial structures and infrastructure with existing access. Construction would

impact existing turf and terrestrial habitat including some trees and shrubs. As such, a minor cumulative adverse impact would occur to terrestrial habitat and aesthetics. These proposals are not anticipated to affect access within the vicinity of the project area as they are located 1.4 miles east and 3.1 miles southeast of the project area, respectively. It is anticipated that these developments will not need a new treatment plant, pump station, or other water utility infrastructure as none have been proposed.

A request to vacate a portion of the St. Paul Street right-of-way between Dewey Street and the Prospect Street right-of-way is under review by the City.

A request to vacate a portion of the street right-of-way at Fairleigh Terrace and Frederick Avenue is under review by the City.

These proposals are not anticipated to impact the project purpose or cumulatively impact road access within the vicinity of Blacksnake Creek project area as they are relatively minor in scale and located about 1.5 miles southwest and 1.8 miles southeast of the project area, respectively. The City's long-term transportation plan would also serve to improve local transportation movement within the City.

A modification to the existing MRLS R471-460 and L455 was authorized in 2007, but is not yet constructed. The levee units comprise the protective works that provide flood protection for areas in St. Joseph, Buchanan and Andrew Counties, Missouri and Elwood, Wathena, Doniphan County, Kansas. R471-460 is located on the right bank of the Missouri River between river miles 441.7 and 456.6 in eastern Doniphan County, Kansas, and northwestern Buchanan County, Missouri. This levee would be raised three feet.

L455 is located on the left bank of the Missouri River in Buchanan County, Missouri and extends from the mouth of Whitehead Creek (Missouri River mile marker 447.3) 10 miles downstream to Contrary Creek at river mile marker 437.3 and provides flood protection for the southwestern portion of the City. L455 would be raised slightly to account for the impacts resulting from the right bank raise. These earthen raises require obtaining large quantities of earthen fill. If both the Blacksnake Creek detention project and the MRLS R471-460 project are constructed in a coordinated time frame, the excavated material from the detention project could be utilized as a source of earthen fill for the levee raise, and potentially result in significant cost savings to the MRLS R471-460 and L455 project.

According to the flood damage reduction study conducted for the levee raise, the Recommended Plan results in positive socioeconomic impacts and adverse impacts primarily occur to terrestrial habitat and wetlands as seven acres of riparian vegetation 13.0 acres of shrub land, and 4.9 acres of farmed wetland would be impacted. Adverse impacts to these resources will be mitigated in kind and the study concluded that there would be no appreciable cumulative impact on project area resources. Similar to the MRLS R471-460 and L455 project, positive socioeconomic benefits are anticipated and an adverse cumulative impact to terrestrial habitat would occur with the Blacksnake Creek Recommended Plan. However, as part of this project, the adverse impacts to terrestrial habitat due to the creek project would also be mitigated to replace impacted vegetation.

Section 4
Plan Implementation

This section presents the requirements for implementing the Recommended Plan, including cost sharing and federal and non-federal responsibilities. These costs are based on a final cost estimate for the project. This final cost reflects a cost update that came about with the review process for the project. The result was a very slight increase in the estimated total project cost. Because the economic results would not be substantially affected by the updated costs, the final economic evaluation presented in Section 3 of this report was not revisited. The cost share for implementation phase is affected by the adjustment. The final cost estimate is presented in this section of the report.

4.1 Cost Sharing

In accordance with the requirements under the Section 205 program, the non-federal sponsor is responsible for a minimum of 35 percent of the TPCs up to a maximum 50 percent of TPCs during the design and implementation period and must provide a minimum of 5 percent of the TPCs in cash.

A summary of the fully funded TPC estimate, which includes project contingency and the application of escalation factors, is shown below in Table 4-1. This estimate forms the basis of the cost share for implementation phase work (design and construction). It is noted that the economic evaluation presented in Section 3.1 is based on project first costs including the value of the non-compensable relocations and exclusive of the application of escalation factors.

Table 4-1 Fully Funded Cost Estimate for Implementation (Design and Construction)

Project Feature	Fully Funded Cost ($1000s)
02 Relocations	$418
06 Fish and Wildlife Facilities	$387
15 Floodway Control & Diversion Structures	$9,540
01 Lands and Damages	$1,290
30 Planning, Engineering & Design	$1,838
31 Construction Management	$483
Project Cost Totals	**$13,958**

Note: Non-compensable LERRD costs were included for the economic screening but are not included in this table for the implementation phase costs eligible for cost share.

4.1.1 Federal Responsibilities

Section 205 projects implemented on non-federal lands are implemented under cost share with the local sponsor. Under this program the federal government will provide 65 percent of the TPCs up to the statutory limit of $10 million, inclusive of the Recommended Planning phase work. Table 4-2 shows the cost breakout under the 65/35 requirements and demonstrates the federal costs inclusive of the Recommended Planning phase work are projected to be below the statutory threshold.

Table 4-2 Cost Share Based on 65/35 Requirements ($1,000s)

TPC	Federal	Non-Federal	Total
Feasibility	$899	$800	$1,699
Implementation	$9,073	$4,886	$13,959
Project Cost Totals	**$9,972**	**$5,686**	**$15,658**

4.1.2 Non-Federal Responsibilities

The City of St. Joseph, Missouri is the non-federal sponsor for this project and is responsible for a minimum of 35 percent of the total implementation phase project costs. In addition, the federal sponsor has the following responsibilities:

- Provide a minimum of 5 percent of TPCs in cash.
- Provide all Lands, Easements, Relocations, Rights of Way and Disposal Areas (LERRD) required for the project, participate in the Project Coordination Team, perform necessary non-federal audits, and perform investigations necessary to identify the existence and extent of hazardous substances on LERRD required for the project.
- Provide, during construction additional planning, design, and implementation costs that would normally be part of the federal share but over the statutory Federal per project limit.
- Operate, maintain, repair, replace, and rehabilitate the completed project for functional portion of the completed project at no cost to the federal government, in accordance with the applicable federal and state laws and any specific directions prescribed by the federal government for so long as the project is authorized. The annualized operation and maintenance costs are estimated at $24,000.
- The federal participation limit is $10 million inclusive of the feasibility study costs. A cost and schedule risk analysis was conducted to assess cost risk and determine cost contingencies for the implementation phase estimate. The cost contingency included in the estimate so the risk of exceeding the federal participation limit is considered low. However, if the Federal participation limit is exceeded, any excess costs above the Federal limit will be the responsibility of the sponsor.

A Project Partnership Agreement for design and construction has been drafted for review by the non-federal sponsor and its legal representative. The non-federal sponsor is aware of its responsibilities. The Project Partnership Agreement will be executed after USACE Northwestern Division approves the project. The Project Partnership Agreement will be executed prior to initiating implementation phase activities.

4.2 Real Estate Considerations

The City of St. Joseph will acquire a fee simple title, road easement, utility easement, and a temporary work area easement to the lands affected by the project. Under current laws and regulations, the non-federal sponsor may receive credit towards its share of project costs for the value of the LERRD provided for project purposes. The estimated LERRD costs are shown as Relocations (estimated at $418,000) and Lands and Damages ($1,290,000) in Table 4-1. Additional information on LERRD of the project is presented in the Real Estate Plan provided in Appendix G.

4.3 Implementation Considerations

The project design assumptions include coordination with the sponsor for design details pertaining to the schedule of the utility relocations, the City's ongoing road improvement project, and the City's design of the proposed separate storm sewer.

The coordination is required to ensure that the designed features for the City projects are compatible with the design requirements and performance requirements of the Recommended Plan.

A type II Independent External Peer Review (Safety Assurance Review) will be conducted on the project design in accordance with EC1165-2-214; Water Resource Policies and Authorities, Civil Works Review.

The need for a VE study will be determined though a CAP VE screening during the agency technical review of the design. If the determination is that there is potential for design improvements to produce savings, a VE study would be conducted. If it is determined that a VE study is not warranted, a memo will be prepared for a waiver of the VE study during design.

The early design activities will include an Indiana bat habitat assessment to make final determinations regarding the Section 7 Consultation. Mitigation is not anticipated, however was identified as a cost risk and costs for an unknown mitigation activity and are included as part of the project contingency.

The Clean Water Act Section 401 Water Quality Certification will be obtained during design. Based on comment by MDNR, estimated costs from a mitigation bank have been identified and are included in the project costs.

In the event that cultural materials are encountered during project activities, all construction should be halted, and the Missouri SHPO will be notified as soon as possible in order to determine the appropriate course of action.

Although considered low risk, if unknown HTRW is found during the implementation phase, the City will be responsible, at City expense for all actions required to remove the HTRW.

Section 5
Public Involvement and Agency Coordination

A public meeting was held just west of the project area at Robidoux Middle School on April 7, 2005. The purpose of the meeting was to present proposed designs to manage flood risk. Attendees were provided an informational handout that summarized flood events and a proposal to construct wet detention within the area of the current proposed project area. The informational handout included two attachments which showed: 1) the area of proposed detention, floodwall and levee, and 2) an additional area of proposed wet detention with enhancements to include "hike and bike trails, water quality improvements and roadway reconstruction" (Appendix B).

The public was provided an opportunity to provide verbal comments during the public meeting and a comment form was also provided to solicit the public's written comments of the proposed project (Appendix B). Spoken and written comments concerning the project primarily included the dislike of levees and floodwalls, the potential taking of land, depreciation of property values, and increased public access to private property.

An additional public meeting to present current design alternatives and the Recommended Plan occurred October 9, 2014, at Lindbergh Elementary School, which is located about one mile southeast of the project area. The meeting format was the same as the public meeting conducted on April 7, 2005. A public meeting summary, public comments and responses are included in Appendix B. A wide variety of questions were received from the public. These ranged from support of the project to questions of basin design and operation, access improvements, impacts to aesthetics and recreation, and other topics.

All agency coordination is included in Appendix B. Agency coordination was initiated in October 2003 with a letter introducing the project to the USFWS. The USFWS responded in December 2003 and stated that the Indiana bat is the only federally listed species likely to occur within the project area and that trees suitable for use by the Indiana bat should be removed between October 1st and March 30th. If tree clearing cannot be scheduled for this timeframe, the Service requires a survey to be conducted by a qualified biologist to determine the presence or absence of Indiana bats. The USFWS also commented that several smaller detention basins throughout the watershed may be a more efficient approach to a large basin at the bottom of the watershed and that it may be a more cost effective to designate greenspace/floodway areas prior to development of the surrounding lands. The USFWS also requested a schedule for project planning and the identification of any additional input needed from the USFWS.

A follow up agency coordination letter was sent to the USFWS and coordination letters introducing the project were provided to the USEPA, U.S. Department of Agriculture –

Natural Resources Conservation Service, MDC, and MDNR in April 2013. An example of the USACE project introduction letter to the agencies is included in Appendix B. The USACE letter includes the project authority, summary need statement, current project status and estimated schedule. The USFWS was the only agency that responded and stated in an agency letter dated May 2013 that they did not have additional comments, but still recommend tree removal to occur between November 15 and March 31 to minimize impacts to the Indiana bat.

Follow-up coordination with the USFWS occurred in June 2015 with an email that included Recommended Plan information and a figure of the proposed construction footprint. The USFWS responded in June 2015 with an email suggesting entering project information on the Information for Planning and Conservation (IPaC) website (http://ecos.fws.gov/ipac). The IPaC generated response contained a list of threatened and endangered species that may occur in the proposed project location and/or may be affected by the proposed project. These species included the threatened piping plover, red knot, and northern long-eared bat, endangered least tern, pallid sturgeon and Indiana bat. Potential impacts to these species are addressed in Section 3.6.15 of this document.

Following the posting of the project public notice, KCD received an email from the USFWS in July 2015 asking how many acres of woodland would be removed due to the proposed project. KCD responded with a voicemail response in July 2015 that the Recommended Plan would result in the removal of approximately 13.4 acres of woodland. The USFWS responded with an email in July 2015 stating that a woodland assessment would be needed to consult on listed bats under Section 7 of the Endangered Species Act. If the assessment results are positive for bat habitat, a bat survey would need to be conducted to determine if maternity colonies are present within the project limits.

In separate correspondence, the USFWS submitted official comments to the public notice. The USFWS stated that they supported the use of dry detention and requested a reevaluation of Missouri Stream Mitigation Method calculations. The USFWS stated that USACE made a preliminary determination that the project may affect but is not likely to adversely affect the Indiana bat and the northern long-eared bat. The Service has indicated that a woodlands assessment is required. This assessment will be conducted early in the design effort, spring-summer 2016. Any mitigation requirements would be identified following the woodland assessment results.

MDNR also responded to the project public notice with an email in August 2015 with statements and questions about the project, and provided construction BMPs. MDNR stated that the request for Section 401 water quality certification is denied due to lack of a complete application. KCD personnel Christy Ostrander, Cassidy Garden and Richard Skinker spoke with MDNR Environmental Scientist Mike Irwin via telephone regarding the proposed project on January 21, 2016. Mr. Irwin indicated that he did not have the Draft DPR/EA when MDNR comments were written, just the public notice and associated information. KCD provided project clarification, answered questions and prepared responses to all MDNR comments and questions to be included in the 401 water quality certification application to be submitted to MDNR prior to

construction. KCD forwarded Mr. Irwin the DPR/EA and Mr. Irwin submitted Missouri Stream Mitigation Method calculations to KCD January 2016. The KCD responses are included in Appendix B.

A public comment was also received in MDNR correspondence in response to the public notice. This comment was primarily concerned with new access roads and utility relocations. The comment also requested a personal visit “from someone who has the authority to make this change in the project design.” KCD project manager Christy Ostrander and representatives of the City of St. Joseph, Missouri visited personally with this landowner on September 15, 2015, to answer questions. The public comment and KCD responses are also included within Appendix B.

The KCD Archaeologist provided project information and the results of a field survey conducted in June 2013 to the Missouri and Kansas SHPO in an agency letter dated December 2013. The field survey identified no archeological sites in the project area, no anticipated adverse impacts to Northwest Parkway as a result of armoring, and requested concurrence with USACE’s determination that the proposed project would have no adverse effect on the St. Joseph Park and Parkway System NRHP District and would not impact any other sites eligible for the NRHP outside of the District.

The Missouri SHPO responded with an agency letter in January 2014 and the Kansas SHPO responded in March 2014 and concurred with the USACE determination that the proposed flood control project will have no adverse effect on the Northwest Parkway, a contributing property to the St. Joseph Park and Parkway System Historic District, a property listed in the NRHP. The Missouri SHPO also stated that if plans change information documenting the revisions should be submitted the SHPO for further review and comment, and that in the event that cultural materials are encountered during project activities, all construction should be halted, and the SHPO notified as soon as possible in order to determine the appropriate course of action.

The Kansas SHPO responded in March 2014 with an agency letter stating concurrence with the USACE determination that the proposed project will have no effect on historic properties and no objection to implementation of the project. The Kansas SHPO also stated that any changes to the project, which include additional ground disturbing activities, will need to be reviewed by the SHPO prior to beginning construction and that if construction work uncovers buried archeological materials, work should cease in the area of the discovery and the SHPO should be notified immediately.

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Section 6
Compliance with Environmental Requirements

6.1 Agency Compliance with Other Environmental Laws

Table 6-1 summarizes federal environmental laws and the project compliance.

Table 6-1 Agency Compliance with Other Environmental Laws

Federal Polices	Compliance
Archeological Resources Protection Act, 16 U.S.C. 470, et seq.	Full Compliance
Clean Air Act, as amended, 42 U.S. C. 7401-7671g, et seq.	Full Compliance
Clean Water Act (Federal Water Pollution Control Act), 33 U.S.C. 1251, et seq.	Full Compliance
Coastal Zone Management Act, 16 U.S.C. 1451, et seq.	Not Applicable
Endangered Species Act, 16 U.S.C. 1531, et seq.	Full Compliance
Estuary Protection Act, 16 U.S.C. 1221, et seq.	Not Applicable
Fish and Wildlife Coordination Act, 16 U.S.C. 661, et seq.	Full Compliance
Land and Water Conservation Fund Act, 16 U.S.C. 4601-4, et seq.	Full Compliance
Marine Protection Research and Sanctuary Act, 33 U.S.C. 1401, et seq.	Not Applicable
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	Full Compliance
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470a, et seq.	Full Compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Full Compliance
Wild and Scenic River Act, 16 U.S.C. 1271, et seq.	Not Applicable
Farmland Protection Policy Act, 7 U.S.C. 4201, et. seq.	Full Compliance
Protection & Enhancement of the Cultural Environment (Executive Order 11593)	Full Compliance
Floodplain Management (Executive Order 11988)	Full Compliance
Protection of Wetlands (Executive Order 11990)	Full Compliance

Environmental Justice (Executive Order 12898)	Full Compliance

NOTES:
a. Full compliance. Having met all requirements of the statute for the current stage of planning (either preauthorization or post-authorization).
b. Partial compliance. Not having met some of the requirements that normally are met in the current stage of planning.
c. Noncompliance. Violation of a requirement of the statute.
d. Not applicable. No requirements for the statute required; compliance for the current stage of planning.

Section 7
Summary and Recommendation

7.1 Summary

In cooperation with the project sponsor, City of St. Joseph, Missouri, USACE proposes to construct the Blacksnake Creek Flood Risk Management Project under the authority of Section 205 of the Flood Control Act of 1948, as amended by the Water Resources Development Act of 1986. The proposed project would involve the excavation of a detention basin to retain floodwater and associated earthwork and utility modifications. The project is located within the City of St. Joseph, Missouri on Blacksnake Creek, 39°48'06.78"N, 94°50'27.96"W.

7.1.1 Alternatives

Four dry detention alternatives were initially formulated (Alternatives 1 through 4) and all of these alternatives included the construction of a detention dam, levee, and floodwall with different detention capacities. These alternatives were screened out early in the feasibility phase due to a variety of issues including excessive cost and constructability. Similarly, nonstructural alternatives were considered too cost prohibitive and were screened out during feasibility.

Four additional alternatives that do not include levees and floodwalls were subsequently formulated (Alternatives 5 through 8). The dry detention area in Alternative 5 is upstream of Karnes Road. Alternative 6 extends it a short distance downstream to Northwest Parkway, and Alternative 7 expands the detention area upstream of Karnes Road to the west. Thus, project scale increases in moving from Alternative 5 to 7. Alternative 8 includes the City's plan to remove Karnes Road and not relocating 161 KV power poles.

Alternative 5: Detention Basin with lower pool height, no levee, flood wall or dam; excavation without impacting structures; overflow spillway on Karnes Road: The Blacksnake Creek floodplain north of Karnes Road between St. Joseph Avenue and an abandoned railroad right-of-way would be excavated to increase detention capacity. The abandoned railroad right-of-way along the east side of the basin would be removed to access additional detention volume to the east. An overflow spillway would be constructed at an elevation of 895 NAVD on Karnes Road. In this alternative, an overflow spillway at Karnes Road would be the point of overtopping. Alternative 5 includes a construction footprint of approximately 23 acres.

Alternative 6: Similar to 5, but more storage by excavation area between Karnes Road and Northwest Parkway: Alternative 6 would increase the detention capacity of Alternative 5 by excavating the area between Karnes Road and Northwest Parkway. Culverts would be constructed to provide a connection between the areas north and south of the Karnes Road. In this alternative, an overflow spillway

constructed at Northwest Parkway would be the point of overtopping. Alternative 6 includes a construction footprint of approximately 28.3 acres.

Alternative 7: Similar to 6, but expanded storage located north of Karnes Road; requires acquisition and removal of homes west of St. Joseph Avenue: Alternative 7 would increase the detention capacity of Alternative 6 by expanding the basin north of Karnes Road to the west. This alternative would require the purchase and demolition of the residences on the west side of the basin along St. Joseph Avenue. In this alternative, an overflow spillway constructed Northwest Parkway would be the point of overtopping. Alternative 7 includes a construction footprint of approximately 37 acres.

Alternative 8 (NED Plan and Recommended Plan): Similar to Alternative 6, but excavates abandoned Karnes Road and uses the volume gained to construct utility pads around three 161 KV power poles that were to be relocated: Alternative 8 is similar to Alternative 6, but takes into account the City's plan to abandon the section of Karnes Road crossing the basin as part of its approved area transportation plan. The point of overtopping is similar to Alternative 6 and includes an assumed primary overflow spillway at Northwest Parkway with a crest elevation of 897 NGVD and a secondary spillway at 898 NGVD. The abandonment of Karnes Roads allows a reduction in cost by eliminating the need to raise, reconstruct, and armor the road, and for the installation of culverts to provide a hydraulic connection between the basin areas north and south of the road. The volume gained by the removal of Karnes Road is used to construct pads around three 161 KV power poles that were to be relocated under Alternative 6 while maintaining the same detention volume. The cost savings associated with removing Karnes Road and not relocating the 161 KV power poles out of the basin is approximately $1 million. Alternative 8 includes a construction footprint of approximately 35.6 acres.

Alternative 9 is an acquisition or buyouts plan that would remove all homes and businesses or public buildings from the 1 percent ACE floodplain. Of the 165 structures in the study area, 146 would be acquired along with their lots, and these properties would be subsequently used for purposes consistent with floodplain management. This alternative was carried through the economic screening as presented in Section 2.6.1 of this report but as a result of the economic screening this alternative was not carried further in the evaluation.

Recommended Plan

The Recommended Plan, Alternative 8, is described in detail in Section 3 of this Draft Integrated DPR/EA. Of the build alternatives considered, Alternative 8 is recommended because it meets the project purpose and need with no significant environmental impacts and is the NED Plan. The Recommended Plan and the other action alternatives proposed would result in similar environmental impacts due to the commonality of an excavated detention basin in the same general area.

No-Action Alternative

In the absence of a federal project, the project sponsor would not follow through with a flood risk management project. The no-action alternative is not anticipated to

appreciably change the existing land use within the basin or project area as it is highly urbanized, but would continue to result in major, periodic adverse impacts to the business and residences impacted by flooding. Some businesses and/or residents may choose to relocate to existing urban, higher ground areas to avoid flooding, or choose to relocate out of the floodplain

Summary of Environmental Impacts

Environmental impacts would be relatively similar for the build alternatives proposed as they are similar in regard to location and general configurations. The construction footprint incrementally increases for alternatives 5 through 7 up to 37 acres and decreases slightly to 35.6 acres for Alternative 8, the Recommended Plan. A moderate, adverse long-term environmental impact would occur to aquatic habitat, terrestrial habitat and aesthetics for all of the action alternatives proposed, primarily due to the clearing of 13.4 acres of riparian vegetation along Blacksnake Creek and the ephemeral stream to the east. However, a moderate, positive long-term impact would occur due to broadening the incised creek and stream channel and placing rock in the creek that would prevent erosion and create small creek meanders. The removal of existing HTRW is the responsibility of the project sponsor and would occur prior to construction. Removing any existing HTRW is considered a long-term, positive impact. A long-term, moderate positive impact would also occur to water quality as combined sewer overflows and flooding would decrease with implementation of the Recommended Plan. Similarly, the Recommended Plan would result in long-term, moderate positive impacts to socioeconomics and stabilize land use. The Recommended Plan results in no environmental justice impacts as no minority or low-income populations are adversely impacted by the Recommended Plan.

Minor, long-term adverse impacts are anticipated to occur to, fish and wildlife, geology and soils, recreation, access, and aquatic habitat. Short-term, minor adverse impacts to air quality, water quality, noise, and disposal areas would occur during construction. The project is not anticipated to appreciably affect extreme climate and weather events, drought, or climate change in general. No adverse impacts are anticipated to occur to wetlands, cultural resources, or threatened and endangered species. The Recommended Plan will not increase the 100-year flood elevation over existing conditions. Accordingly, floodplain impacts are considered to be short-term and minor. A LOMA would need to be submitted by the City to FEMA to request a revision to the existing floodplain map to show changes to floodplains, floodways, and flood elevations.

Adverse cumulative impacts would occur to terrestrial habitat, aquatic habitat, fish and wildlife and aesthetics. Positive cumulative impacts would occur to flood risk management, socioeconomics and water quality. Impacts to resources as a result of implementing the Recommended Plan are considered less than significant and mitigation measures are discussed below.

Mitigation Measures
The Recommended Plan would result in clearing approximately 13.4 acres of riparian vegetation and 22.2 acres of turf. As part of the project, trees would be planted by the construction contractor within the vicinity of the impacted riparian corridor, north and south of the project area within an area of approximately 95 acres. Disturbed areas would be seeded concurrently or as soon as practicable following construction.

The Recommended Plan results in impacts to both Blacksnake Creek and an ephemeral stream to the east of the creek. Based on the stream impact assessment, the Recommended Plan results in a net debit of 9,388.02. In-kind stream mitigation would be conducted using a mitigation bank located as near as practicable to the Blacksnake Creek watershed.

No mitigation is proposed as a result of project impacts to recreational facilities as similar facilities are located within the local area. However, the City plans to either relocate or construct new recreational features impacted by the project, although locations have not been identified.

In accordance with the USFWS guidance provided within their May 2, 2013, project coordination letter, tree clearing would be scheduled between November 1 and March 31 of the given year to avoid adverse impacts to the Indiana bat. In subsequent correspondence, the USFWS has indicated that an Indiana bat assessment will be required. The assessment will be conducted early in the design effort.

Public Availability
Prior to a decision on whether to prepare an Environmental Impact Statement, USACE circulated a Notice of Availability (Notice) to the public and resource agencies with a thirty day comment period ending on July 30, 2015. The Notice was emailed to individuals/agencies/businesses listed on the USACE Regulatory Office email mailing list. The Notice informed these individuals that the Draft Integrated DPR is available on the USACE webpage or that they could request a hard copy in order to provide comment.

Recommendation
A thorough feasibility study has been conducted to investigate the flood risk management problems and opportunities in the Blacksnake Creek Basin, St. Joseph, Missouri. The study evaluated structural and non-structural measures. The study identifies an economically feasible and environmental and socially acceptable plan to reduce flood risk within the community.

Alternative 8, for construction of a dry detention located at St. Joseph Avenue and Karnes Road, is the Recommended Plan. The construction footprint is approximately 35.6 acres and involves clearing of approximately 13.4 acres of riparian vegetation and 22.2 acres of turf. The Recommended Plan uses natural topography to create 440 acre-feet of detention storage. At current FY2016 federal water resources interest rate of 3.125 percent, the Recommended Plan's benefit-cost ratio is 4.8, with net annual

benefits of $2,410,000. At the seven percent interest rate the benefit-cost ratio is 2.5. The project would represent a strong contribution to national economic outputs.

I have given consideration to all aspects of the project related to the public interest, including the anticipated environmental, economic, and social effects and engineering feasibility of the proposed plan. The non-federal sponsor, the City of St. Joseph, Missouri has stated that prior to implementation, it will through signing the Project Partnership Agreement, agree to cost share and to perform the required items of cooperation. I recommend that the Recommended Plan proposed herein be approved for implementation phase for the design and construction of the proposed Blacksnake Creek Section 205 Flood Risk Management Project to decrease the frequency of flooding within the City of St. Joseph, Buchanan County, Missouri.

This recommendation reflects the information available at this time and current departmental policies governing formulation of individual projects. It does 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.

JUL 11 2016

Date

Andrew D. Sexton
Colonel, Corps of Engineers
District Commander