BLACKSNAKE CREEK
ST. JOSEPH, MISSOURI

Preliminary Assessment - Section 205
Feasibility Phase

FINAL REPORT

Prepared by:
URS

for:

U.S. Army Corps of Engineers
Kansas City District
August 2002

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Preliminary Assessment -- Section 205
Feasibility Phase Report of Flood Damage Reduction

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Study Authority

1. The U. S. Army Corps of Engineers, Kansas City District (the District) is authorized to study flood damage reduction for areas along the Blacksnake Creek, Missouri. This study was conducted under the authority of Section 205 of the Flood Control Act of 1948 (PL 80-858), as amended, of the U.S. Army Corps of Engineers (the Corps) Continuing Authorities Program (CAP). This report, prepared by URS under contract to the District, was completed at the request of the City of St. Joseph by letter dated 9 November 2000. The City is the District's potential feasibility cost-sharing partner.

Study Purpose

2. The purpose of this analysis is to conduct an initial appraisal of flood protection opportunities along the Blacksnake Creek and evaluate the federal interest in flood damage reduction within the Blacksnake Creek Basin in Missouri. Federal interest (*i.e.*, participation) in a flood control project requires a demonstration of economic feasibility, which is established by determining whether the benefits to the national economy exceed the annual economic costs.

Location/Congressional District

3. The Blacksnake Creek Basin (the Basin) is located in Andrew and Buchanan Counties, Missouri and includes the northwest portion of the City of St. Joseph (see Figure 1). Blacksnake Creek is a left bank tributary of the Missouri River that flows

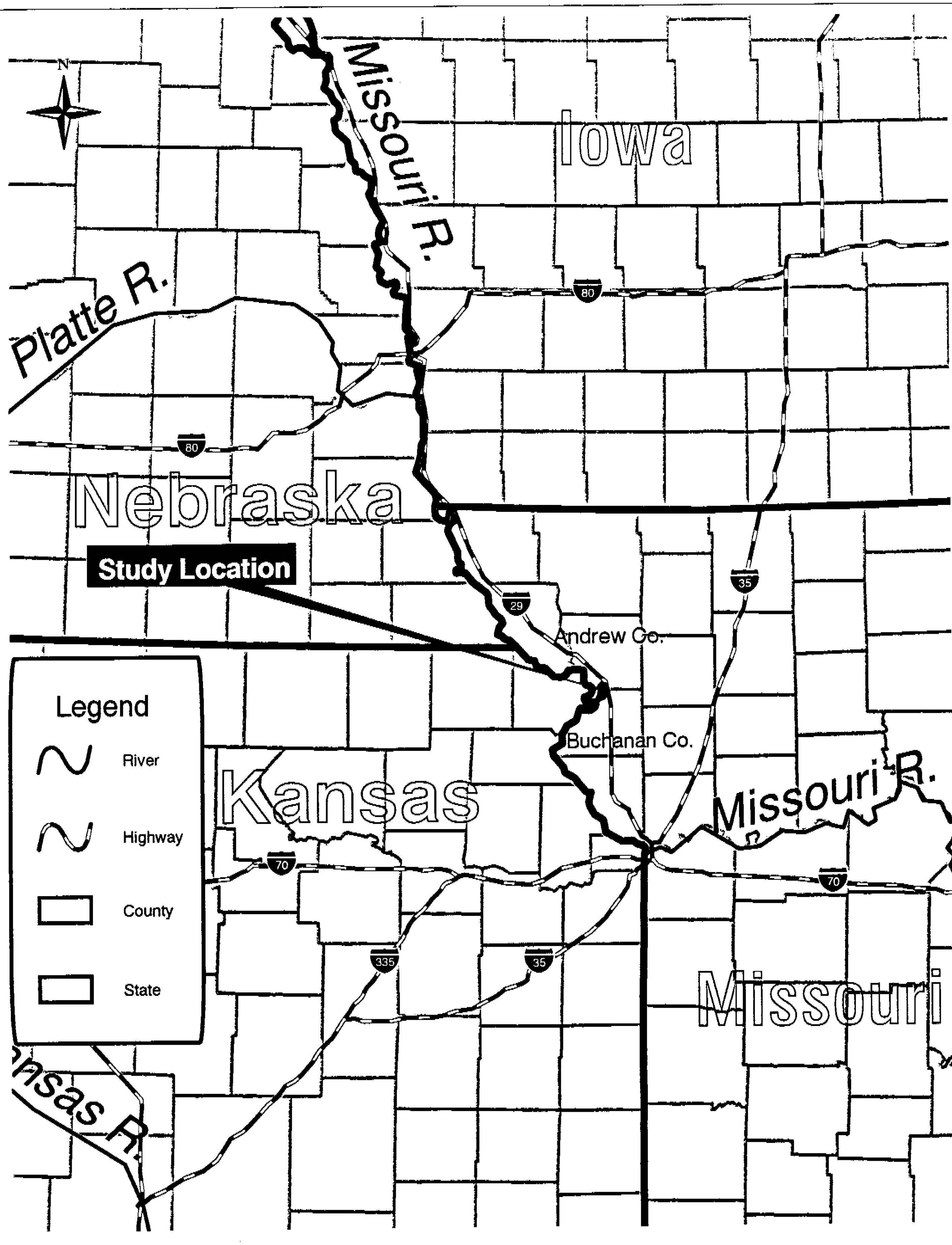


Figure 1
Blacksnake Creek Location Map

south-southwest through the City and joins the Missouri River at river mile 449.1. The study area is located in Missouri's 6th Congressional District (Congressman Sam Graves).

Prior Studies and Reports

4. Prior reports and studies by the Corps and others were reviewed as part of this investigation. Following is a list of documents reviewed and used in this report as they relate to a potential Blacksnake Creek project:

5. U.S. Army Corps of Engineers, Kansas City District studies and reports:

- Reconnaisance Report for St. Joseph, Missouri, US Army Corps of Engineers- Kansas City District, December 1987
- Flood Plain Information, Blacksnake Creek, St. Joseph, Missouri, US Army Corps of Engineers- Kansas City District, April 1971

6. Other agencies' studies, reports, and documents:

- Federal Emergency Management Agency (FEMA), Flood Insurance Administration (FIA), Flood Insurance Studies (FIS) for City of St. Joseph, Missouri, Buchanan County (rev. September 19, 1984);
- Black & Veatch, Draft Stormwater Management Report, November 20, 1998
- Various newspaper articles from the St. Joseph News-Press and St. Joseph Gazette (see Attachment B)

Most Relevant Studies

7. Information from the following documents was deemed the most significant to the problem identification and plan formulation:

Reconnaissance Report

8. A reconnaissance level evaluation of the Blacksnake Creek (and other tributaries of the Missouri River) was conducted in 1987. The report evaluated two different size detention basins in the area to the north of Karnes Road and recommended construction of the larger size detention basin and a channel to control flows in excess of the basin's capacity. The basin was designed to detain 327 acre-feet of water, with a dam structure situated along Karnes Road at a height of 905 feet NGVD. The basin had a 3 foot by 6 foot concrete box outlet structure designed to discharge 440 cubic feet per second (cfs) into the existing combined sewer system. The construction cost of the detention basin was estimated at $2.73 million dollars (1987 price level). The combined channel and detention basin was shown to be cost effective and had a 1.3 benefit-cost ratio (BCR) with annual net benefits of $157,000 (1987 price level)

Draft Stormwater Management Report

9. Like the Reconnaissance Report, the Draft Stormwater Management Report recommended a detention basin to the north of Karnes Road. The report ranked various improvements and stated that the detention basin was at the top of the priority list based on cost and effectiveness. The basin had a capacity of 351 acre-feet with twin 6 foot by 5 foot outlet openings. The estimated cost (excluding land acquisition) was $2.4 million (1998 price level)

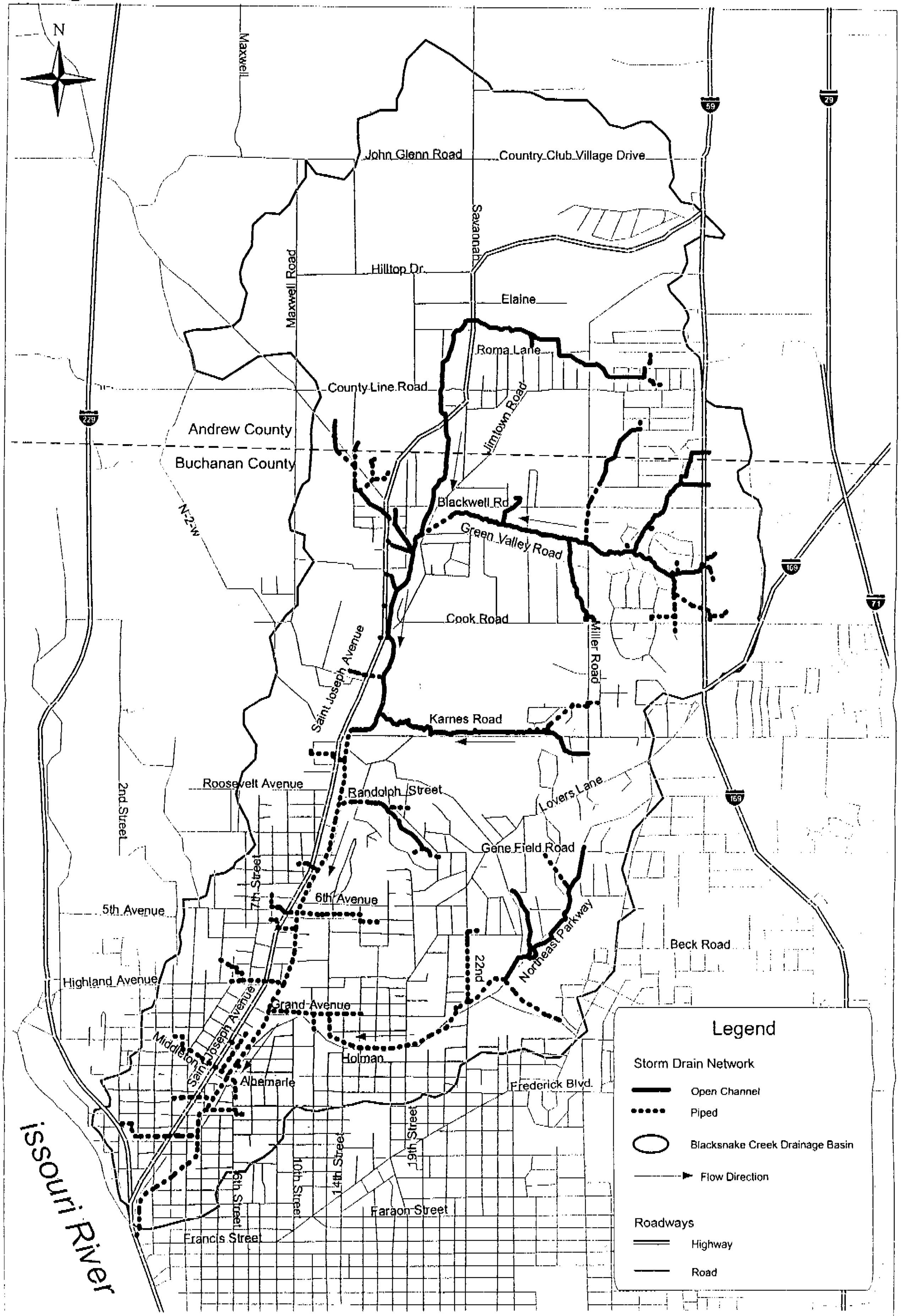
Existing Conditions

Basin Description

10. The Blacksnake Creek watershed, located in Buchanan and Andrew Counties, has a total drainage area of 8.2 square miles. The elongated basin drains via natural and piped conduits towards the south-southwest into the Missouri River. The elevation change along the Blacksnake Creek varies from 828 feet at its mouth to 1,070 feet near its source. The southern portion of the watershed is heavily urbanized while the northern portion is less densely developed. The watershed is shown in Figure 2

11. The 1987 Reconnaissance Report states, "The channel in the lower 3.2 square miles of the basin is enclosed in a conduit, approximately 2.5 miles in length, constructed to carry the streamflow, stormwater and combined sanitary flows. Above the conduit entrance at Karnes Road the stream remains largely unmodified. The flood plain in this are has an average width of 400 feet. Channel dimensions are about forty feet wide and 10 feet deep with a bottom slope of forty three feet per mile."

12. The main stem of Blacksnake Creek flows parallel to St. Joseph Avenue. South of Karnes Road the system is largely piped and north of Karnes Road the storm system consists mostly of open channels. The piped portion of the system is a combined sewer and dry weather flows are routed to the treatment plant via a 36 inch diameter diversion 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 egg-shaped pipe near its outlet at the Missouri River. There is a large wooden flap valve at the combined sewer outlet.



1000 0 1000 2000 Feet

Figure 2
Blacksnake Creek Watershed

13. There are several large tributaries (both open channel and piped) that enter Blacksnake Creek. In the upstream open channel area between Blackwell and Green Valley Road, there is a large tributary which enters the left bank of the main stem via an 8 foot diameter pipe. There is another large open channel branch entering along the left bank just north of the combined sewer inlet at Karnes Road. There is also a large (8 foot diameter) combined sewer entering the main stem combined sewer at Grand Avenue. There are also numerous smaller pipe and unpiped tributaries entering the main stem along its length.

Problem Description

Causes of Flooding

14. Flooding in the Blacksnake Creek Basin results primarily from flash flooding from local storm events. During intense storm events (greater than or equal to a 10-year frequency event) 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. Shallow flood flows, typically less than 6 feet deep, may contain wastewater as well as stormwater since flow can both exit and enter the combined sewer at numerous locations. Consequently, there is potential for health as well as flood hazards.

15. Backwater from the Missouri River flows generally does not cause flooding on the Blacksnake Creek, due to the significant differences in drainage areas (420,300 square miles vs. 8.2 square miles) and flood timing. In addition, the elevation of the majority of the basin is well above the Missouri River flood stage.

Flood Hazard Areas

16. The City of St. Joseph was contacted during this investigation to identify flood hazards associated with the Blacksnake Creek and its tributaries. A meeting was held with municipal engineers and public works personnel. Based on this meeting and historical data, the most significant flooding hazards in the Blacksnake Creek Basin were identified in areas south of Karnes Road and especially along Burnside Avenue. Approximately 200 homes and businesses are located within the 100-year floodplain for the Blacksnake Creek below Karnes Road (based on a preliminary delineation of the Blacksnake Creek FEMA Q3 digital flood mapping).

17. A windshield survey of 290 structures within the floodplain was conducted. The survey included variables such as type of building, usage, condition, quality, main floor elevation, ground elevation, low opening elevation, presence of a basement, presence of a garage, size and exterior material. A structure inventory guideline was prepared for use during this windshield survey and is included as Attachment A. The building data was collected and used to determine depreciated structure values and applicability of generalized damage functions for use in the economic analysis.

18. The Blacksnake Creek watershed was divided into four reaches for analysis as shown in Figure 3. The first reach, located just upstream of the confluence with the Missouri River (Blacksnake Creek station 0 to station 63+00), contains the highly developed area to the south of Grand Avenue. This area contains a large percentage of the commercial development and the Wire Rope Corporation of America buildings. It is subject to flooding when the capacity of the combined sewer is exceeded. The second reach (Blacksnake Creek station 63+00 to station 132+00) is located between Grand Avenue and Karnes Road and is also subject to flooding when the combined sewer is exceeded. This reach contains a larger percentage of residential development. The third reach (Blacksnake Creek station 132+00 to 168+00) is located between Karnes Road and just north of Cook Road and contains primarily open channel stream segments.

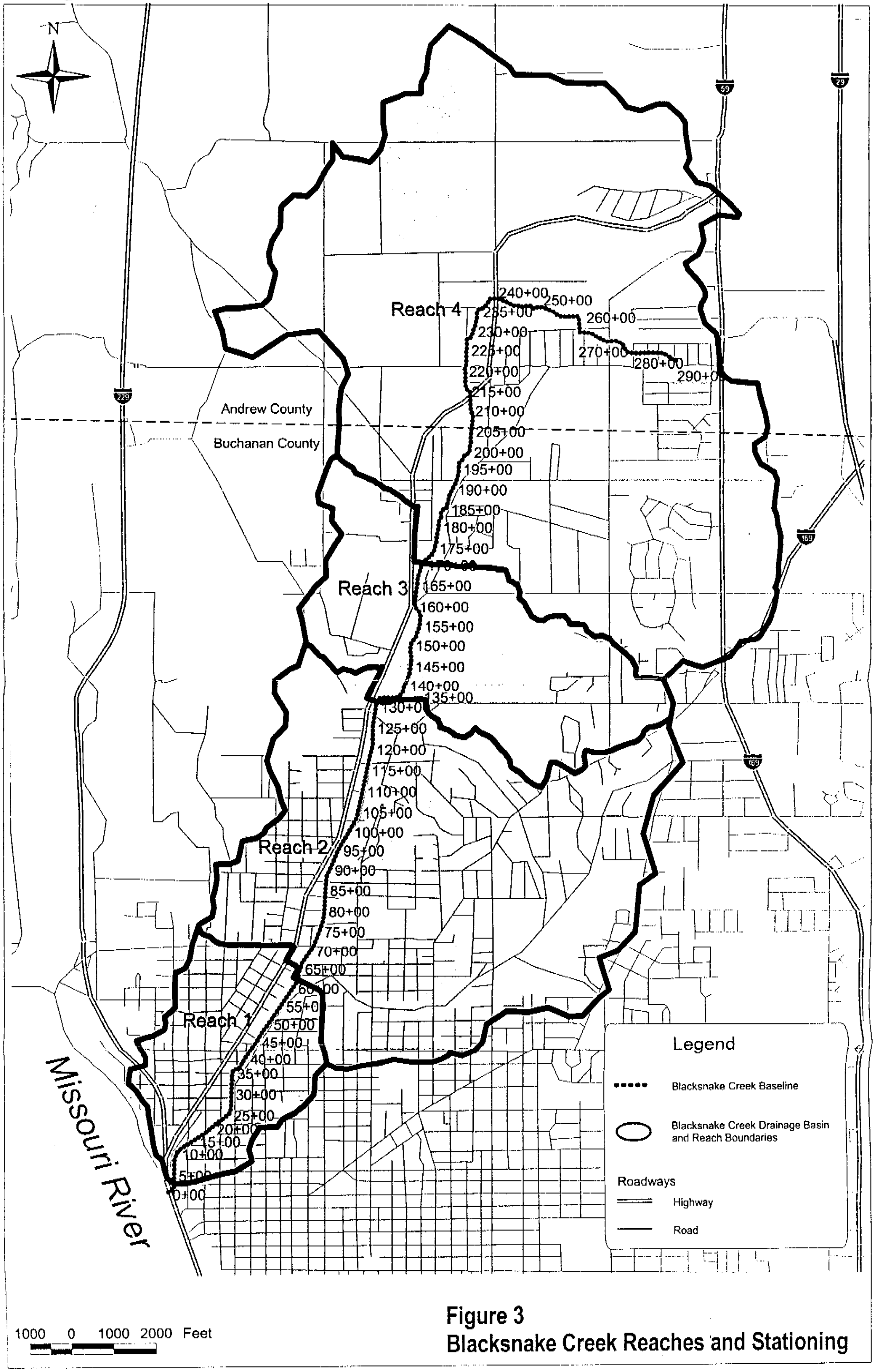


Figure 3
Blacksnake Creek Reaches and Stationing

The fourth reach (Blacksnake Creek station 168+00 to 287+00) is located to the north of Cook Road. Reaches one and two are subject to flooding due to the capacity limitations of the combined sewer. Reaches three and four are conveyed mainly by open channels and flooding problems in these reaches were judged to be less severe than in reaches one and two.

Past Flood Damage

19. Within recent history, one of the most damaging floods of record in the Basin resulted from the storm of June 9, 1984, which caused greater than $3.9 million (1987 price level) in flood-related losses. A total of 129 flood insurance claims were submitted to the Federal Emergency Management Agency (FEMA) for this storm and claims paid amounted to approximately $3.6 million (1987 price level). An additional $300,000 was paid to the City under FEMA's Public Assistance Program. Other notable damaging storms occurred in June 1949, June 1943, May and August 1959 and May 1962.

Expected Future Conditions Without Flood Protection

20. 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 St. Joseph has remained stable, development can be expected to continue in the upper portion of the basin. This continuing development is expected to increase flooding in the lower portion of the basin. This initial assessment is based on without project future conditions being the same as current conditions. This is a conservative assumption and any increases in future flows due to development would only serve to increase flood damages and benefits.

Needs and Opportunities

Flood Protection

21. Evaluation of flooding problems in the Blacksnake Creek Basin has identified the area to the south of Karnes Road as the most in need of flood protection. Plan formulation for this initial appraisal focused on flooding problems and opportunities in this area. However, more detailed future hydrologic and hydraulic (H&H) analyses may indicate other flood prone areas within the watershed that could also benefit from a flood protection project.

Water Quality Improvement

22. Although water quality is not the focus of this investigation, any improvements to the combined sewer system (or reductions in flow to the system) are likely to reduce combined sewer overflows and thereby increase water quality. In addition, there may be opportunities for environmental enhancement for possible future consideration by the District and/or local sponsor under other authorities.

Plan Formulation

23. As part of this investigation, the District has coordinated with interested federal, state, and local entities to identify problems and opportunities for flood damage reduction in the Blacksnake Creek Basin. In addition, a literature search and review was conducted to identify available information regarding water resources issues in the Basin. Field reconnaissance was also performed to identify opportunities for flood damage reduction.

24. Although formal plan formulation for an initial assessment does not attempt to identify the best or optimum plan, an array of alternatives were considered. 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 presented in the reconnaissance report is still a viable alternative since conditions within the basin have not changed substantially since the reconnaissance report was developed, and its conclusions are therefore considered still valid. In addition, the Draft Stormwater Management Plan suggests that the potential local sponsor would support such an alternative. Consequently, the detention basin alternative north of Karnes Road was chosen for reanalysis.

Proposed Detention Basin Plan

25. A structural alternative providing flood damage reduction up to approximately the 100-year design level was evaluated. The alternative included a detention basin north of Karnes Road (at the combined sewer inlet) and levees/floodwall along the edge of the basin to protect nearby homes.

26. An on-line detention basin upstream of Karnes Road would effectively reduce peak discharges. The detention basin was conceptually designed with an overflow crest elevation of 904 feet NAVD88 and a 6.5 foot wide by 4 foot high outlet plate orifice

discharging into the existing 12 foot diameter combined sewer. An overflow spillway is designed to convey flows above the 100-year frequency storm. The spillway is a 40-foot wide structure with a crest elevation of 904 feet NAVD88. The detention basin is designed with approximately one foot of freeboard and the detention dam and levee/floodwall top elevations have been set to 905 feet NAVD88. The basin is shown in Figure 4 and its stage/storage/outflow relationship is shown in Table 1.

Table 1

Stage-Storage-Outflow for Proposed Basin

(outlet = 4' high x 6.5' wide orifice invert el 873.61 NAVD88)

Return Period (years)	Stage (tt NAVD88)	Storage (Ac-ft)	Outflow (cfs)
2	890.8	65	424
5	895.3	135	504
10	897.7	182	540
25	900.3	236	572
50	902.1	280	591
100	903.8	332	639
250	904.6	357	650
500	905.0	367	654

27. The detention basin embankment was assumed to have 3:1 side slopes with a 30 foot crest width. Karnes Road would be reconstructed along its crest. The upstream face was assumed to have 18-inch thick riprap and the downstream face was assumed to be grass. The total length of the detention basin structure along Karnes Road is approximately 820 feet and its maximum height would be 13 feet above the downstream grade elevation in the park.

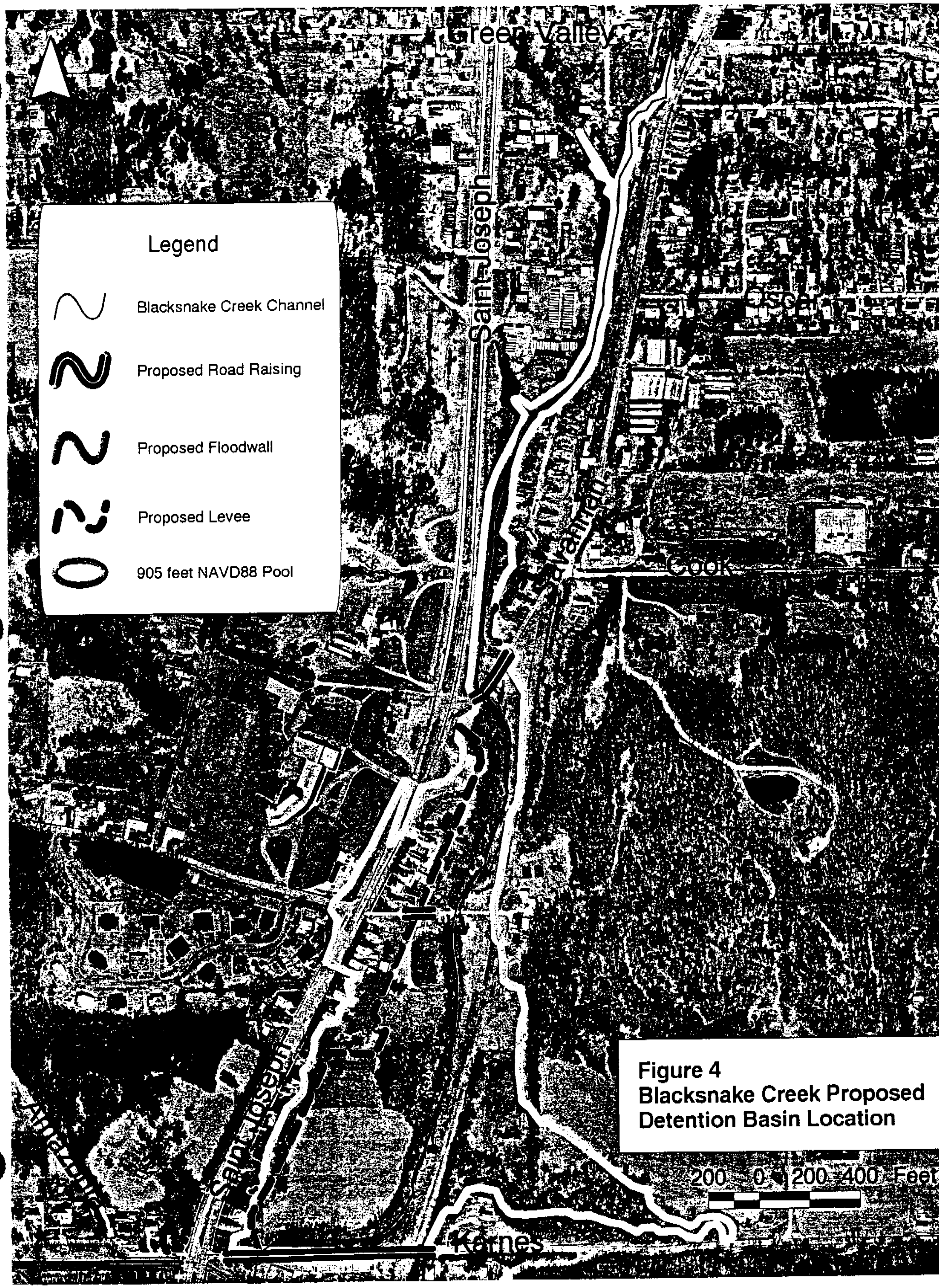


Figure 4
Blacksnake Creek Proposed Detention Basin Location

28. The detention basin would require construction of a levee along its western edge in order to prevent flooding of adjacent homes (and property). The levee was assumed to have a 10 foot top width and 2:1 side slopes. A total of approxmately 2,500 feet of levee would be required. The levee would have a maximum height of approximately eight feet but would be lower in most areas.

29. A small piece of floodwall (approximately 180 feet) will also be required just north of Savanah Road along the east bank in order to protect two homes which would be affected by the detention basin's backwater pool. The floodwall was assumed to be constructed of reinforced concrete and was only approximately 3 feet high.

Plan Analysis and Assumptions

Hydrologic and Hydraulic Analysis

Background

30. The first aspect of assessing the flooding potential of a river is to identify or develop H&H data. This is usually done using a recent study. In many cases, the hydrologic and hydraulic data generated by FEMA to develop the Flood Insurance Rate Map (FIRM) is sufficient for this level of analysis. However, the Flood Insurance Study (FIS) used information from a Corps of Engineers (COE) study performed in 1971 and the data may be out of date. Consequently, more current hydrology and hydraulics were required for this study.

Hydrology

31. Hydrology (discharge-frequency) relationships were developed using two methods. The first method was the existing Storm Water Management Model (SWMM) model for the Blacksnake Creek Watershed developed for the City of St. Joseph. The second method was a transfer equation. Both methods are described in the following section.

32. SWMM is a comprehensive model that can perform hydrologic and hydraulic calculations. The hydraulics module (EXTRAN) is a 1-dimensional non-steady state model which can incorporate backwater and looped systems. The model obtained from the city is a 3rd party version of the EPA SWMM model called XP-SWMM. This version of SWMM has both graphical input and output routines making it easier to make changes in the model and to visualize results. The Blacksnake Creek SWMM used the RUNOFF, TRANSPORT and EXTRAN modules. The RUNOFF module computes the hydrology using SCS unit hydrograph methods. The TRANSPORT block routes flows downstream

in areas where there are no significant restrictions or backwater. The EXTRAN block also routes flows downstream but incorporates backwater effects.

33. Since the SWMM model did not incorporate routing of flood flows in the streets, the model could not accurately compute hydrology for large (greater than 5 year) events south of the combined sewer inlet at Karnes Road (the large flows are lost from the model). The model was only used for hydrology north of Karnes Road.

34. The second method used to determine peak discharges was a transfer equation. In order to arrive at discharges downstream of Karnes Road a transfer equation with the following form was used:

$$Q_1/Q_2 = (A_1/A_2)^{0.8}$$

Where: Q_1 and Q_2 are peak discharges for drainage areas 1 and 2
A_1 and A_2 are areas for drainage areas 1 and 2

The 0.8 coefficient is based on the regression equations developed for the State of Missouri and used by the USGS. The existing condition peak discharges for the four study reaches are shown in Table 2.

35. It should be noted that the existing SWMM may underestimate the low frequency flows due to analysis limitations. The hydraulics for the area to the north of Karnes Road was modeled using the Transport module of SWMM. This module can not incorporate backwater or flow over roadways. Some potential flow is therefore assumed to be stored in the system, underestimating the flow in downstream reaches. Although the flows may be underestimated, the results are conservative and any increases in flows would only result in higher damages and benefits. Therefore, refinement was not considered necessary at this level of study.

Table 2

Existing Condition Peak Discharges (cfs)*

Rch.	Location	2 year	5 year	10 year	25 year	50 year	100 year	250 year	500 year
4	Total	1,447	2,187	2,650	2,943	3,147	3,375	3,613	3,762
3	Total	1,685	2,598	2,994	3,342	3,644	3,934	4,389	4,675
2	Overland	0	0	1,466	2,262	2,762	3,248	3,868	4,223
	Pipe	1,900	1,900	1,900	1,900	1,900	1,900	1,900	1,900
	Total	1,900	1,900	3,366	4,162	4,662	5,148	5,768	6,123
1	Overland	0	0	1,140	1,968	2,495	3,008	3,669	4,050
	Pipe	2,087	2,500	2,500	2,500	2,500	2,500	2,500	2,500
	Total	2,087	2,500	3,640	4,468	4,995	5,508	6,169	6,550

* Reach 1 & 2 surface flow assumed same as flow at inlet times ratio of $areas^{0.8}$ minus pipe capacity (not modeled).

36. In order to analyze the proposed detention basin just north of Karnes Road, the SWMM model was modified to include the detention and overflow structures. The 2, 5, 10, 25, 50, 100, 250 and 500-year frequency flows were then routed through the proposed detention basin. Peak discharges in reaches 3 and 4 were taken directly out of the SWMM and are the same as the existing condition discharges. Discharges in reaches 1 and 2 were zero for storms less than the 100-year frequency event (for the overland portion) since the proposed condition flows are now entirely contained within the combined sewer. The proposed discharge-frequency relationships as shown in Table 3.

37. The proposed detention structure with a capacity of 367 acre-feet at elevation 905 feet NAVD88 is sufficient to detain the 100 year flood with at least 1 foot of freeboard.

Table 3

Proposed Condition Peak Discharges (cfs)*

Rch.	Location	2 year	5 year	10 year	25 year	50 year	100 year	250 year	500 year
4	Total	1,447	2,187	2,650	2,943	3,147	3,375	3,613	3,762
3	Total	1,685	2,598	2,994	3,342	3,644	3,934	4,389	4,675
2	Overland	0	0	0	0	0	100	268	371
	Pipe	1,007	1,403	1,576	1,728	1,852	1,900	1,900	1,900
	Total	1,007	1,403	1,576	1,728	1,852	2,000	2,168	2,271
1	Overland	0	0	0	0	0	0	69	199
	Pipe	1,161	1,640	1,849	2,034	2,185	2,359	2,500	2,500
	Total	1,161	1,640	1,849	2,034	2,185	2,359	2,569	2,699

* Reach 1 & 2 surface flow assumed same as flow at inlet times ratio of areas$^{0.8}$ minus pipe capacity (not modeled).

Hydraulics

38. The area near Karnes Road was modeled using the EXTRAN block of XP-SWMM. The model from the City of St. Joseph was modified slightly so that the existing and proposed storage upstream of Karnes Road was included. Both overflow over Karnes Road and flow into the combined sewer were incorporated into the model. Since the existing condition model below Karnes Road was not accurate, this portion of the model was deleted. Hydraulics for the area downstream of Karnes Road was modeled using HEC-RAS.

39. To supplement the SWMM results a Hydrologic Engineering Center River Analysis System (HEC-RAS) model was developed for the Blacksnake Creek Watershed. The model includes only the main stem of Blacksnake Creek and does not include flow that is contained in the combined sewer south of Karnes Road. The model includes the entire mainline of the Blacksnake Creek from its outlet at the Missouri River (station 0+00 to its

headwaters near the intersection of County Line Road and Route 29 (station 287+00). The HEC-RAS model considers only the overland portion of flow. The discharge-frequency relationships were entered into the HEC-RAS model to compute water surface profiles and these profiles were then imported into the economic model to analyze project damages and benefits. The complete HEC-RAS and XP-SWMM models are included in Attachment C.

40. It should be noted that there is much uncertainty in modeling of shallow flows through streets and yards. Under existing conditions, flood waters will likely flow along several different paths dividing and recombining (especially at small flood depths). Shallow flood flows may not be one-dimensional and flow may enter or exit the combined sewer at different locations. This uncertainty was reflected in the confidence bands defined in the Flood Damage Analysis.

Economic Evaluation

Introduction

41. Establishing federal interest requires identifying a least one plan for which benefits exceed costs. Project benefits were divided into three categories: (1) the reduction of flood damage to structures and their contents, (2) the reduction in "other" costs associated with flooding events including damage to cars, landscaping and emergency response, and (3) reduced Flood Insurance Administration costs. Benefits created by a project are equal to the difference between the anticipated damages if no action is taken (future without-project conditions) and anticipated flood damages with the project in place (with-project conditions). Costs include engineering and design, construction and construction management. Operation and maintenance costs were not considered since they would primarily consist of mowing the detention basin area and were assumed small in relation to other project costs.

42. Approximately 290 homes and businesses are located within the 500-year flood plain for the Blacksnake Creek. The location and depreciated replacement value of these structures is shown in Table 4. Since there is a significant amount of damageable property in the floodplain, there may be significant economic benefits from a project that reduces the frequency of flooding.

Table 4

Estimated Depreciated Replacement Values and Content Values by Reach and Type for Study Area*

	Residential Property				Nonresidential Property			
Rch.	**No.**	**Structure**	**Content**	**Total**	**No.**	**Structure**	**Content**	**Total**
1	6	$337,000	$147,000	$484,000	58	$42,289,000	$134,673,000	$176,962,000
2	136	$15,406,000	$6,702,000	$22,108,000	23	$7,020,000	$7,020,000	$14,040,000
3	23	$3,262,000	$1,419,000	$4,681,000	1	$24,000	$24,000	$48,000
4	34	$3,012,000	$1,310,000	$4,322,000	9	$19,250,000	$19,250,000	$38,500,000
Total	199	$22,017,000	$9,577,000	$31,594,000	91	$68,583,000	$160,967,000	$229,550,000

* Totals may not match due to rounding. Content value for residential structures assumed to equal 43.5% of structure depreciated replacement value (as per EM 1110-2-1619 Table 6-4). Approximately 62% of nonresidential content value based on interview. Remainder of nonresidential content value is based on assumption that depreciated replacement value is equal to content value.

43. The Hydrologic Engineering Center's Flood Damage Analysis Program (HEC-FDA) was used to calculate project damages and benefits. The model input included variables determined during the structure inventory along with depreciated replacement values and stage vs. frequency curves from the HEC-RAS model. Structure depreciated replacement values were computed based on Institute for Water Resources (IWR) guidelines.

44. Generalized damage functions used in the HEC-FDA program relate the flood depth at a structure to the percent of damage at that structure. In this study, depth damage data were derived from two sources: The "structure" and "content" damage functions for residential and nonresidential structures were obtained from FEMA as part of their rate review tables and the "other damage" function was obtained from the Passaic River Basin (PRB) Study. The "other damage" functions describe the depth-damage relationship for landscaping and autos and also include costs for emergency actions taken

as a result of flooding. The PRB "other damage" functions were considered to be applicable to the Blacksnake Creek basin since the damageable properties are similar and since the range of flood depths is also expected to be similar.

45. Since only depreciated structure values were calculated, assumptions needed to be made for the content and other values. For residential structures, the content value was set at 43.5% of the depreciated structure value (as per EM-1110-2-1619 Risk-Based Analysis for Flood Damage Reduction Studies). For non-residential structures, the content to depreciated structure value ratio was set at 100%. For both residential and non-residential structures, the other value was set at 100% of the depreciated structure values since these "other damage" functions were derived using this assumption. The other value was not, however, assumed to equal 100% of the structure value.

46. Unique depth damage functions were developed for Wire Rope Corporation of America. Separate damage functions for structure, content (machinery and inventory) and other were developed. This business represents a large portion of potential damages in the lower portion of the Blacksnake Basin. The damage functions were based on an update of previously completed damage functions and on an interview with WRCA personnel.

Benefits

47. Annual project benefits result from flood reductions in reaches 1 and 2 (below Karnes Road). The proposed detention basin is expected to contain the 100-year frequency flood without overtopping and will significantly reduce downstream peak discharges from (5,508 cfs to 2,359 cfs for the 100-year frequency storm). The chance of residual flooding downstream of Karnes Road will be extremely small. Annual residual damages with the project in place are expected to be about $177,000 and would result from storms greater in magnitude but less frequent than the 1 percent chance event. Residual damages

may also be due to flows in excess local sewer system capacities. A summary of these damages and benefits are shown in Tables 5, 6 and 7.

48. Since the detention basin alternative provides protection against a 100-year frequency storm, the project may be certified by FEMA and flood insurance may no longer be required for residents in the 100-year floodplain. The eliminated FIA policy administrative costs may therefore be taken as a project benefit. Although the precise number of policies in the floodplain has not yet been determined, the number is likely to be approximately 50 policies. At the current administrative cost of $141/policy/year, there is a project benefit of $7,050.

Table 5

Summary of Expected Annual Damages by Damage Category

Reach	Without-Project Condition			With-Project Condition		
	Residential	Non-Residential	Total	Residential	Non-Residential	Total
1	$20,510	$165,210	$185,720	$15,980	$40,810	$56,780
2	$351,620	$32,560	$384,180	$77,670	$5,890	$83,550
3	$60	$10	$70	$60	$10	$70
4	$35,810	$330	$36,150	$35,810	$330	$36,150
Total:	$408,000	$198,110	$606,110	$129,520	$47,040	$176,550

* totals may not match due to rounding

Table 6

Summary of Expected Annual Damages by Damage Type

Reach	Without-Project Condition			With-Project Condition		
	Structure/ Content	Other	Total	Structure/ Content	Other	Total
1	$157,090	$28,630	$185,720	$46,150	$10,630	$56,780
2	$263,910	$120,270	$384,180	$51,470	$32,080	$83,550
3	$40	$30	$70	$40	$30	$70
4	$22,520	$13,630	$36,150	$22,520	$13,630	$36,150
Total:	$443,570	$162,540	$606,110	$120,180	$56,370	$176,550

* totals may not match due to rounding

Table 7 Summary of Expected Annual Benefits	
Benefit Description	**Benefit**
Structure, Content & Other Damage Avoided	$429,600
Reduced FIA Administrative Costs	$7,100
Total Expected Annual Benefits	$436,700

49. As part of the economic analysis uncertainty was considered in the damage/benefit calculations. Uncertainty was considered in both the H&H and also in the structure inventory variables. A summary of the uncertainty assumptions is shown in Table 8. The complete HEC-FDA model is shown in Attachment D.

Table 8 Summary of Uncertainty Assumptions		
Variable	**Standard Deviation**	**Units**
First Floor Elevation	0.6	Feet
Stage-Discharge	0.9	Feet
Content/Structure Value Ratio	25%	N/A
Other/Structure Value Ratio	10%	N/A
Discharge-Frequency	100 (reaches 1 and 2) 10 (reaches 3 and 4)	Years (equiv. Record length)

Costs

50. A conceptual site layout was developed to provide sufficient detail to allow the development of gross quantity estimates. Emphasis was placed on components that represented significant cost items. The development and examination of engineering details that do not substantially affect cost or performance were minimized during the conceptual design and evaluation process. First construction cost estimates developed in this analysis were based on gross quantity estimates and general unit costs to determine

the economic viability of potential flood control measures. The total first cost was calculated to be $5.1 million or $329,100 annually (at 6-1/8% over 50 years).

51. Engineering and design (E&D) costs were assumed to be 12%; supervision and administration (S&A) costs were assumed to be 8%. Contingency costs were estimated to be 20%. These estimates, as well as the mobilization and demobilization costs, are similar to those used for preliminary cost estimates in other pre-feasibility level analyses.

52. The economic evaluation considered annual benefits against the annual costs of the alternative. In this analysis, annual costs included the calculation of interest during construction (IDC) or operation and maintenance (O&M). A summary of costs is presented in Table 9.

53. The alternative selected for investigation in the initial appraisal analysis is not meant to represent the only method that may be applied to the Basin. Rather, it represents a possible solution that may meet Corps criteria for an implementable plan and help establish a federal interest in flood control in the Basin. The proposed plan would provide protection for a 100-year frequency storm event. The complete cost estimate is shown in Attachment E.

Table 9

Summary of Costs (2001 price level, 50-year period of analysis, 6-1/8%)

Construction Cost	$4,171,560
Planning Engineering and Design (12%)	$500,590
Construction Mgmt (8%)	$333,730
Land Cost	$92,760
Total Project First Cost	$5,098,600
Interest During Construction*	$351,300
Total Investment Cost	$5,449,900
Annualized Investment Cost	$351,800
Annual O&M Cost	$5,000
Total Annual Cost	$356,800

*IDC was based on a 1 year engineering and design followed by 2 years of construction

54. A flood detention structure north of Karnes Road costing $5.1 million dollars was evaluated to determine if there is a federal interest in a flood damage reduction project along the Blacksnake Creek. The detention basin alternative appears to be economically viable with a BCR of 1.2 and net annual benefits of $79,900 as shown in Table 10.

Table 10

Summary of Plan Economics

(2001 price level, 50-year period of analysis, 6-1/8%)

Annual Benefits	$436,700
Annual Costs	$356,800
Net Excess Benefits	$79,900
BCR	1.2

Summary of Findings

55. This investigation has demonstrated federal interest in flood damage reduction in the Blacksnake Creek Basin. A cost-effective conceptual flood damage reduction alternative has been developed. It is anticipated that benefits of flood damage reduction measures would exceed project costs, resulting in positive contributions to the National Economic Development (NED) account.

56. The proposed detention basin would significantly reduce flood damages in the study area. The preliminary analysis conducted during this initial appraisal indicates that the potential economic benefits exceed project costs, that the proposed measures are technologically feasible, and that they may be accomplished in a cost effective and efficient manner. Therefore, based on the results of the initial appraisal, there is clearly a federal interest in flood damage reduction in the Blacksnake Creek Basin.

Financial Responsibilities

57. The City of St. Joseph would be the likely candidate to serve as the non-federal sponsor for a flood control feasibility study of the Blacksnake Creek Basin. The City needs to understand the feasibility and construction cost-sharing responsibilities. For flood damage protection features, the non-federal sponsor is responsible for all lands, easements, rights-of-way, and relocations (LERR) for the project, plus a cash contribution of a minimum of 5 percent of total project costs. In the event that LERR costs plus 5 percent of the total project costs does not equal at least 35 percent of the total project costs, the non-federal sponsor must contribute additional cash to equal 35 percent of the total project cost. The overall cost sharing percentage will be 65% federal/35% non-federal.

58. In accordance with the Corps' *Digest of Water Resources Policies and Authorities* (EP 1165-2-1, July 30, 1999), studies to determine the existence and extent of Hazardous Toxic & Radiological Waste (HTRW) problems will be treated as study costs and shared accordingly. However, where hazardous substances regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) are found to exist, the non-federal sponsor shall be responsible for any subsequent studies and investigations required to determine the appropriate response and clean-up actions. Should HTRW be discovered on lands required for the project, the non-federal sponsor shall not proceed with land acquisition until mutually agreed upon by both parties. If the land has already been purchased, the federal government and the non-federal sponsor shall decide whether to proceed with construction.

59. The non-Federal sponsor will be responsible for operation, maintenance, repair, replacement and rehabilitation of the project at 100 percent non-federal expense upon completion of construction.