Kansas Citys, Missouri and Kansas
Flood Damage Reduction Feasibility Study
(Section 216 – Review of Completed Civil Works Projects)
Engineering Appendix to the Interim Feasibility Report

Chapter A-1

GENERAL

CHAPTER A-1
GENERAL
(Introductory Discussion for the Engineering Appendix)

The focus of the engineering effort during the feasibility study is on understanding existing conditions, associated data collection and inventories, framing the nature of problems, developing potential solutions to those problems, refining solutions in light of evaluation criteria, and offering the final engineering necessary to support a plan (or plans) within the planning process.

The engineering for this study was developed to the level of detail sufficient to prepare a feasibility baseline cost estimate(s), general project schedule, and support the recommended plan. The results of engineering investigations, studies, and feasibility level designs (hereinafter normally termed "design") are presented in this engineering appendix to the feasibility report. The location and vicinity map of the project is shown on Plate A-1.1.

A-1.1 BACKGROUND

The existing Kansas Citys Flood Damage Reduction Project provides local flood protection for the metropolitan areas of Kansas City, Missouri and Kansas City, Kansas. This feasibility study serves to re-examine the performance of these units.

Section 216 of the 1970 Flood Control Act provides authority to reexamine completed civil works. Section 216 reads as follows:

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

The Kansas Citys Flood Protection Project consists of seven authorized levee units along reaches of the Kansas and Missouri Rivers. The seven units include:

1) Argentine
2) Armourdale
3) Birmingham
4) Central Industrial District – Kansas section (CID-KS)
   Central Industrial District – Missouri section (CID-MO)
5) East Bottoms
6) Fairfax-Jersey Creek
7) North Kansas City – Airport section
   North Kansas City – Lower section

The Kansas Citys project is authorized as seven levee units as the Central Industrial District Unit and the North Kansas City Unit were considered to be one unit regardless of the geopolitical boundaries involved. These two units are separated for the purposes of the feasibility study.

The existing project extends over the lower 10 miles of the Kansas River and, on the Missouri River, from 6.5 miles upstream to 12.5 miles downstream of the mouth of the Kansas River. The seven units of the flood protection system were designed and constructed in conjunction with each other, but are independently operated to some extent. The total protected area covers about 32 square miles and is characterized by dense industrial and commercial development. Some limited residential habitation is also present. Communities (or portions thereof) within the study area include Kansas City, North Kansas City, Randolph, and Birmingham all in Missouri; and Kansas City, Kansas.

This engineering appendix supports the Interim Feasibility Report which is aimed at examining potential improvements to increase the existing project performance consistent with the original authorization. This engineering appendix (similar to the main report) focuses on four of the seven levee units that compose the Kansas Citys system: the Argentine Unit, the North Kansas City Unit, the East Bottoms Unit, and the Fairfax-Jersey Creek Unit. A fifth levee unit, the Birmingham Unit, was determined to meet the authorized level of protection assuming continued adequate operations and maintenance efforts. The Final Feasibility Report will address the two remaining levee units (Armourdale and the Central Industrial District (CID) Units).

A-1.2 GENERAL DESCRIPTION OF LEVEE UNITS

The quantities of certain smaller features as represented herein may change as development or other activities make it necessary. Quantities shown are from the best information available at the time of appendix compilation. Furthermore, the quantities shown for pump plants and drainage structures, in most cases, include both Federal and nonfederal quantities.

A-1.2.1 Argentine Unit

The Argentine Unit is located in Wyandotte County, Kansas, on the right bank of the Kansas River. The unit begins at the Santa Fe Railroad embankment upstream from the Turner Bridge at a point approximately 4,000 feet east of the mouth of Barber Creek. The beginning portion of the levee unit parallels the Santa Fe Railroad embankment before turning northwesterly toward the Barber Creek mouth. At about Kansas River Mile (RM) 10.1, the unit turns to follow the course of the Kansas River. The levee unit ends on the Kansas River at a point about 2,000 feet downstream of the 18th Street Bridge (Kansas RM 4.7). A floodwall containing two stoplog gaps crosses the train tracks to the south and ties into high ground.

Modification and strengthening of works originally constructed by the Kaw Valley Drainage District began in May, 1951 and were completed in November, 1955 by the Corps of Engineers. More recent improvements, separately authorized as the 1962 Modification, were completed in April, 1978.

The flood protection facilities consist of levees, stability berms, floodwalls, underseepage control, 2 stoplog gaps, 6 pumping plants and 18 drainage structures. The levees total approximately 5.2 miles long. The floodwalls total about 1,350 feet.

A-1.2.2 Armourdale Unit

The Armourdale Unit is located along the left bank of the Kansas River from RM 7.0 to RM 0.3, near the confluence of the Kansas and Missouri River. The original levees and floodwalls were constructed under the jurisdiction of the Kaw Valley Drainage District. The protection is separated into three sections totaling about 5.8 miles in length. The uppermost levee section is a tieback from high ground west of Mattoon Creek, then heads downstream to the Union Pacific Railroad tracks. From the Union Pacific Railroad tracks, the levee extends from the railroad embankment near the mouth of Mattoon Creek downstream along the left bank of the Kansas River to the floodwall. The second portion is a floodwall that begins north of the Chicago, Rock Island, and Pacific Railroad Bridge and extends downstream to connect with the third levee section. The third levee section ties back into high ground at the embankment of the Lewis and Clark Viaduct.

Construction of the Federal project began in May, 1949 and was completed in February, 1951. More recent improvements, separately authorized as the 1962 Modification, were completed in April 1976.

The flood protection unit consists of levees, stability berms, retaining walls, floodwalls, underseepage control including 45 relief wells, 2 sandbag gaps and 2 stoplog gaps, 10 pump plants, and 36 drainage structures. The levees stretch about 5.7 miles through the Armourdale Unit and the floodwalls total approximately 6,600 feet.

A-1.2.3 Birmingham Unit

The Birmingham Unit is located on the left bank of the Missouri River, approximately 12.4 miles downstream from the mouth of the Kansas River. The original construction was done under the jurisdiction of the Birmingham Drainage District allowed by a resolution dated February 18, 1946. The upstream section of the levee was raised and strengthened in 1952 by the Federal Government. The downstream section was strengthened and modified in 1954 and 1955. The levee begins at the bluff southeast of Randolph, Missouri and extends southwest along an abandoned railroad fill. It continues south to the Missouri River and downstream until it turns north and west along the left bank of the old Liberty Bend channel to the old Wabash Railroad. From there, the levee goes upstream along the right bank of Shoal Creek to high ground at Liberty Road.

The flood protection works include a levee, stability berms, floodwalls, underseepage control, 3 sandbag gaps, 2 stoplog gaps, 2 pump plants, and 4 drainage structures. The levee is about 11.0 miles long and the floodwalls total approximately 430 feet.

A-1.2.4 Central Industrial District – Kansas Unit

The Central Industrial District – Kansas flood protection unit is located in Wyandotte County, Kansas, and extends from the Kansas/Missouri state line along the right bank of the Missouri River to the mouth of the Kansas River. It then continues upstream along the right bank of the Kansas River to RM 3.4. The Kaw Valley Drainage District is the local agency responsible for operation and maintenance. The original unit was constructed by the Kaw Valley Drainage District prior to May, 1948, when initial Federal improvements began. The bulk of the improvements were completed by November, 1955. The most recent improvements were completed in December, 1979.

The unit consists of a system of levees and floodwalls, underseepage control including 17 relief wells, a stoplog gap, a sandbag gap, 10 pump plants, and 23 drainage structures. The levee is approximately 1.7 miles long and the floodwalls total about 7,900 feet.

A-1.2.5 Central Industrial District – Missouri Unit

The Central Industrial District – Missouri flood protection unit is located in Kansas City, Missouri within Jackson County. The unit extends along the right bank of the Missouri River, upstream from the Grand Avenue Viaduct (RM 365.7), to the Kansas/Missouri state line (RM 367.2). The initial construction began in March, 1946 and was completed in September, 1947. Significant improvements and repair of 1951 flood damage followed the initial construction and were completed in November, 1955.

The unit consists of a system of levees, floodwalls, underseepage control, 1 sandbag and 7 stoplog gaps, 7 pump plants, and 5 conduits. The levees total about 430 feet in length and the floodwalls are about 1.5 miles long.

A-1.2.6 East Bottoms Unit

The East Bottoms Unit is located in Kansas City, Missouri within Jackson County. The unit extends downstream along the right bank of the Missouri River from the Armour-Swift-Burlington (A.S.B.) Bridge, RM 365.6 (adjusted 1960) to the mouth of the Blue River, RM 357.7 (adjusted 1960). Then the levee turns and heads west upstream along the left bank of the Blue River to the Union Pacific Railroad embankment.

The initial construction was completed in September, 1950, and the City of Kansas City formally accepted the project on July 30, 1951. The most recent work on the East Bottoms Unit was completed in August, 1974.

The unit consists of a system of levees, floodwalls, stability berms, retaining walls, underseepage control including 28 relief wells, 3 stoplog gaps, 11 pump plants, and 17 drainage structures. The levee portion is about 9.2 miles long. The floodwall portion is approximately 2,190 feet long.

A-1.2.7 Fairfax-Jersey Creek Unit

The Fairfax-Jersey Creek Unit is located on the left bank of the Kansas River from the Union Pacific Railroad Bridge (Kansas RM 0.3) downstream to the mouth of the Kansas River. It then extends along the right bank of the Missouri River from Missouri RM 367.5 to RM 373.9 (1960 adjusted mileage).

Initial construction occurred in April, 1940 and was completed in May, 1941. Numerous modifications and improvements were constructed in the late 1940s, early 1950s, and 1955, with the most recent completed in June 1955.

The flood protection facilities consist of levees, floodwalls, underseepage control including 113 relief wells, 4 stoplog gaps, 1 sandbag gap, 13 pump plants, and 23 drainage structures. The total length of levees is about 5.3 miles and the floodwalls are approximately 4,040 feet. The Fairfax Drainage District provides operation and maintenance from levee Sta. 31+50 (boundary line with Kaw Valley Drainage District) to Sta. 313+72 (bluff at upstream end of unit).

A-1.2.8 North Kansas City – Airport Section

The North Kansas City – Airport Section is located in Kansas City, Missouri within Clay County. The protection lies along the left bank of the Missouri River from a few feet beyond the city boundary with North Kansas City, Missouri (RM 369.6, 1960 adjusted) to the downstream floodwall at the Hannibal Bridge (RM 366.2, 1960 adjusted). This corresponds to stationing 70+40 and stationing 210+40, respectively.

Construction began in May, 1946 and Kansas City, Missouri accepted the unit in October, 1947. Several improvements have been made since the initial construction, with the most recent work being completed in June, 1955.

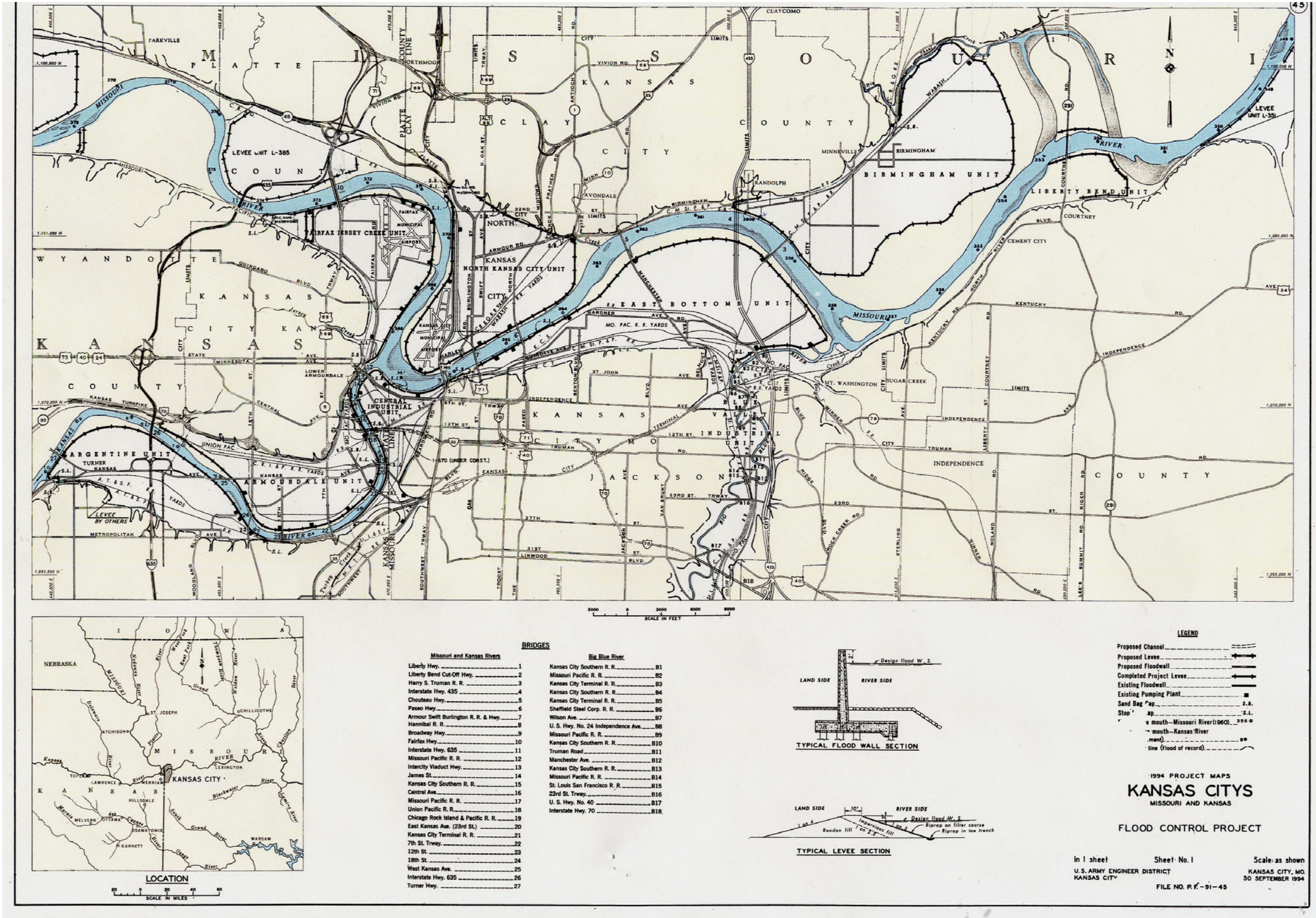
The flood protection facilities consist of levees, floodwalls, underseepage control including 48 relief wells, 3 pump plants, and 3 drainage structures. Total lengths of levee and floodwall are approximately 2.5 miles and 530 feet, respectively.

A-1.2.9 North Kansas City – Lower Section

The North Kansas City Unit portions maintained by the North Kansas City Levee District are often called the "downstream section" or "lower section" and are located in both North Kansas City and in Kansas City, Missouri. These portions include a short upper section extending downstream along the left bank of the Missouri River from the bluff just north of the Kansas City, Missouri Waterworks intake to where the Airport section (described above) begins (Sta. 0+00 to Sta. 70+40). After the Airport section ends, the "downstream section" resumes at the Hannibal Bridge (Sta. 210+40) and continues in an easterly direction. It follows along the left bank of the Missouri River to a point where the North Kansas City hillside ditch exits to the Missouri River near the Missouri River Chouteau Bridge. At the hillside ditch outlet, a long hillside tieback turns back sharply to the Northwest and runs to a termination point just west of the North Cherry Street bridge (Sta. 469+17). Construction began in 1946. Several improvements have been made since initial construction, with the most recent work being completed in June, 1955.

The unit consists of a system of levees, floodwalls, underseepage control, 3 stoplog gaps and 1 sandbag gap, 6 pump plants and 6 conduits. The North Kansas City – Lower section has approximately 6.2 miles of levees and about 310 feet of floodwalls.

PLATE A-1.1
Location and Vicinity of Kansas Citys Flood Protection Project



A-1.3 SPONSORS AND OWNERSHIP

Discussions with local sponsors have provided much information used in this study. The local project sponsors are listed below:

Protection Unit	Sponsor
Argentine	Kaw Valley Drainage District
Armourdale	Kaw Valley Drainage District
Birmingham	Birmingham Drainage District*
Central Industrial District – Kansas	Kaw Valley Drainage District
Central Industrial District – Missouri	City of Kansas City, Missouri
East Bottoms	City of Kansas City, Missouri
Fairfax-Jersey Creek	Fairfax Drainage District and Kaw Valley Drainage District
North Kansas City – Airport	City of Kansas City, Missouri
North Kansas City – Lower	North Kansas City Levee District

* Note: for purposes of the feasibility study, the funding and study team representation for the Birmingham Drainage District is being provided by the City of Kansas City, Missouri.

A-1.4 STUDY DEVELOPMENT

A Corps of Engineers (COE) reconnaissance level report was completed in August, 1999. The Reconnaissance Report identified a Federal interest in further investigations. That recommendation led to the current Feasibility Study. An early effort under feasibility was development of the Inventory of Drainage Features Report submitted to the COE and performed by HNTB Corporation in June, 2001. The general purpose was to obtain original drainage designs of interior structures and to compare those designs with current conditions for each unit. More specifically, the tasks included the compilation of an inventory for each levee unit's drainage system capacity criteria and assumptions, along with the recording of flood protection penetration information for stormwater conduits.

The Inventory of Drainage Features Report was incorporated into work on existing conditions analysis of each unit in the protection system. Additionally, information was gathered (where available) from the original design documents, Operation and Maintenance (O&M) manuals, and associated studies. The Corps utilized current hydrology/hydraulics models, and geotechnical/structural risk and uncertainty (R&U) study methods to develop the engineering portions of the existing conditions (baseline) analysis of the existing project. Much of this analysis was based on data and observations from recent high water events (since the original project design), especially those in 1993 and 1995. This new engineering analysis, along with the economic (HEC-FDA) analysis, established a complete R&U approach to estimating existing conditions flood damages. The engineering and economic evaluations taken together with a summary baseline environmental review and an HTRW review of the study area formed the full picture of existing conditions. A review of existing conditions results by the study team provided guidance during the scoping and development of future conditions (with and without project) work. This Engineering Appendix to the Interim Feasibility

Report identifies those first phase areas. There are other potential areas of interest identified for a second phase feasibility investigations to be included in the final Feasibility Report document.

The engineering risk and uncertainty analysis is summarized below. Details and calculations supporting the results appear within the various chapters of the engineering appendix.

Geotechnical and Structural engineers determined the most likely expected modes and sites of failure prior to overtopping in each Unit. A full range of conditional probabilities of failure versus river stage elevation encompassing the PFP and PNP were determined by geotechnical and structural engineer PDT members for each site/mode of failure in each Unit.

The geotechnical probabilities of failure were developed based on procedures identified in ETL 1110-2-556, Risk-Based analyses for Geotechnical Engineering for Support of Planning Studies, except that the acceptable factor of safety identified in the ETL was modified to a more realistic factor of safety based on Kansas City District 1993 flood observations and historical experience.

To produce the structural probability of failure versus river stage curve, critical sections of each structure were analyzed (stability and strength factors of safety determined) using material strengths and soil properties. Next, the soil and material parameters were varied to plus and minus one standard deviation from the mean, one at a time, and the factor of safety was recomputed. A Taylor series expansion was used to compute a probability of failure.

The first phase areas of interest are as follows:

- **Argentine Unit.** Findings for overtopping risk and geotechnical/structural risk have led the PDT to undertake evaluations which are aimed at increasing the unit's overall level of performance. Reduction of geotechnical/structural risk has been examined in conjunction with an increase in overtopping protection. This portion of the study considered raises to meet the 0.2% chance of exceedance (500-year), the 0.2% (500-year) plus-3-feet, and the 0.2% (500-year) plus-5-feet water surface profile elevations along the Argentine levee/floodwall. The Argentine Unit includes a number of features and components which were examined and documented:
    - Levees
    - Floodwalls
    - Pump Plants
    - Closures
    - Drainage Structures
    - Relief Wells Systems
    - Utilities

  The Argentine efforts have generated the majority of Phase 1 feasibility analysis and design documents.
- **East Bottoms Unit – Missouri and Blue Rivers Confluence Site.** Findings for geotechnical risk have led the PDT to undertake evaluation of measures to better control underseepage near the confluence of the Missouri and Blue Rivers. This site is at the lower end of the East Bottoms protected area. The recommended

solution is construction of a number of relief wells with a header system that directs underseepage towards the existing drainage ditch and pump station.

- **Fairfax-Jersey Creek Unit - Floodwall near BPU Power Plant.** Findings for structural risk have led the PDT to undertake evaluation of strengthening and/or replacement measures for this floodwall. The Fairfax floodwall is an inverted T-type wall with a key. Steel sheet pile located below the key provides protection from underseepage. The wall is approximately 1450 ft. long with 34 monoliths. The original construction drawings required a minimum pile length of 20 ft. Field tests were recently performed, and the results show that actual pile length is 19 ft. in some cases. These shorter piles may be inadequate to support the floodwall under some rare conditions. The recommended solution is strengthening (additional piles and buttresses) of the existing wall.
- **Fairfax-Jersey Creek Unit – Jersey Creek Sheet Pile Wall.** The feasibility examination of the Fairfax-Jersey Creek sheetpile wall (Sta. 287+86 to Sta. 302+32) is aimed at understanding the risk at this site, and developing solutions for successfully reconstructing this wall which is exhibiting age-related deterioration. Good solutions for this site include placing new sheetpile landside of the existing wall by a crane. Open and closed cell designs are practical solutions, with the main difference being cost. The open cell solution is efficient for this site and is the recommended solution.
- **North Kansas City Unit – Harlem Area Levee Segment.** Findings for geotechnical risk have led the PDT to undertake evaluation of measures to control underseepage in the area. The geotechnical R&U analysis is corroborated by observations during the 1993 flood event and documentation from the original design memorandum that suggested the possible need for additional underseepage control measures that were never constructed. The recommended solution is construction of a new buried collector system parallel to the levee with temporary pumping measures (under flood conditions).
- **North Kansas City Unit – National Starch Area Levee Segment.** Findings for geotechnical risk indicate the need for measures to improve underseepage control in the area lying along the left (north) bank of the Missouri River between the Heart of America Bridge and the Paseo Bridge, generally within or adjacent to National Starch Corporation properties. The geotechnical R&U analysis is corroborated by observations during the 1993 flood event which indicated significant underseepage pressures landward of the levee. The recommended solution is construction of a series of pressure relief wells and a pump station to effectively draw down the pressures in this area.

In order to obtain a clearer overview of the areas of interest for this first phase, Plates A-1.2 through A-1.11 are provided on the following pages. The footprint mapping details the location of each area of interest and the proposed improvements/remedies. As subsequent chapters provide discussion of each Phase 1 area of interest, these Plates will be valuable visual and summary references. For further discussion and characterization of alternatives, refer to the main Interim Feasibility Report.

PLATE A-1.2
Argentine Footprint Mapping (1 of 5)

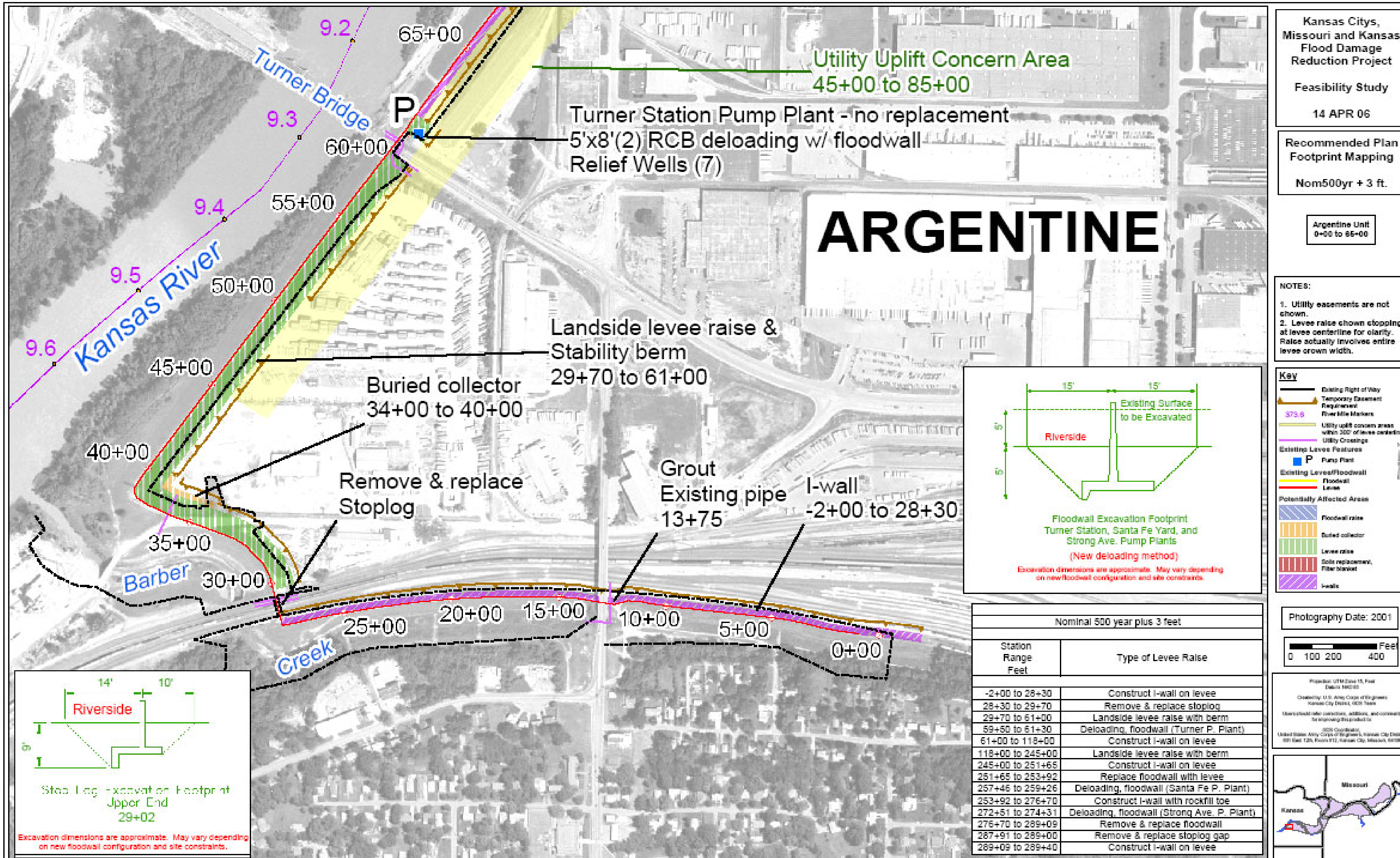


PLATE A-1.3
Argentine Footprint Mapping (2 of 5)

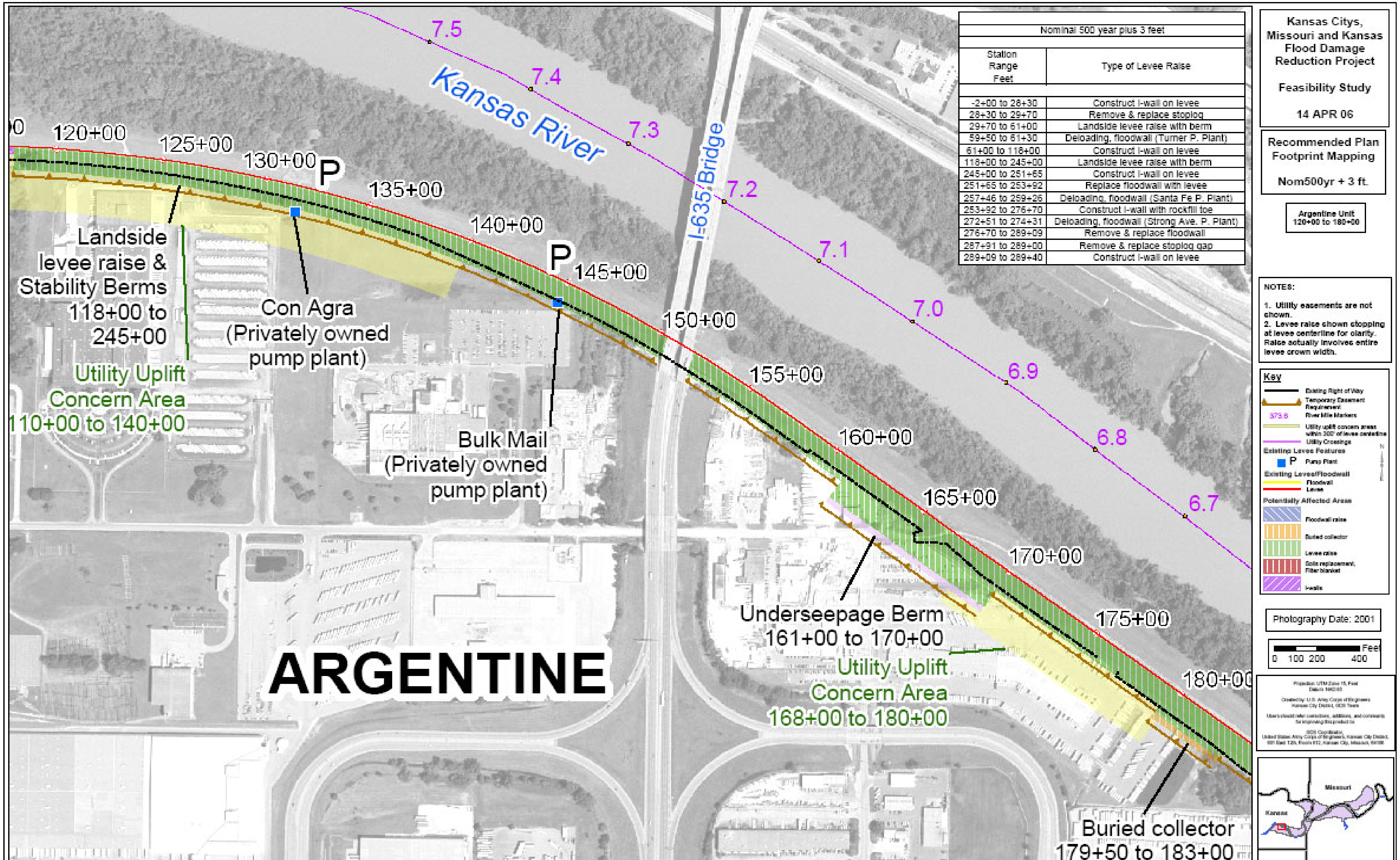
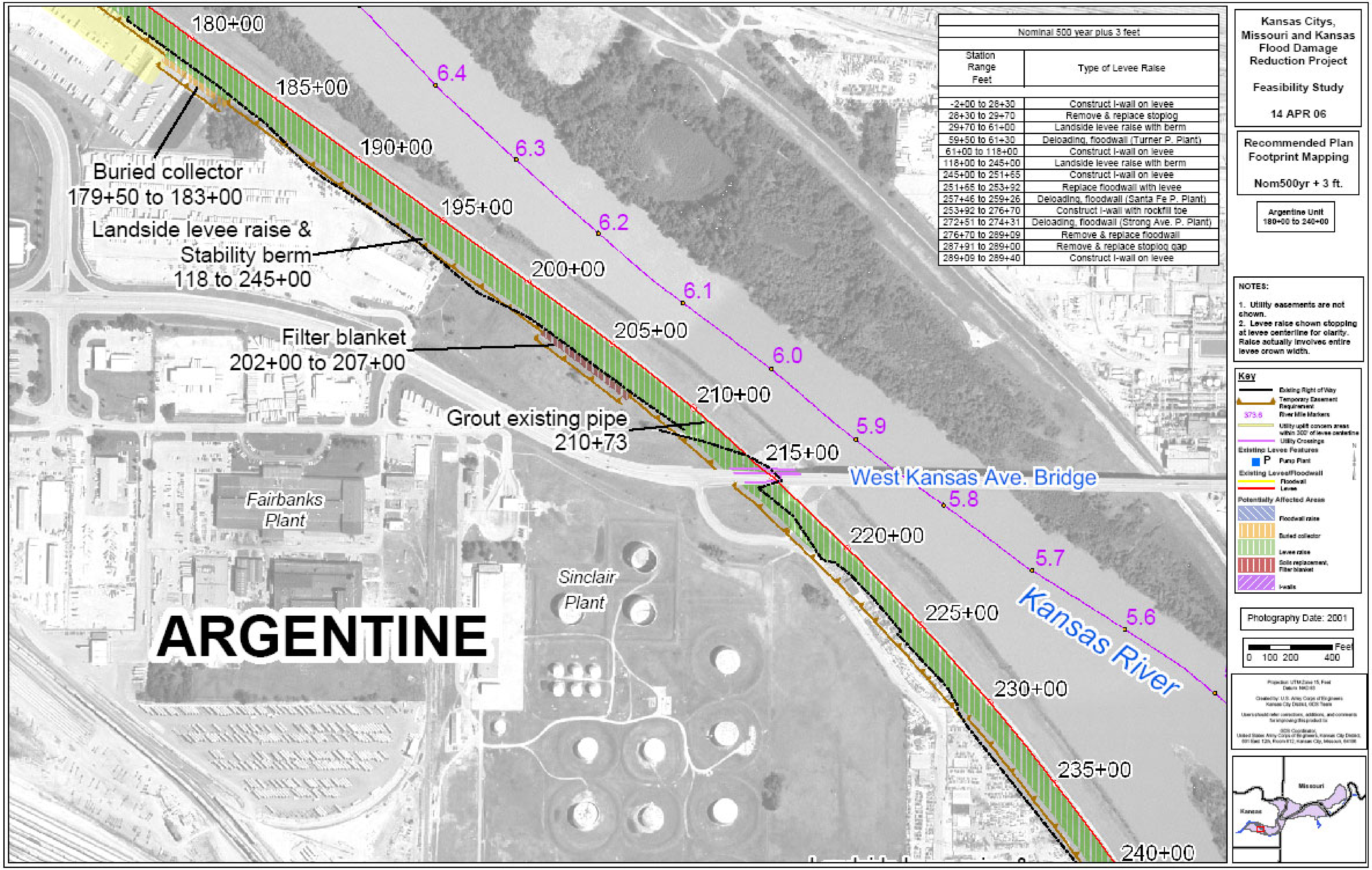
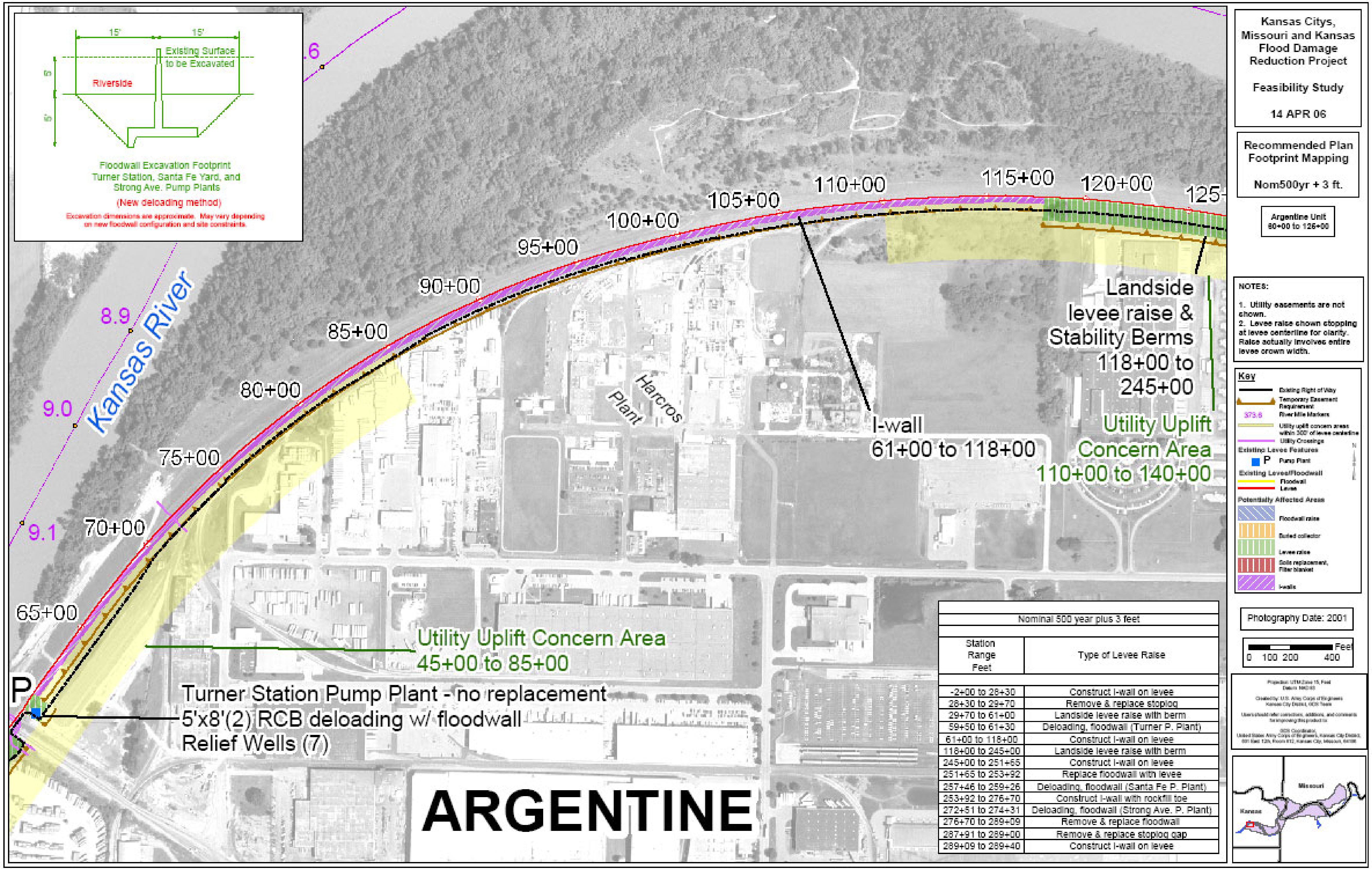


PLATE A-1.4
Argentine Footprint Mapping (3 of 5)



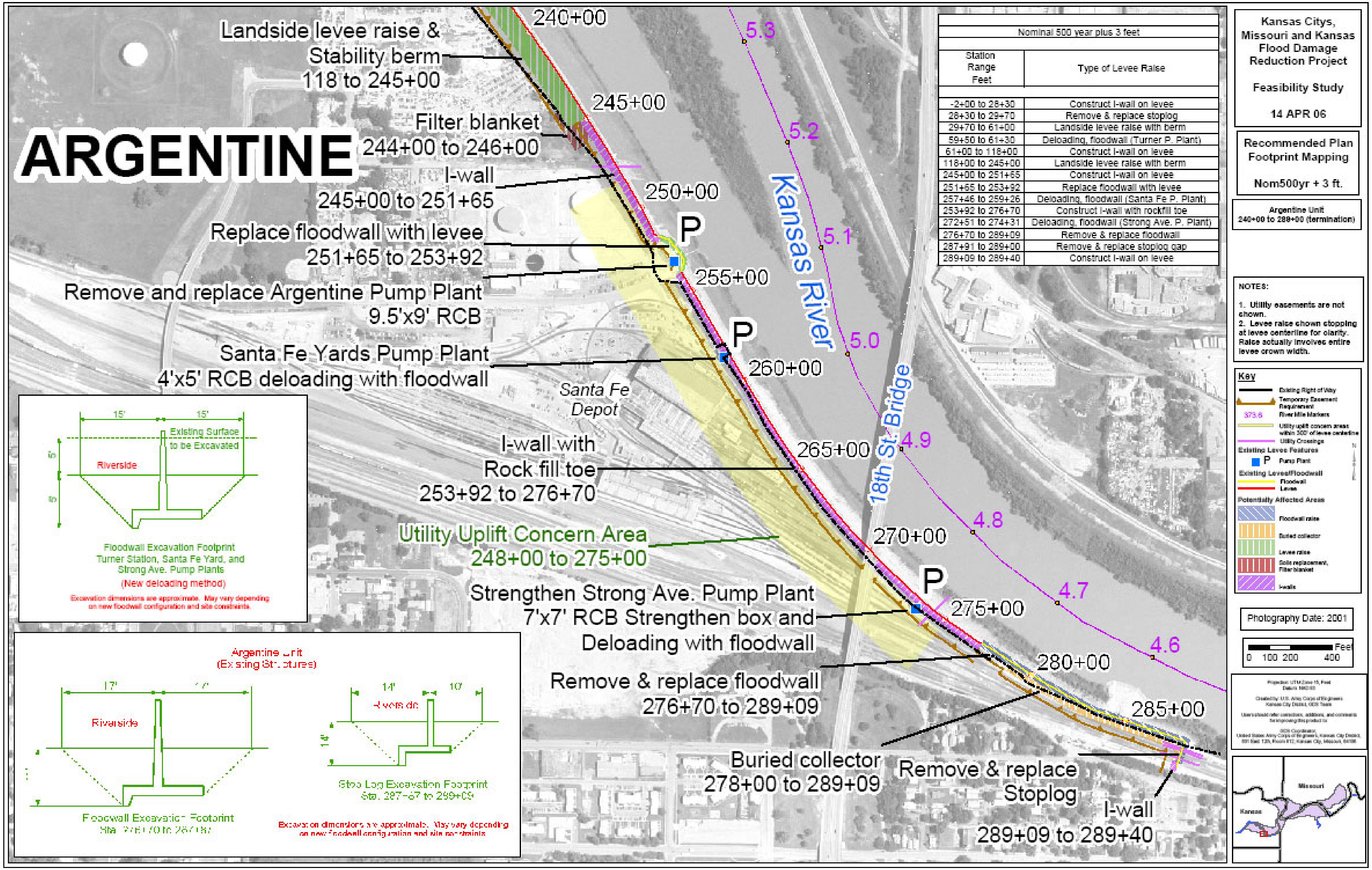
Station Range Feet	Type of Levee Raise
-2+00 to 28+30	Construct I-wall on levee
28+30 to 29+70	Remove & replace stoplog
29+70 to 61+00	Landside levee raise with berm
59+50 to 61+30	Deloading, floodwall (Turner P. Plant)
61+00 to 118+00	Construct I-wall on levee
118+00 to 245+00	Landside levee raise with berm
245+00 to 251+65	Construct I-wall on levee
251+65 to 253+92	Replace floodwall with levee
257+46 to 259+26	Deloading, floodwall (Santa Fe P. Plant)
253+92 to 276+70	Construct I-wall with rockfill toe
272+51 to 274+31	Deloading, floodwall (Strong Ave. P. Plant)
276+70 to 289+09	Remove & replace floodwall
287+91 to 289+00	Remove & replace stoplog gap
289+09 to 289+40	Construct I-wall on levee

Argentine Footprint Mapping (4 of 5)



Nominal 500 year plus 3 feet	
Station Range Feet	Type of Levee Raise
-2+00 to 28+30	Construct I-wall on levee
28+30 to 29+70	Remove & replace stoplog
29+70 to 61+00	Landside levee raise with berm
59+50 to 61+30	Deloading, floodwall (Turner P. Plant)
61+00 to 118+00	Construct I-wall on levee
118+00 to 245+00	Landside levee raise with berm
245+00 to 251+65	Construct I-wall on levee
251+65 to 253+92	Replace floodwall with levee
257+46 to 259+26	Deloading, floodwall (Santa Fe P. Plant)
253+92 to 276+70	Construct I-wall with rockfill toe
272+51 to 274+31	Deloading, floodwall (Strong Ave. P. Plant)
276+70 to 289+09	Remove & replace floodwall
287+91 to 289+00	Remove & replace stoplog gap
289+09 to 289+40	Construct I-wall on levee

Argentine Footprint Mapping (5 of 5)



Nominal 500 year plus 3 feet

Station Range Feet	Type of Levee Raise
-2+00 to 28+30	Construct I-wall on levee
28+30 to 29+70	Remove & replace stoplog
29+70 to 61+00	Landside levee raise with berm
59+50 to 61+30	Deloading, floodwall (Turner P. Plant)
61+00 to 118+00	Construct I-wall on levee
118+00 to 245+00	Landside levee raise with berm
245+00 to 251+65	Construct I-wall on levee
251+65 to 253+92	Replace floodwall with levee
257+46 to 259+26	Deloading, floodwall (Santa Fe P. Plant)
253+92 to 276+70	Construct I-wall with rockfill toe
272+51 to 274+31	Deloading, floodwall (Strong Ave. P. Plant)
276+70 to 289+09	Remove & replace floodwall
287+91 to 289+00	Remove & replace stoplog gap
289+09 to 289+40	Construct I-wall on levee

PLATE A-1.7
East Bottoms (Missouri and Blue Rivers Confluence Area) Footprint Mapping

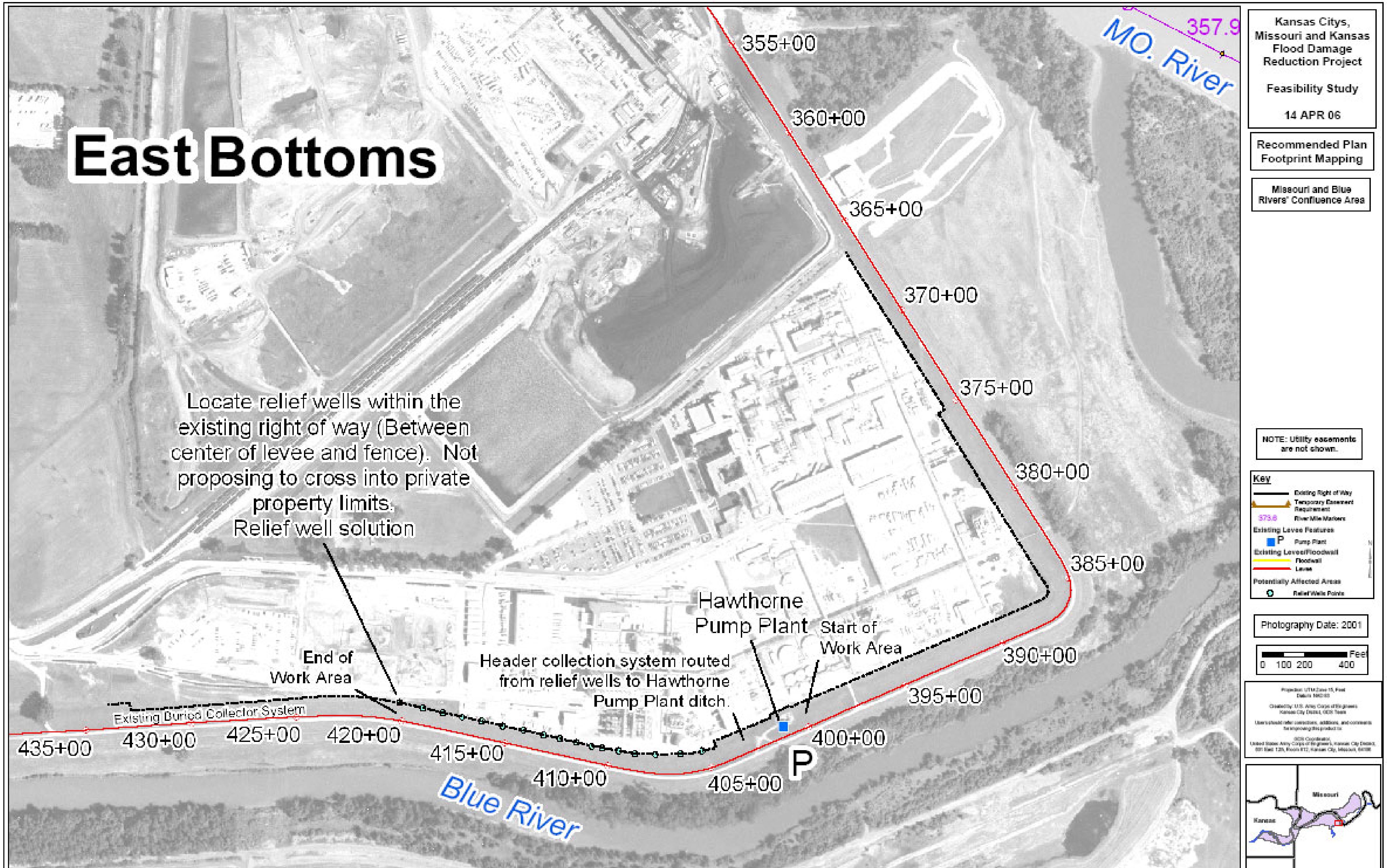


PLATE A-1.8
Fairfax-Jersey Creek (BPU Floodwall) Footprint Mapping

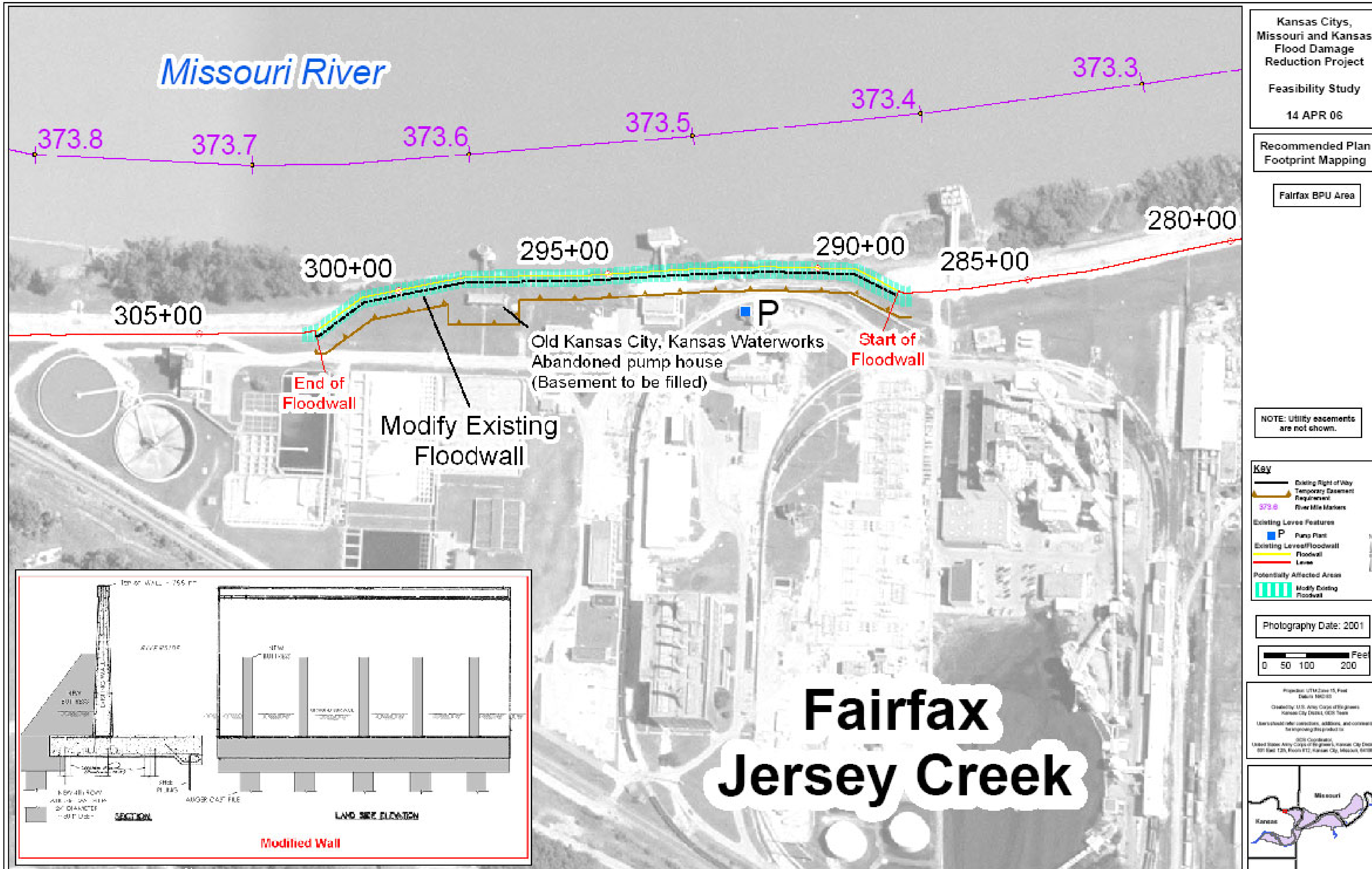


PLATE A-1.9
Fairfax-Jersey Creek (Jersey Creek Sheet Pile Wall) Footprint Mapping

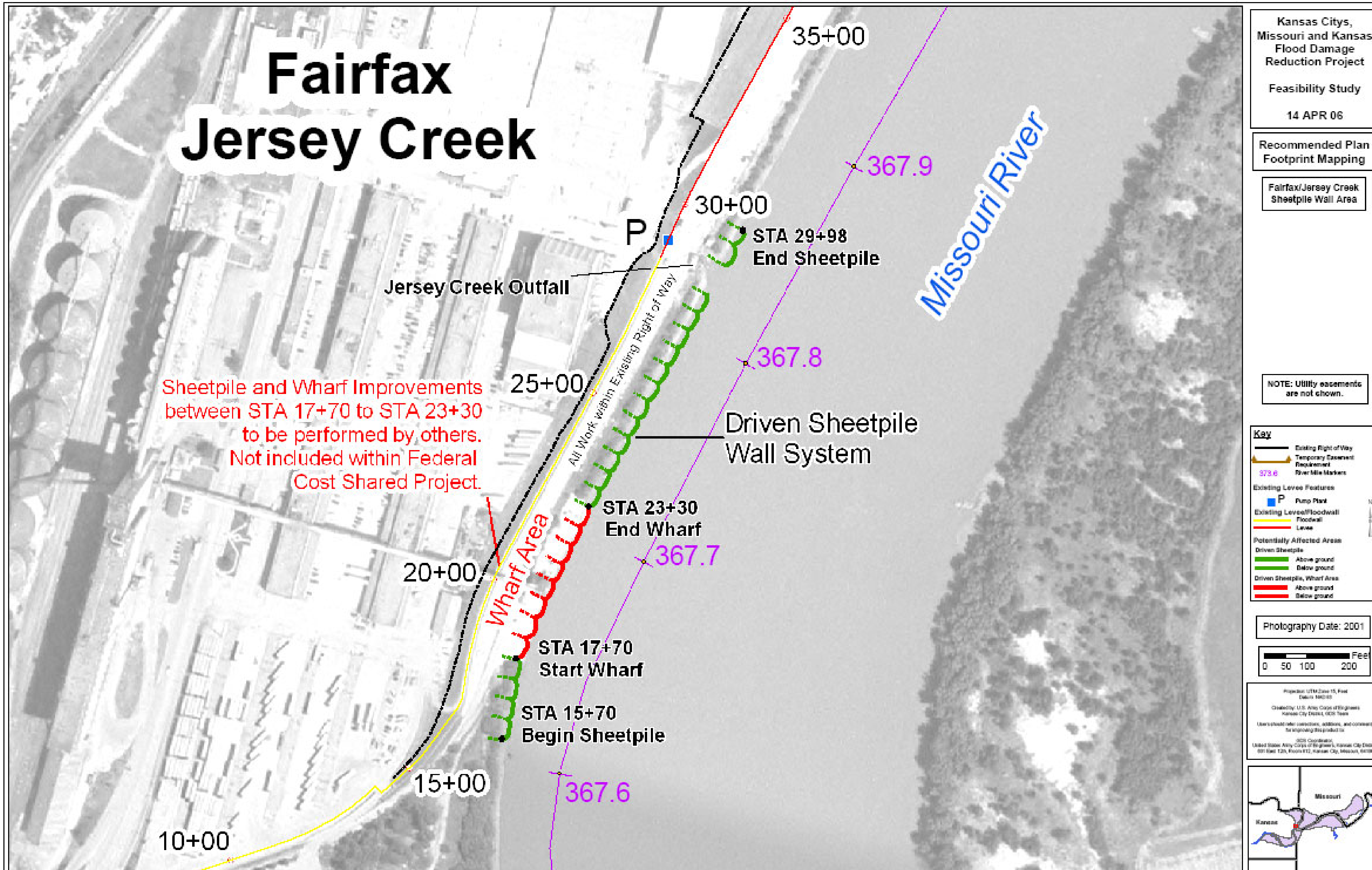


PLATE A-1.10
North Kansas City – Lower (Harlem Area) Footprint Mapping

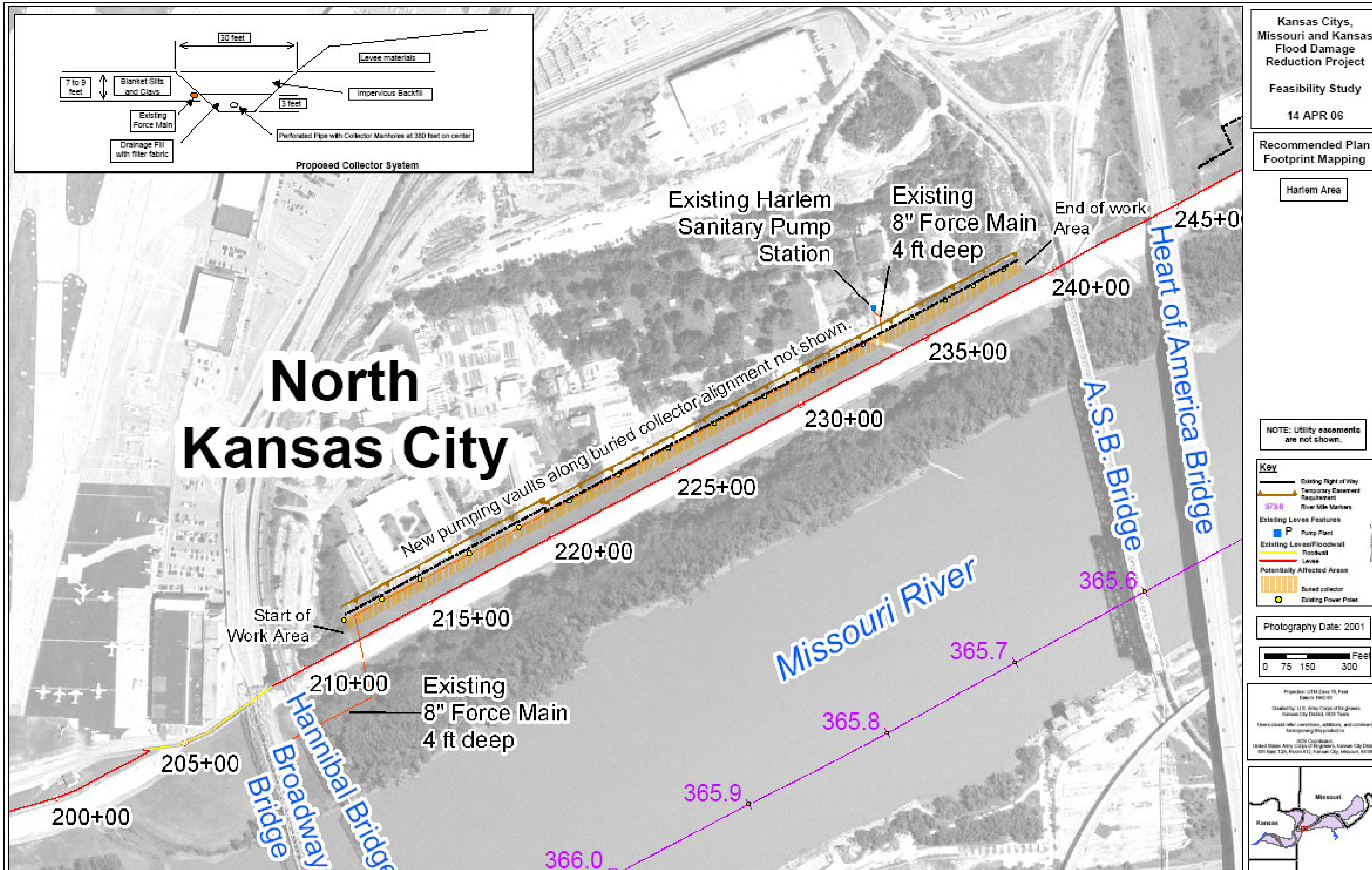
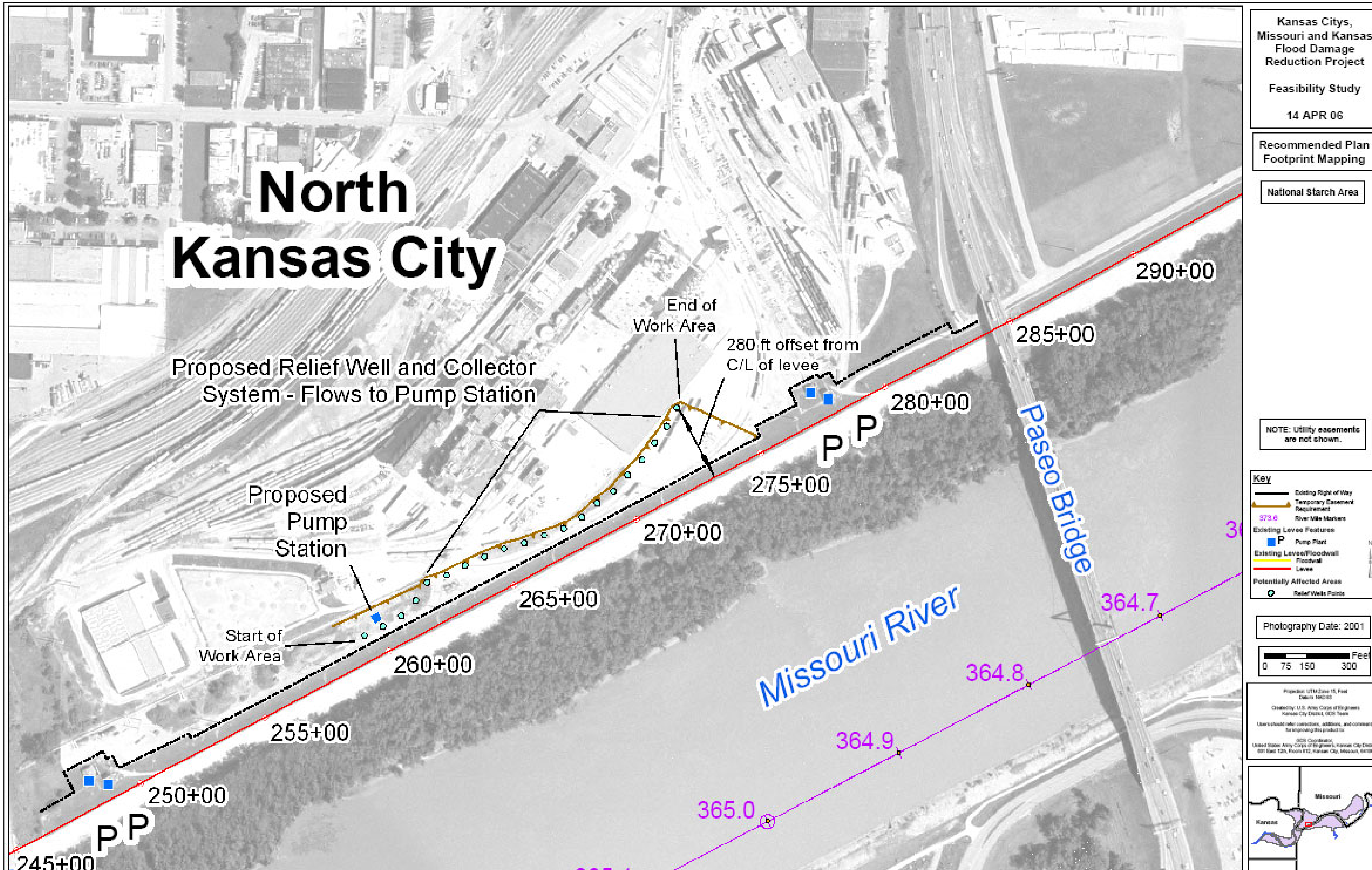


PLATE A-1.11
North Kansas City – Lower (National Starch Area) Footprint Mapping



A-1.5 LEVEE/FLOODWALL FEATURES INVENTORY

The pages in this section represent a culmination of effort throughout the study to list and describe the levee unit features within the project scope. An early baseline for these listings was the Reconnaissance Report findings. Field investigation and discussions with sponsors and Corps personnel built upon that initial listing during early feasibility work. As the study progressed, existing conditions were analyzed. Information from those findings was then incorporated into the features listings. Certain units and/or features warranted further analysis (Phase 1 areas of interest or those slotted for Phase 2 work) as part of the future conditions work. Analysis results from those investigations have provided additional information presented in the inventory. The inventory will continue to be updated as the study moves forward into Phase 2.

The feature listings are divided by levee unit and contain the following main headings:

- Underseepage Control
- Levees
- Floodwalls
- Closure Structures
- Pump Plants
- Storm Sewers
- Utility Lines

For each heading classification in the levee/floodwall features inventory, the following information is generally provided:

- location along the protection unit
- associated physical parameters
- reference for analysis and backup information
- notes gathered throughout the study about the feature

Each type of feature has its own color code, which links the feature type to the graphic representation of the levee unit. Station numbers listed in the spreadsheets are identified with the same station numbers as shown on the aerial view of the levee system. Each unit has a general overview layout graphic as well as several cut-sheets taken from a grid of the overview sheet. Note that all graphics associated with the inventory listing are of <u>existing conditions only</u>. In contrast, the footprint mapping exhibits provide the recommended alternatives for each area of interest.

It has been determined that some levee unit sponsors do not own and operate all of the drainage structures in their respective levee unit. In addition to privately owned conduits or pumps draining a particular property, there are a few pump plants in the Argentine, Armourdale, Central Industrial District – Kansas, and North Kansas City – Lower protection units owned by different entities. Some pump stations within the boundaries of Argentine, Armourdale, and the CID – Kansas are owned and operated by the Unified Government of Wyandotte County/Kansas City, Kansas. Pump stations within North Kansas City – Lower are owned by the City of North Kansas City and leased to the levee district. Where applicable, notes are made to those effects within the spreadsheet feature listings in this chapter.

The spreadsheet information shown on the following pages serves as an easily accessible central location for summary of the feasibility study effort. This levee/floodwall features inventory will continue to be a focal point throughout the remainder of feasibility engineering work. Updates will be made as appropriate during and following Phase 2 analysis.

EXHIBIT A-1.1
Argentine Unit – Levee/Floodwall Features Inventory


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Argentine Unit
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
1 inch equals 1,500 feet
Feet
0
1,800
3,600
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
0+00	28+50	None	10	Refer to the Geotechnical Chapters of this Appendix	Bedrock varies along Santa Fe Foothill Ditch and Barber Creek Channel - see borings
28+50	39+00	Sheet piling at Stop Log Gap to Elev. 756; Riverside toe trench to approx. 10' depth	13	The critical existing condition section for the Argentine Unit is located at approximately Station 37+80. Refer to the Geotechnical Chapters of this Appendix for more information.	Bedrock varies along Santa Fe Foothill Ditch and Barber Creek Channel - see borings. The critical area for seepage and slope stability for existing conditions considers only 5 foot average blanket thickness of silt (ML) material along Barber Creek.
39+00	59+00	None	10 to 15	Refer to the Geotechnical Chapters of this Appendix	Critical area for existing condition is beyond Station 53+50 and extending to Turner Bridge
59+00	75+00	None	15 to 13	Refer to the Geotechnical Chapters of this Appendix	
75+00	95+00	None	6 to 10	Refer to the Geotechnical Chapters of this Appendix	Existing conditons analysis suggested that a toe wall was likely required for landside expansion. Future conditions analysis recommends an I-wall in this area (see Levees and Stability Berms sheet).
95+00	105+00	None	10 to 14	Refer to the Geotechnical Chapters of this Appendix	
105+00	186+00	None	14 to 15	Refer to the Geotechnical Chapters of this Appendix	
186+00	210+00	None	14 to 16	Refer to the Geotechnical Chapters of this Appendix	
210+00	217+50	None	6	Refer to the Geotechnical Chapters of this Appendix	
217+50	255+00	None	14 to 17	Refer to the Geotechnical Chapters of this Appendix	
255+00	276+70	None	15 to 6	Refer to the Geotechnical Chapters of this Appendix	
276+70	287+92	Sheet piling under Floodwall and Stop Log Gap	6	Refer to the Geotechnical Chapters of this Appendix	

LEVEES AND STABILITY BERMS

Reach		Stability Berm		Analysis	Comments
Station	Station	Spring Point (ft.)	Width (ft.)		
LEVEES					
0+00	28+48	N/A	N/A	Refer to the Geotechnical and Structural Chapters of this Appendix	
29+48	214+37	N/A	N/A	Refer to the Geotechnical and Structural Chapters of this Appendix	
214+99	251+65	N/A	N/A	Refer to the Geotechnical and Structural Chapters of this Appendix	
253+92	276+70	N/A	N/A	Refer to the Geotechnical and Structural Chapters of this Appendix	
STABILITY BERMS					
15+00	28+00	*	8'	Refer to the Geotechnical and Structural Chapters of this Appendix	Riverside Stability Berm
30+25	35+66	19'	65'	Refer to the Geotechnical and Structural Chapters of this Appendix	Riverside Stability Berm
61+00	68+00	12'	48'	Refer to the Geotechnical and Structural Chapters of this Appendix	Landside Stability Berm
168+00	186+00	16'	85'	Refer to the Geotechnical and Structural Chapters of this Appendix	Riverside Stability Berm
178+00	186+00	10'	45'	Refer to the Geotechnical and Structural Chapters of this Appendix	Riverside and Landside Stability Berm
194+00	206+00	16'	45'	Refer to the Geotechnical and Structural Chapters of this Appendix	Landside Stability Berm
217+50	233+00	12'	45'	Refer to the Geotechnical and Structural Chapters of this Appendix	Landside Stability Berm

*Information not found

Argentine Unit

FLOODWALLS									
Reach		Wall Type	Foundation Type	Piles		Cutoff		Analysis	Comments
Station	Station			Type	Length (ft.)	Type	Length (ft.)		
251+65	253+92	Inverted T- Type	Spread	None	N/A	None	N/A	Refer to the Structural Chapters of this Appendix	
276+70	287+92	Inverted T- Type	Spread	None	N/A	*	*	Refer to the Structural Chapters of this Appendix	Wall is interlocked with an existing floodwall that has a pile foundation

*Information not found

Argentine Unit

CLOSURE STRUCTURES								
Station (ft.)	Function	Type	Gap Height (ft.)	Width (ft.)	Foundation Type	Closure Materials	Analysis	Comments
29+02	Railroad	Stoplog	4.0	100	Concrete Sheet Piling	28-6"X8" Creosoted Timber	Refer to the Structural Chapters of this Appendix	5 Removable steel posts
288+57	Railroad	Stoplog	6	101	Concrete Sheet Piling	36-6"X8" Creosoted Timber	Refer to the Structural Chapters of this Appendix	4 Removable steel posts

*Information not found

Argentine Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Turner Station (Kaw Valley Pump No. 4) / 60+40 (42+41[1])	776.8	(1) Storm Sewer System Flow: The delivery system is a closed sewer paralleling Kansas State Hwy. 132 to the north. (2) Seepage Flow: Service area is between Sta. 68+00 to Sta. 156+00, totaling 13.4 cfs, currently ponds in undrained sites.	Twin 5'x8' RCB	Refer to the Pump Station Analysis Chapter of this Appendix	A. The extra room for future pumping capacity was accounted for in the original design. B. The original sewer system was designed to serve 434 acres and assumed that area to be fully developed. B. Stage 20.0 ft is when the pumping is initiated, which is the point when the HGL is 3 ft below then lowest MH. C. It was determined that the whole drainage area would not contribute to the peak runoff. D. Time of concentration was based upon the 434 acre tract serviced by the sewer system, not the total area. E. The Bulk Mail center has been built in this area and services a portion of the original 625 acres. 625 acres has been reduced to approximately 594 acres. This migh have alleviated any burden that the extra impervious area would have caused. The percent impervious was estimated from 1996 aerial photography. F. Two pumps were added (outside) in the 1980s.
Bulk Mail / 131+50	774.7	Storm Runoff	48" CIP	Refer to the Pump Station Analysis Chapter of this Appendix	A. This pump plant services the Post Office property. B. The plant was not analyzed in the overall hydrology within the "Supplement on Interior Drainage". C. The pump plant is owned and operated by the Post Office. D. The percent impervious was estimated by visual inspection of 1996 aerial photography. E. The drainage district sponsor explained that this pump is not critical to the integrity of the levee. If the Bulk Mail pump was to go off-line the water would pond on the Bulk Mail Center property and some runoff would flow to the Turner Pump Station. The Turner Station would be able to handle the small amount of additional runoff contributed by the Bulk Mail Center because this area was originally designated to contribute to the Turner Station.
ConAgra / 145+00	774.5	Storm Runoff	36" RCP	Refer to the Pump Station Analysis Chapter of this Appendix	A. This pump plant services what used to be the Swift Packing Company property - it is now ConAgra. B. The plant was not analyzed in the overall hydrology within the "Supplement on Interior Drainage". C. The pump plant is owned and operated by ConAgra. D. The percent impervious was estimated by visual inspection of 1996 aerial photography. E. The drainage district sponsor explained that this pump is not critical to the integrity of the levee. If pump was to go off-line the water would pond on the ConAgra property. Some runoff would flow to the Turner Pump Station. The Turner Station would be able to handle the small amount of addition runoff contributed by the ConAgra land because this area was originally designated to contribute to the Turner Station.
Argentine / 253+14 (242+97[1])	771.6	Storm Sewer System Flow: This collects local runoff, which is collected in two separate ditches. Main ditch collects water from the uplands. The North ditch collects water from the bottoms.	9.5'x9' RCB	Refer to the Pump Station Analysis Chapter of this Appendix	A. The sewer and ditch system that services this area has sufficient capacity up to the confluence of the North Santa Fe Ditch and The Main Santa Fe Ditch. At this confluence point the maximum runoff of 2029 cfs at stage 14.0 is too great for a conduit that only has a maximum capacity of 790 cfs. B. The conduit mentioned in comment "A" is a continuous composite conduit. The inlet is an 11' x 8' RCB that leads into a 9.5'x9 RCB which ties into the pump station. C. Ponding that occurs under the pumping conditions is less then the ponding that occurs unavoidably under gravity flow conditions at stage 14.0. Therefore, extra pumping capacity will not solve the most severe ponding condition. D. Gravity flow capacity equals pumping capacity at stage 26 (752.8), yet the gates must be closed at stage 23.6 (elev. 750.8) to prevent backflow from the Kansas River inundating the catch basins near 23rd & Argentine. E. The service area has been reduced by 134 acres due to the construction of the Ruby Street Sewer. F. One new pump was added to this station in recent years, located just outside the pump house.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

Superscript 1 refers to 1950 levee stationing.

Argentine Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Santa Fe Yards / 253+36 (248+19[1])	771.4	Storm Sewer System Flow: Runoff from the southeast portion of the RR yards, a small amount of nearby residential runoff, and a small amount of over flow from the Strong Ave. Sewer.	4'x5' RCB	Refer to the Pump Station Analysis Chapter of this Appendix	A. Ponding occurs at the inlet of the 36" pipe, point 16 (see 1950 "Supplement on Interior Drainage" plate 33) that passes underneath the tracks and drains a low area south of the tracks. The 36" pipe drains the bypass flow from the Strong Ave Sewer. B. Ponding occurs near the rail car repair shop at MH #22 and #23. (see 1950 "Supplemental on Interior Drainage" plate 33) C. At the turntable, ponding is 1.5 ft due to the lack of sewer capacity. This ponding could easily be prevented by installing a 12" flap gate on the 12" line in manhole 57 (see 1950 "Supplement on Interior Drainage" plate 33). D. During the site visit interview, the team was told there is a significant amount of ponding due to the lack of pumping capacity of this plant. The Santa Fe Railroad, pumps all storm drainage on their property to a holding tank. The water is held in the tank to separate the oil (diesel fuel) from the water. The water is then pumped into the Kansas City Kansas sanitary sewer system. Santa Fe railroad no longer gravity discharges to the river. The option to discharge to the river is still available, but is not done unless absolutely necessary.
Strong Ave. / 273+41 (263+21[1])	771.1	Storm Sewer System Flow: Flow from a residential area south and west of the railroad yards.	84" RCP	Refer to the Pump Station Analysis Chapter of this Appendix	A. The analysis in the 1950 "Supplement on Interior Drainage" shows that gravity discharge out performs pump discharge when the river stage is below 23.0 ft. Therefore, it was suggested to start the pumping at stage 23.0 instead of stage 16.0. B. The original pump plant had only one 16" centrifugal sewage pump, which was insufficient to pump the QSystem Capacity. Yet due to the extreme insufficient capacity of the sewer system it was shown that increasing the pump capacity would not solve the ponding problem, because the most extreme ponding occurred under gravity flow conditions. This is probably why the Ruby Street Sewer system was constructed. C. The City of KCK, in the 1990s, constructed a pump station at 26th and Strong Avenue. At some stage of a design rainfall event, storm water is diverted from the Strong Avenue sewer to the Ruby Avenue storm sewer. The Strong Ave. Sewer has been made to be predominately a sanitary sewer with the construction of the Ruby Street Sewer system (which now collects the majority of the storm runoff that originally was collected by the Strong Ave. Sewer) and added the connection to the 16th Street Sanitary Sewer. D. The service area has been reduced in size from 607 to 175 acres since its original design. E. An 18" Cascade pump was installed in 1995. It is believed to replace the function of the 16" Worthington pump. The 18" pump is cited to have a capacity of 8000 gpm @ 39.5' TDH. The 16" was cited to have only 6000 gpm at the same TDH; therefore the capacity has increased. (see the pump curve found in the 1950 "Supplement on Interior Drainage", plate 43)

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

Superscript 1 refers to 1950 levee stationing.

Argentine Unit

STORM SEWERS								
Structure ID	Description	Location		Structure Information			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
1	Conduit just west of 55th Street: This drains a relatively small amount of flow that accumulates near the toe of the levee at the inlet.	13+75	50	12"	CMP	Flap gate (RW)	Refer to the Civil Chapters of this Appendix	A. The conduit drains a small area along the toe of the levee, as shown by the operational drawings of the latest O&M manual. B. This drainage structure was not analyzed in the overall hydrologic analysis within the "Supplement on Interior Drainage". C. The conditions of the area draining to this structure have not changed significantly since the conduit's design.
2	Turner Ditch Outlet: The flow is transported by Turner Ditch which parallels Thorne Road and services this area.	35+10 (16+50[1])	130	36"	RCP	Flap Gate (RW) Sluice Gate (LW)	Refer to the Civil Chapters of this Appendix	A. The upstream ditch controls the flow to be discharged through the 36" RCP. B. The capacity of the drainage system described in the 1950 "Supplement on Interior Drainage" was based upon an area of 24 acres and a time of concentration of 64 minutes. Since then the area has been increased to 50 acres due to the expansion of the Lock Joint Company. This, in turn, increased the percent impervious. C. The original outlet (10' x 3' RCB with 4' x 3' bulk head) has been abandoned. It was replaced by a 36" RCP in 1958.
3	Turner Industrial Sewer	60+40 (42+41[1])	124	2 - 5'W X 8'H	RCB	Leaf Gate (RW) Sluice Gate (LW)	Refer to the Civil Chapters of this Appendix	A. This is the outlet structure for Turner Pump Station. B. The time of concentration was based upon the area serviced by the sewer system (a 434 acre tract). C. The sewer system was designed based upon the assumption that only 434 acres would be developed. Therefore, if more development occurs within the total 625 acres area, then the sewer may not have capacity. D. The system was designed so that at no point in the system the HGL would be higher the 3 ft below the ground level. E. The entire 625 acres is now developed. The Bulk Mail Center and ConAgra pump plants have been built in this area and service a portion of the original 625 acres. The 625 acres contributing to the Turner pump plant has been reduced to approximately 574 acres. This alleviated any burden that the extra impervious area would have caused. This area is now developed with the construciton of Bulk Mail Center and the ConAgra. The maximum seepage flow rate of 13.4 cfs at stage 40.8 no longer applies because the pumps located on each of the developed areas now assume a portion of this flow. Maximum ponding of 125 acre-ft no longer applies because the ponding is now pumped to the river during high river stages.
4	Thompson-Hayward Chemical Company: The conduit services miscellaneous drainage from the industry.	97+70	55	8"	CIP	Gate Valve (RW)	Refer to the Civil Chapters of this Appendix	A. This drainage structure was not analyzed in the overall hydrology within the "Supplement on Interior Drainage". B. This conduit is not believed to be a storm drainage structure. A pipe profile was found which shows that the flow type must be pressure; because of the flow type and size it is believed to be a force water main. C. As the contributing flow is assumed to be industrial flow, the adequacy of the conduit is not affected by storm events. However, conditions have not significantly changed in the area.

***Not Found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

Superscript 1 refers to 1950 levee stationing.

Argentine Unit

STORM SEWERS								
Structure ID	Description	Location		Structure Information			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
5	Thompson-Hayward Chemical Company: The conduit services miscellaneous drainage from the industry.	104+85	55	4"	CIP	Gate Valve (RW)	Refer to the Civil Chapters of this Appendix	A. This pipe was not analyzed to drain any large drainage areas. B. It appears that this pipe drains a small pond located on the Thompson-Hayward Chemical Company property. The exact function of the pond is not known. C. As the contributing flow is assumed to be industrial flow, the adequacy of the conduit is not affected by storm events. However, conditions have not significantly changed in the area.
6	Bulk Mail Center	131+33	***	20"	SP	Flap Gate (RW)	Refer to the Civil Chapters of this Appendix	A. This pipe is one of the two force main pipes that carry water pumped by the Bulk Mail Center Pump Plant to the gatewell structure. These pipes cross the levee because the gatewell structure is on the riverside of the levee. B. As alluded to in the table, this conduit is only dependent upon the Bulk Mail Center Pump Plant operation.
7	Bulk Mail Center	131+37	***	36"	SP	Flap Gate (RW)	Refer to the Civil Chapters of this Appendix	A. This pipe is one of the two force main pipes that carry water pumped by the Bulk Mail Center Pump Plant to the gatewell structure. These pipes cross the levee because the gatewell structure is on the riverside of the levee. B. As alluded to in the table, this conduit is only dependent upon the Bulk Mail Center Pump Plant operation.
8	Bulk Mail Center	131+50	***	48"	CIP	Sluice Gate (RW)	Refer to the Civil Chapters of this Appendix	A. This drainage structure was not analyzed in the overall hydrologic analysis researched by the team. B. The seepage flow is contributed from the area between approximately station 120+00 to station 140+00. C. This conduit is the gravity outlet structure for Bulk Mail Center Pump Station. D. The Bulk Mail Center was constructed in an area that was originally used to store seepage flow during high river stages. A portion of the flows described in the 1950 "Supplement on Interior Drainage", paragraph 13 is now pumped through this outfall by in-house pumps located on this property. Consequently, the pumps have relieved the load on the Turner Pump Station. E. The Bulk Mail Center has been built in an area which was originally used for storage of seepage flow. This storage area has now been filled in. The percent impervious was estimated from visual inspection of 1996 aerial photography.

***Not Found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

Superscript 1 refers to 1950 levee stationing.

Argentine Unit

STORM SEWERS

Structure ID	Description	Location		Structure Information			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
9	ConAgra outlet (possible seepage outlet)	145+00 (127+00[1])	45	36"	RCP	Flap Gate (RW) Sluice Gate (RW)	Refer to the Civil Chapters of this Appendix	A. This drainage structure was not analyzed in the overall hydrologic analysis researched by the team. B. The seepage flow is contributed from the area between station 140+00 to station 165+65. C. This conduit is the gravity outlet structure for ConAgra Pump Station. D. The Swift Packing Company (now ConAgra) was constructed in an area that was originally used to store seepage flow during high river stages. A portion of the flows described in the 1950 "Supplement on Interior Drainage", paragraph 13 is now pumped through this outfall by in-house pumps located on this property. Consequently, the pumps have relieved the load on the Turner Pump Station. E. The Swift Packing Company (now ConAgra) has been built in an area which was originally used for storage of seepage flow. This storage area has now been filled in. The percent impervious was estimated from visual inspection of 1996 aerial photography.
9A	Detention Pond outlet	190+00	***	60"	RCP	Flap Gate (RW) Sluice Gate (RW)	Refer to the Civil Chapters of this Appendix	A. It appears to be the outlet structure of a detention pond adjacent to it. The detention pond was located during the site visits. The exact purpose of the detention pond is unknown. B. This drainage structure was not analyzed in the overall hydrologic analyses researched by the team. C. The 16" CIP at station 210+73 was described in the 1950 "Supplement on Interior Drainage" to discharge seepage that ponds in this area. It is believed that this 60" RCP now performs the seepage discharge function. Seepage is contributed from the area between station 165+65 (156+001) and station 212+50 (200+001) D. The condition at the Design Flood Stage is shown. The gate will be closed and the flow though the pipe will be zero. The pipe will discharge only when the river is low enough. The purpose of this pipe will simply be to speed up the removal of seepage water. The ponded seepage water will now have a direct outlet to the river as opposed to the slower process of being removed by infiltration and evaporation. E. The percent impervious was estimated by visual inspection of 1996 aerial photography and it does not appear that the conditions in the area of the pond have changed significantly over time.
10A	Ramp Drainage	218+17		36"	RCP	Flap Gate (RW) Sluice Gate (LW)	Refer to the Civil Chapters of this Appendix	A. This drainage structure was not analyzed in the overall hydrology. B. Drains the small area enclosed by an on-ramp to Kansas Ave. C. There are seepage flow ponds in the area adjacent to the levee (contributed from area between station 212+50 and station 253+14). Only the condition at the Design Flood stage is shown. The gate will be closed and the flow though the pipe will be zero. The pipe will discharge only when the river is low enough. The purpose of this pipe will simply be to speed up the removal of seepage water. The ponded seepage water will now have a direct outlet to the river as opposed to the slower process of being removed by infiltration and evaporation. D. The percent impervious was estimated by visual inspection of 1996 aerial photography and it does not appear that the conditions in the area of the ponds has changed significantly over time.

***Not Found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

Superscript 1 refers to 1950 levee stationing.

Argentine Unit

STORM SEWERS								
Structure ID	Description	Location		Structure Information			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
11	Sinclair Oil Company Outlet	247+32 (229+32^1)	109	24"	CIP	Flap Gate (RW) Sluice Gate (RW)	Refer to the Civil Chapters of this Appendix	A. The conduit picks up Sinclair Oil Company area drainage (See 1962 "Design Memorandum No.2" refer to the Plate 33) B. This pipe drains the water that ponds on the Sinclair Oil Company property. The percent impervious was estimated by visual inspection of 1996 aerial photography and represent a similar condition to the design of the conduit.
12	Santa Fe Ditch System Outlet	253+14	40	9.0'W X 9.5'H	RCB	Sluice Gate (LW)	Refer to the Civil Chapters of this Appendix	A. This is an outlet structure for the Argentine Pump Station (Kaw Valley East Pump). B. The conduit services the runoff from the railyards and the uplands. Runoff is collected by the Santa Fe Ditch system and ponds at the inlet of the 9.0' x 9.5' RCB. C. The drainage area is reduced by 134 acres due to the Ruby Street Sewer. D. Two new pumps were added to the Argentine Pump Station in recent years. They are located just outside the pump house. While specific information could not be obtained in a reasonable amount of time, a greater capacity is now available for pumping needs. This means that more flow could potentially be pumped through the outlet conduit.
13	Santa Fe Yard Sewer	258+36 (246+17^1)	93	4.0'H X 5.5'W	RCB	Leaf Gate (RW) Sluice Gate (LW)	Refer to the Civil Chapters of this Appendix	A. This is the outlet structure for the Santa Fe Yards Pump Station. B. The conduit services the eastern tip of the railyards. C. The outfall conduit no longer discharges to the river. D. The pump plant pumps all drainage to a holding tank so that ponded water can be treated and discharged into the City's sanitary sewer system. E. The pump plant is not designed to drain the overflow from the Strong Avenue Sewer, but it is forced to during high intensity rainfalls when the Strong Avenue Sewer overflows. There are ponding problems which appear to be related to the pump capacities, but could potentially be related to the outlet conduit.
14	Strong Avenue Sewer	273+41 (263+21^1)	109	7.0'W X 7.0'H	RCB	Flap Gate (RW) Sluice Gate (LW)	Refer to the Civil Chapters of this Appendix	A. This is the outlet structure for the Strong Avenue Pump Station. B. The Ruby Street Sewer System was built to intercept much of the storm runoff from the Strong Avenue Sewer and the Strong Avenue Sewer was made to intercept sanitary flow from the 16th Street Sewer and other sewers in the area, making it primarily a sanitary sewer. C. A low flow weir has been installed and the low flows are forced across the river and eventually to the treatment plant. D. The area was reduced from 517 acres to 175 acres (considered current design) when the Ruby Street Sewer System was built. The reduction of the drainage area decreased the severity of the surcharge problems of the Strong Avenue Sewer. However, the capacity of the pumps in the pump station is what controlled the flow received by the outlet conduits. The pump capacity was increased in recent years, putting more flow through the boxes.

***Not Found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

Superscript 1 refers to 1950 levee stationing.

Argentine Unit

STORM SEWERS								
Structure ID	Description	Location		Structure Information			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
16	16th Street Sewer	280+48 (270+41[1])	83	36"	RCP	Flap Gate (RW) Sluice Gate (RW)	Refer to the Civil Chapters of this Appendix	A. This outfall drains a residential area south of the tracks. The area served is above the design flood stage and is not subject to flood damage. B. There are two manholes in this system which are 0.8 ft below the design flood elevation. They need to be sandbagged at stage 31.2 feet. C. Ponding is a maximum at 14.0 ft. flood stage. D. The estimated percent impervious from visual inspection of 1996 aerial photography reflects the fact that the area has not changed significantly since original design of the outlet conduit.
17	Ruby Street Sewer System outlet	284+35 (274+25[1])	***	10'W X 10'H	RCB	Sluice Gate (Lw)	Refer to the Civil Chapters of this Appendix	A. The Ruby Street Sewer was built by local interests in 1958 to handle the coincident 30-year event with a river stage of 14.0 feet. B. The area served is above the design flood stage and is not subject to flood damage. C. The system is designed to be a pressurized gravity flow pipe. D. Gates are seldom closed due to the steep HGL slope. A high river stage should not back flow out of the inlets. E. The purpose of this storm sewer system was to eliminate the surcharging of the Strong Avenue Sewer system and also to separate the storm flow from the sanitary. F. The percent impervious was estimated from visual inspection of 1996 aerial photography and reflects no significant change from the time of original conduit design.
17A	Eastern End Conduit	288+10	***	6"	***	Gate valve (LW)	Refer to the Civil Chapters of this Appendix	A. This drainage structure was not analyzed in the overall hydrologic analyses researched by the team. B. This structure appears to drain a small area near the toe of the floodwall, as shown by the operational drawing of the latest O&M manual. However, it could possibly just be a cable sleeve that passes through the levee. C. As the drainage district personnel are not aware of the purpose of this conduit, it is probably insignificant. However, personnel are not aware of any changes to the land in the vicinity of the conduit.

***Not Found after reasonable search

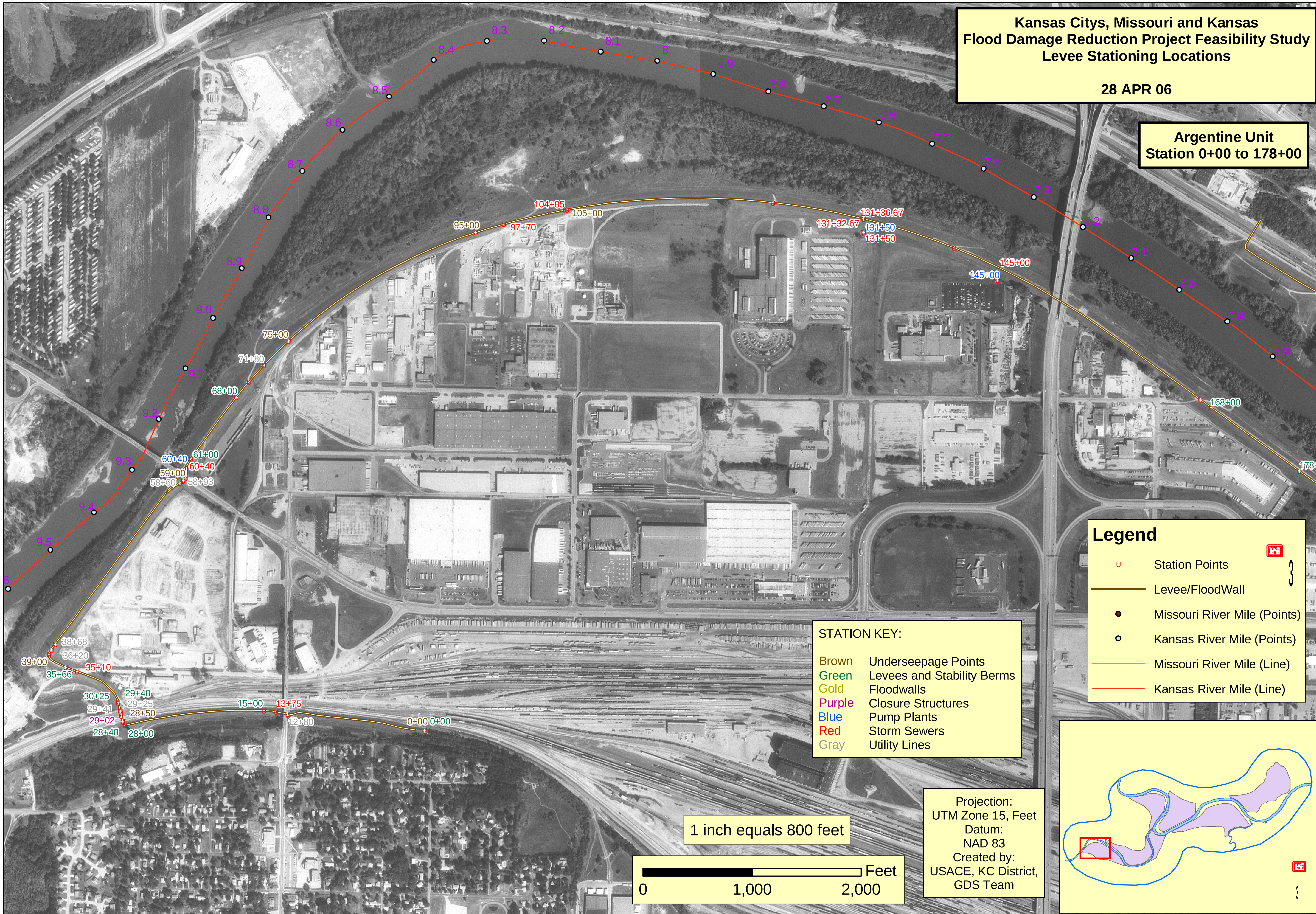
Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

Superscript 1 refers to 1950 levee stationing.

Argentine Unit

UTILITY LINES						
Station (ft.)	Function	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Comments
12+80	Gas	SP	*	*	N/A	on bridge
29+25	Gas	SP	2.5"	N/A	N/A	Relocate due to construction of new stoplog gap for N500+3
29+35	Cable Sleeve	6"	N/A	N/A		
29+41	Cable Sleeve	*	6"	N/A	N/A	
36+20	Gas	SP	4"	*	Gate Valve	
58+60	Water Line	SP	16"	95	N/A	Line has been relocated south of bridge and is below river bed
58+93	Gas	SP	2-18"	90	N/A	2 Gas Mains; they have been relocated north of the bridge and are now below river bed
71+80	Petroleum	SP	8"	N/A	N/A	Williams Pipeline
97+10	Groundwater	CIP	8"	*	*	Line from well to treatment plant
214+40	Sanitary Sewer	DIP	18"	*	N/A	Capped Riverside
214+70	Gas	SP	24"	*	Gate Valve	on West Kansas Avenue Bridge
215+20	Water Line	SP	10"	*	N/A	
248+05	Utility Sewer	DIP	30"	100	Sluice Gate	
274+09	Sanitary Sewer	CIP	30"	155	Sluice Gate	
288+37	Cable Sleeve	SP	6"	N/A	N/A	Relocate due to construction of new stoplog gap for N500+3
288+47	Gas	SP	2.5"	N/A	N/A	
288+87	Cable Sleeve	SP	6"	N/A	N/A	

*Information not found



Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Argentine Unit
Station 0+00 to 178+00
8.3
8.2
8.1
8
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
8.4
8.5
8.6
8.7
8.8
8.9
9.0
9.1
9.2
9.3
9.4
9.5
104+85
105+00
95+00
97+70
131+36.67
131+32.67
131+50
131+50
145+00
145+00
168+00
178+00
75+00
71+80
68+00
61+00
60+40
60+40
59+00
58+60
58+93
38+68
36+20
39+00
35+66
35+10
30+25
29+48
29+25
29+41
28+50
29+02
28+48
28+00
15+00
13+75
12+80
0+00
0+00
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
1 inch equals 800 feet
0 1,000 2,000 Feet
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team

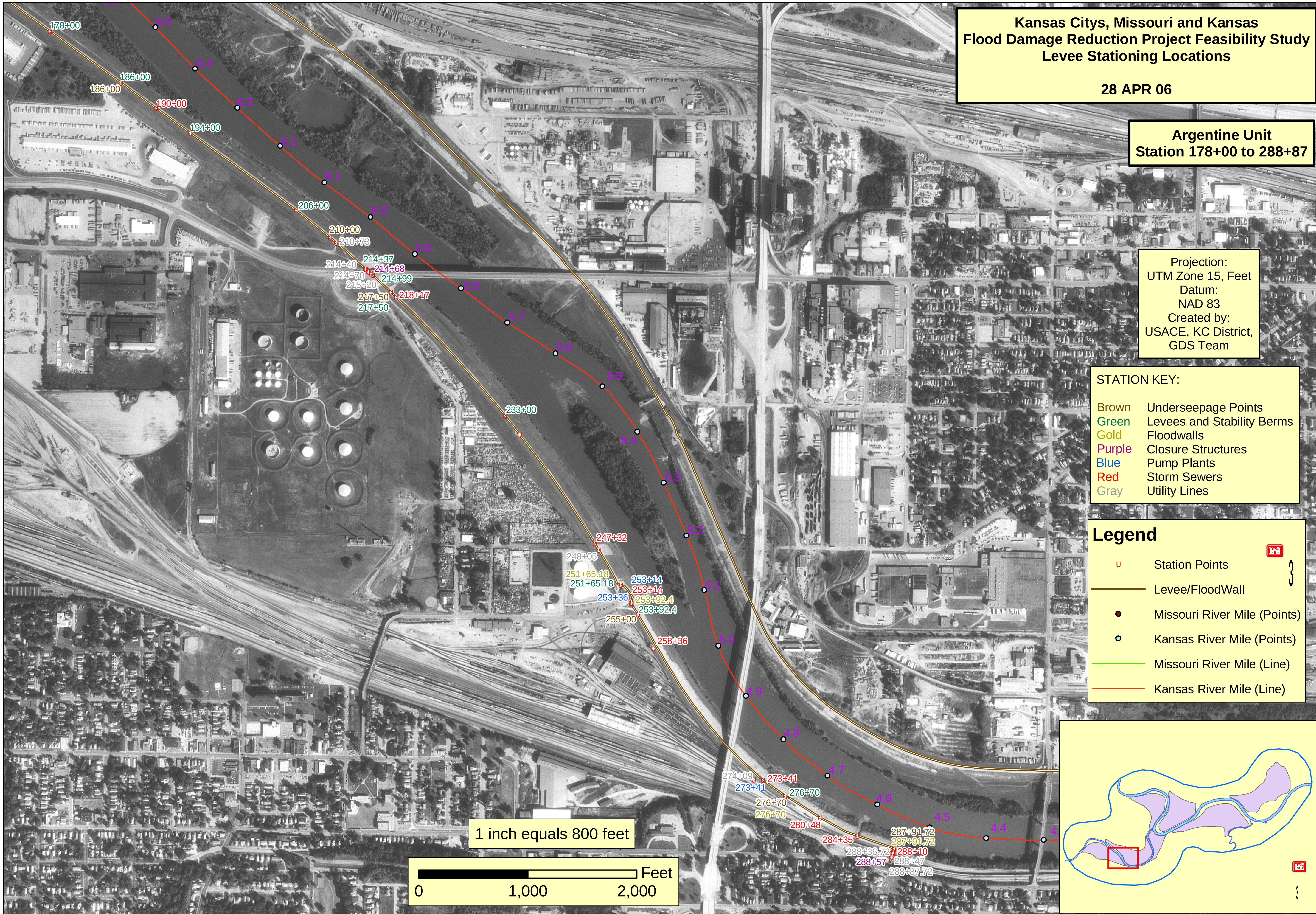
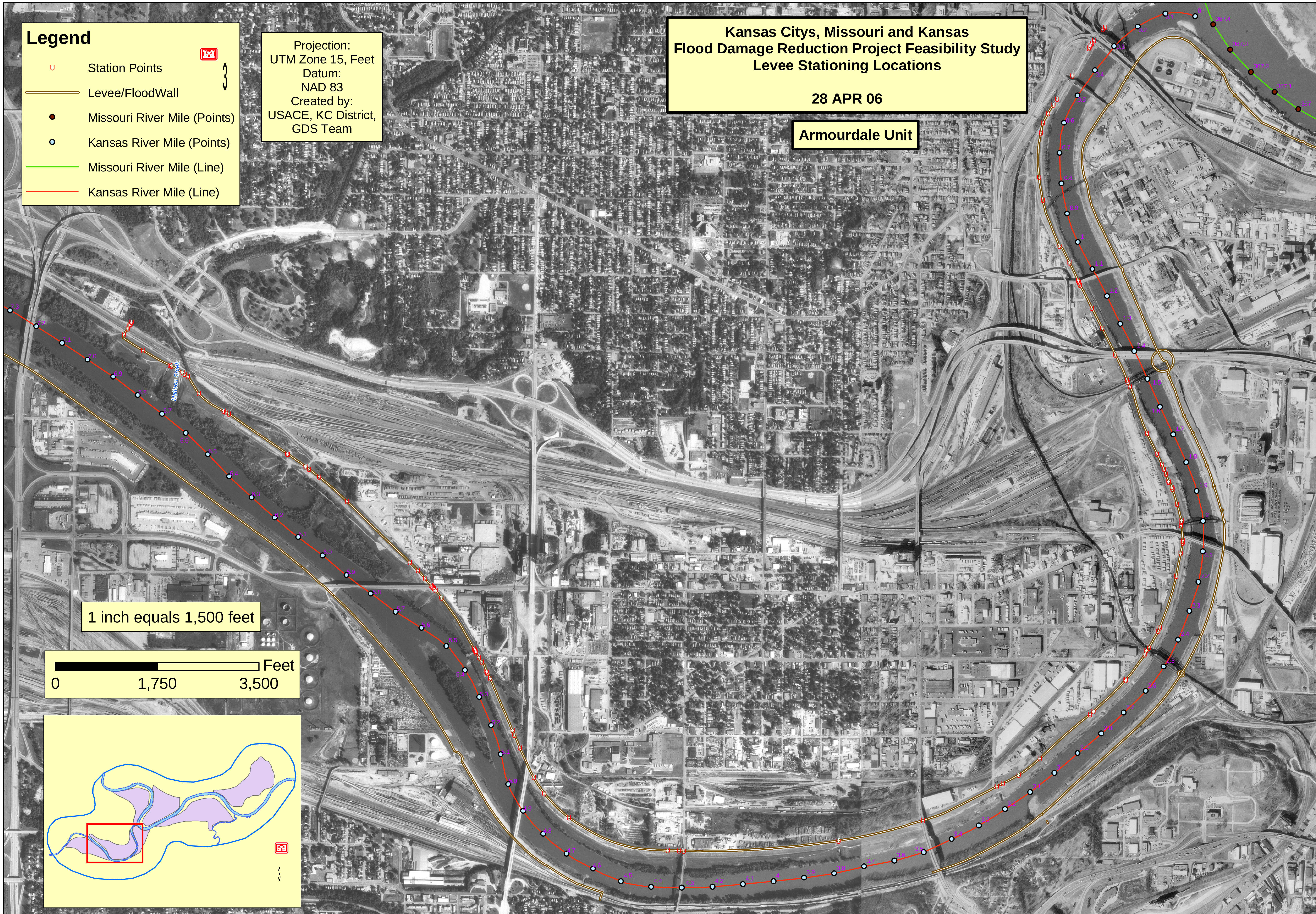

Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Argentine Unit
Station 178+00 to 288+87
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
1 inch equals 800 feet
Feet
0
1,000
2,000
178+00
186+00
186+00
190+00
194+00
206+00
210+00
210+73
214+37
214+40
214+68
214+70
214+99
215+20
217+50
218+17
217+50
233+00
247+32
248+05
251+65.18
251+65.18
253+14
253+14
253+36
253+92.4
253+92.4
255+00
258+36
274+09
273+41
273+41
276+70
276+70
276+70
280+48
284+35
287+91.72
287+91.72
288+36.72
288+10
288+57
288+47
288+87.72
6.5
6.4
6.3
6.2
6.1
6.0
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4

EXHIBIT A-1.2
Armourdale Unit – Levee/Floodwall Features Inventory



Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Armourdale Unit
1 inch equals 1,500 feet
Feet
0
1,750
3,500

Armourdale Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
-10+33 (0+05 UE)	-7+48 (2+90 UE)	Sheet Piling associated with Stop Log Gap at Station 0+40 UE to 2+90 UE	8	To be determined in Phase 2	To approximate elevation 750 on landside and 746 on riverside
-7+48 (2+90 UE)	-2+88 (7+50 UE)	Cutoff Trench at approximately Sta. 3+50 UE to 7+50 UE	8	To be determined in Phase 2	To approximate elevation 751
-2+88 (7+50 UE)	6+10 (16+48 UE)	None	8	To be determined in Phase 2	
6+10 (16+48 UE)	15+00	None	8	To be determined in Phase 2	
15+00	35+00	None	8	To be determined in Phase 2	
35+00	60+30	None	8	To be determined in Phase 2	
60+30	77+78	None (Floodwall)	10	To be determined in Phase 2	
77+78	80+00	None	11	To be determined in Phase 2	
80+00	94+00	Landside Area Fill	12	To be determined in Phase 2	Current area fill elevation 760.00 out to 200 feet. The critical area for seepage and slope stability for existing conditions (approximately Station 89+14) considers 12 foot average blanket thickness of Silt (ML) material.

Armourdale Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
94+00	103+00	None	9	To be determined in Phase 2	
103+00	130+00	None	9	To be determined in Phase 2	
130+00	190+00	None	4	To be determined in Phase 2	
190+00	246+90	24 Relief Wells; Landside Area Fill Station 220+00 to 226+00	16	To be determined in Phase 2	Shawnee Avenue Pump Station; Area fill to elevation 748; See attached chart for well locations
246+90	250+50	None	15	To be determined in Phase 2	Sheet piling extends nearly to or below base of blanket
250+50	257+65	None	11	To be determined in Phase 2	
257+65	295+00	14 Relief Wells	22	To be determined in Phase 2	Surface discharge wells; See attached chart for well locations; RR "slot" is critical point for relief wells
295+00	302+58	7 Relief Wells	14	To be determined in Phase 2	Central Avenue Pump Station; See attached chart for well locations; Basements of Beef Packing Co. are driving need for relief wells
302+58	344+03 (61+00 LE)	None	8	To be determined in Phase 2	

Armourdale Unit

Relief Well Details

Header-Well System I

Well No.	*Station*
1	190+75
2	193+25
3	195+80
4	198+30
5	200+80
6	203+25
7	205+74
8	214+15
9	219+16
10	220+16
11	222+09
12	224+07
13	228+38
14	230+53
15A	232+38
16	233+96
17	237+95
18	239+95
19	240+95
20	241+89
21	242+90
22	243+96
23	245+15
24	246+35

Well System II

Well No.	*Station*	
1	268+11	abandoned
2	269+35	abandoned
3	270+53	abandoned
4	271+53	abandoned
5	272+53	abandoned
6	273+58	abandoned
7	274+63	
8	275+77	
9	277+25	
10	278+01	
11	278+85	
12	280+19	
13	281+10	
14	282+29	

Header-Well System III

Well No.	*Station*
1	296+23
2	297+06
3	298+20
4	299+20
5	300+20
6	301+19
7	302+40

Header-Well System I: Includes 24 fully penetrating artesian wells located along the landside levee toe. They are variably spaced and connected by a gravity header system which collects the discharge from each well and directs it to the Shawnee Avenue Pumping Plant, where the water is pumped to the river. Each well consists of a 12-inch stainless steel perforated CMP screen and 12-inch asbestos bonded bituminous-coated riser centered in a 30-inch gravel packed hole drilled to bedrock. The maximum yield of the relief well system is 32 cfs.

Well System II: Includes 8 active artesian wells similar in construction to those in Well System #1. The discharge is carried by grouted gutters into the depressed railroad "slot" area. The discharge from the wells must be allowed to pond in the slot area to a depth of 5 feet during major high water periods. The ponded water offsets the excess uplift in the slot area due to hydrostatic pressure.
The maximum yield at design discharge is 26 cfs for the system. The system was designed for a factor of safety of 0.80 in the slot which increases to 1.0 during design flood events.

Header-Well System III: Includes 7 artesian wells discharging into a gravity header system which collects the discharge from each well and directs it to the Central Avenue Pumping Plant, where the water is pumped to the river. The maximum yield under flood conditions is 10.5 cfs for the system. The system was designed for a factor of safety of slightly over 1.0 for the average basement floor.

Armourdale Unit

LEVEES, STABILITY BERMS, AND RETAINING WALLS					
Reach		Stability Berm		Analysis	Comments
Station	Station	Spring Point (ft.)	Width (ft.)		
LEVEES					
- 10+38 (0+00 UE)	9+71 (20+09 UE)	N/A	N/A	To be determined in Phase 2	EM 1110-2-1902; Appendix VI & VII
9+71	60+30	N/A	N/A	To be determined in Phase 2	
77+78	246+90	N/A	N/A	To be determined in Phase 2	
250+50	257+65	N/A	N/A	To be determined in Phase 2	
302+58	332+85	N/A	N/A	To be determined in Phase 2	
332+85 (39+72 LE)	354+14 (61+00 LE)	N/A	N/A	To be determined in Phase 2	
2+67 (13+05 UE)	5+37 (15+75 UE)	20	30	To be determined in Phase 2	Riverside Berm
6+10 (6+48 UE)	15+50	12	60	To be determined in Phase 2	Riverside Berm
326+64 (43+50 LE)	340+14 (57+00 LE)	11-15	45	To be determined in Phase 2	Riverside Berm
56+50	60+30	N/A	N/A	To be determined in Phase 2	These Retaining Walls parallel the Levee System
220+50	226+00	N/A	N/A	To be determined in Phase 2	
227+46	246+88	N/A	N/A	To be determined in Phase 2	
250+52	257+66	N/A	N/A	To be determined in Phase 2	

Armourdale Unit

FLOODWALLS									
Reach		Wall Type	Foundation Type	Piles		Cutoff		Analysis	Comments
Station	Station			Type	Length (ft.)	Type	Length (ft.)		
FLOODWALLS									
60+30	77+78	Inverted-T	Spread	None	N/A	N/A	N/A	To be determined in Phase 2	3' Key Length on some
246+90	250+50	Inverted-T	Spread	None	N/A	N/A	N/A	To be determined in Phase 2	
257+65	302+58	Inverted-T	Concrete Sheet and Bearing Pile	Concrete	*	Sheet	15'	To be determined in Phase 2	Future analysis will require pile lengths.
RETAINING WALLS									
60+30	63+10	Inverted-T	Spread	None	N/A	N/A	N/A	To be determined in Phase 2	3' Key Length
257+65	259+13	*	*	*	*	*	*	To be determined in Phase 2	Retaining walls are separated from the floodwall with a small berm and is placed along railroad tracks.

* Information not found

Armourdale Unit

CLOSURE STRUCTURES								
Station (ft.)	Function	Type	Gap Height (ft.)	Width (ft.)	Foundation Type	Closure Materials	Analysis	Comments
-9+98 (1+65 UE)	Railroad	Stoplog	8.3	171.0	Sheet Piling and Inverted-T	Timber and Steel Posts	To be determined in Phase 2	
62+35	N/A	N/A	8.4	47.0	N/A	N/A	To be determined in Phase 2	Abandoned, field verified
226+75	Railroad Bridge	Stoplog	6.4	30.0	Sheet Piling and Inverted-T	Timber and Steel Posts	To be determined in Phase 2	
275+42	Railroad Bridge	Sandbag	3.8	29.9	Sheet Piling	Sandbags	To be determined in Phase 2	
276+26	Railroad Bridge	Sandbag	3.3	24.0	Sheet Piling	Sandbags	To be determined in Phase 2	

Armourdale Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Osage Pump Plant / 76+83 (82+30[1])	772.1	Storm Sewer System Flow: The flow comes from Prospect Park and the West Armourdale Sewer System.	72" CIP	To be determined in Phase 2	A. Manhole #42 (see 1948 "Supplement on Interior Drainage", plate 14) separates the lowlands from the uplands. B. The excess runoff that bypasses the upland sewer system is stored in a large depression south of Muncie Boulevard. C. The flowline out at MH #42 is two feet higher than the critically low spots at the intersections of 18th Street and West Kansas Avenue and at 18th Street and Osage Avenue. Because of the 2 ft. of available head, the trunk sewer can discharge the hillside runoff through the 30-inch lateral sewers onto the intersections mentioned above. D. From field observations performed in 1948, flooding seemed to be more extreme at 18th Street and West Kansas Avenue. E. Development has occurred in lower areas adjacent to the levee, increasing percent impervious area. This, in turn, has decreased the ponding area for seepage to collect. While the seepage flow was not designed to be collected and pumped, it may reach the pumping plant and decrease its pumping capacity. F. A pump was originally proposed to limit ponding in the area south of MH #42 so that, at a stage of 26.2 ft., the ponding will not be in excess of 0.158 in. This is the same ponding experienced at a stage of 14.0 ft. under gravity conditions.
12th Street Sewer System / 129+20 (136+40[1])	769.6	(1) Storm Sewer System Flow (2) Seepage Flow	5' x 6' RCB	To be determined in Phase 2	A. Seepage will collect in the low areas between the levee and the railroad track between stations 103+001 and 135+001, covering about 10 acres. Seepage will begin at about stage 32.8 and will reach a max flow of 3.2 cfs at design-flood stage (40.8). B. The ponding that is caused by the river tailwater which limits the capacity of the outfall is less then the ponding due to the insufficient capacity of the sewer during low river stages. In other words, the temporary ponding due to the higher river stages between 14 ft and 21.9 ft is less than the unavoidable ponding that occurs during lower stages from 14 ft and below. C. Pumping is started at stage 21.9', which corresponds to the ground elev. of the lowest manhole in the system. It is shown that the gravity flow capacity of the system is greater then the pump capacity at stage 21.9', but due to the high river stage resulting in backwater requires the gate to be close which effectively makes the sewer capacity zero. D. The COE, in the 1948 "Supplement on Interior Drainage", proposed no additional pumping capacity because the ponding due to the lack of pumping capacity is less then the ponding due to the sewer capacity. E. The new pumps were installed in 1996. These two pumps were cited to have a capacity of 8000 gpm @ TDH 39.5 each. This capacity was compared to the original pumps at the same head and the team found that the original pump only had 6000 gpm @ TDH 39.5. This shows that the pump plant capacity has increased at the stages stated in the table. However, it is unknown how much the capacity has increased. F. Areas were originally determined to be undrained have been developed, thereby increasing the percent impervious. This increase could cause the peak flow to make the design pump capacity insufficient.
Mill Street Pumping Plant / 156+75 (163+00[1])	768.7	(1) Storm Sewer System Flow (2) Seepage Flow	6' x 8' RCB	To be determined in Phase 2	A. Seepage between stations 135+401 and 180+001 will begin at a stage of 32.8 ft. and reach a maximum flow of 4.5 cfs at the design flood stage (40.8 ft.). Seepage will pond in the depressed areas between the levee and the railroad tracks to the north. This area is drained by evaporation and infiltration. B. The present pump starting stage as indicated by the City of Kansas City, Kansas in 1948, is 14.9 ft. on the Hannibal Bridge gage. The pump operator actually uses that gage as a warning and the pumps are started when backflow in the sewer is about to pond in the intersection of Mill Street and Shawnee Avenue, which is equivalent to a stage of 19.4 ft. on the Hannibal Bridge gage. At this stage the sewer capacity and pump capacity are equal, therefore no additional pumping capacity was proposed. C. The Design Memorandum No. 3 written by the COE for the 1962 Modification states that the existing pump plant is outdated and is scheduled to be replaced by the city of Kansas City, Kansas. D. Overland flow cannot supplement sewer delivery to this outlet, due to a recently placed landfill adjacent to the levee. The landfill encroaches heavily on former ponding areas. E. Areas that were originally undrained are now serviced by the pump plant due to the development in the area. The outlet now drains more then the original 304 acres, possibly the total 580 acres, and has an increased percent impervious as reflected in the table. F. Two new pumps were installed in 1996. These pumps were cited to have a capacity of 8000 gpm @ TDH 39.5. This capacity was compared to the original pumps at the same head and the team found that the original configuration had one pump with 6000 gpm @ TDH 39.5 and another pump with 5750 gpm @ TDH 39.5. This shows that the pump plant capacity has increased at the stages stated in the table. However, it is unknown how much the capacity has increased.

***Not found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 377.5 and elevations correspond to the river at the pump plant location.
Superscript 1 refers to 1948 levee stationing.

Armourdale Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
5th Street (Armourdale Industrial) Pump Plant/ 185+70	767.5	(1) Storm Sewer System Flow (2) Seepage Flow	72" RCP	To be determined in Phase 2	A. It is believed that when the packing industry dissolved and left this area, it was decided by either the Kaw Valley Drainage District or local interests to improve the drainage system so that the land would be more appealing for development. For this reason, the 5th Street Pump Plant was installed. This changed the drainage characteristics that existed during the composition of the 1948 "Supplement on Interior Drainage". B. Originally, water that was collected in the area of the 5th Street pump plant services was allowed to pond and would have been removed by infiltration and evaporation. It is the area described in the 1948 "Supplement on Interior Drainage", paragraph 24g, as the non-draining area. This non-draining area would have ponded water and then overflowed to the Shawnee Avenue Sewer System if the ponded water reached a certain control elevation. Now the 5th Street Pump Plant removes the water from this area. C. The typical design condition variables do not apply, as it appears that the pump plant was just designed to handle certain flow rates at certain stages. No problems were reported with this pump plant.
Midwest Cold Storage Pump Plant / 194+60 (200+00[1])	766.0	Storm Sewer System Flow	24" CIP	To be determined in Phase 2	A. The 1948 "Supplement on Interior Drainage" explains that the pump was for the Midwest Cold Storage property. The outfall for the pump was a 6" removable pipe and pumped over the levee. B. It is believed that the Armourdale Pump Plant has made the function of this pump plant unnecessary. The Kaw Valley Drainage District is unaware of its use. However, the status has not been confirmed and the pump plant may be used periodically for the Midwest Cold Storage property.
Shawnee Ave Pumping Plant / 230+77	765.2	(1) Storm Sewer System Flow: The flow is from the Shawnee Sewer System. (2) Seepage Flow: The flow is from the Header Well System I.	7.5' x 7.5' RCB	To be determined in Phase 2	A. The average elevation of the low lying contributing area is 14 feet below the design flood elevation. B. It was shown that this pump plant was replaced with a new pump plant in the plans for the 1962 revision. It was necessary to increase pump capacity because of the ponding that occurred during design flood stage. C. Ponding will occur under gravity flow due to inadequate sewer capacity. D. The main purpose of this plant is to discharge seepage from the Header Well System I. The current design needed to handle more seepage because the Design Flood elevation increased from original pump plant construction. E. The recent (late 1970s) storm sewer system along Shawnee Ave., in conjunction with urban renewal, increased the delivery of storm water. F. Because of the seepage at stage 40.8, 88 acres of once pervious area is now computed to be impervious which increases runoff. Note that the area between 180+001 and 235+001 is storage. G. Railroad fill across Shawnee Avenue near the levee denies overland flow to the outlet.
KCS Railroad Pump Plant / 276+79 (276+00[1])	762.4	Seepage Flow	42" CIP	To be determined in Phase 2	A. No performance curves were found for the pump, so the capacity was assumed to be 2.23 cfs, which is the pump rating. B. The pump outfall is through a 6 inch pipe 8 inches below the top of wall. Gravity flow is through a 10" CIP. Because of the low capacity of the pump, it was proposed (in the "Supplement on Interior Drainage") to construct a pump plant with a capacity of 13.5 cfs. This did not happen. C. Wells #1 through #6 no longer discharge to the KCS Pump because of a stability berm that now covers the discharge openings at the top of the structure. D. This pump is to be operated only when the Kansas River is below elevation 747.4 and falling. If the Kansas River is rising, the plant sluice gate must be closed which causes ponding in the railroad area. E. An open ditch conveys seepage water to the plant. Due to the open ditch, there is a runoff flow in an uncontrolled condition. The worst case is at stage 17.7 when the runoff is 4.6 cfs. F. The main purpose of this pump is to discharge seepage. A new pump was added in 1995.

***Not found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 377.5 and elevations correspond to the river at the pump plant location.
Superscript 1 refers to 1948 levee stationing.

Armourdale Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
National Beef Pump Plant/ 295+52 (294+30[1])	761.5	Storm Sewer System Flow: Flow from the Riverside Sewer System.	24" CIP	To be determined in Phase 2	A. The plant was originally built to service the National Beef Packing Plant which included surface runoff, seepage, and negligible sanitary flow on the National Beef property. This industry has dissolved, but the drainage characteristics have not changed. Therefore, the pump is still in service. B. Seepage flow has been removed because the Header Well System III was built and now collects the seepage flow. C. The Kaw Valley Drainage District refers to this pump plant as the Central Avenue pump plant, yet the operational drawings label this pump plant as the National Beef pump plant. D. The pump capacity remains inadequate at the Design River Stage, but ponding should not cause damage.
Central Ave Pump Plant / 299+20	762.0	Seepage Flow: Header Well System III	3" CIP	To be determined in Phase 2	A. The well system consists of seven artesian wells. B. Conditions have not changed since the pump plant design.
East Outfall Sewer Pump Plant	763.7	Storm Sewer System Flow: The water is from the railyards area.	30" DIP	To be determined in Phase 2	A. This pump is located in the railyards 650 feet west of 4th Street and Berger Avenue. B. A 24" DIP sewer line intercepts drainage from a 33" RCP culvert located under the tracks just west of the pump plant. C. The plant pumps water through the 24" sewer line to the 30" DIP outfall at station 246+53. D. The static head was determined as the difference between the centerline of the pipe at the sluice gate for the 30" DIP outfall and the minimum water level in the station. The elevation at the sluice gate is 748.1 (approx. stage 29.0 ft.). The impact of higher river stages on the static head was disregarded since the probability of simultaneous occurrence with the peak discharge of the pump plant was very remote. E. Conditions in the area contributing to the pump plant have not changed significantly since the design of the plant.

***Not found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 377.5 and elevations correspond to the river at the pump plant location.
Superscript 1 refers to 1948 levee stationing.

Armourdale Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Compositi on	Control Structure Type LW = landward RW = riverward		
1	Union Pacific Storm Sewer Outlet	7+50 UE	50	24"	RCP	Sluice gate (RW) and Flap gate (RW)	To be determined in Phase 2	A. This pipe drains the ponding areas (north of Union Pacific railroad tracks and between the tracks of the two railroad companies) isolated by the relocation of the stoplog gap and additional floodwall construction. This floodwall construction (after "Supplement on Interior Drainage" is the reason fo the "Upper End" stationing). B. During high river stages, ponding is allowed to spill over onto the tracks because the closing of the stoplog gap will be complete and prevent any trains from using the tracks. C. The missing information can be estimated if deemed necessary. However, there are no indications that significant changes have taken place in the surrounding area.
3	Mattoon Creek Basin Storm Sewer Outlet: The conduit discharges all runoff that originates in the Mattoon Creek drainage basin.	12+79 UE	56	12'W x 8'H	RCB	Sluice gate (LW)	To be determined in Phase 2	A. The pipe drains a total of 745 acres in the Mattoon Creek basin. The area includes two separate sections - 534 acres is mostly residential and the other 211 acres consists of the Union Pacific Railroad Yard. B. The missing information can be estimated if deemed necessary. However, there are no indications that significant changes have taken place in the surrounding area. C. The 66" that used to empty into this RCB has been plugged and abandoned. Therefore, the original 745 acres may now be reduced if the 745 acre area included the drainage that was drained by the 66" RCP.
3A	I-70 and Railroad Ditch Drainage: Flow is contributed from the ditch just north of the railyards, which collects I-70 drainage from the pipe inlet to 14th Street.	15+33 UE	120	108"	RCP	Sluice gate (RW) Flap gate (RW)	To be determined in Phase 2	A. This 108" RCP services ditch drainage from the railroad and Interstate I-70. B. The pipe was jacked under the adjacent access ramp and the railroad. C. The missing information can be estimated if deemed necessary. However, there are no indications that significant changes have taken place in the surrounding area.
3B	St. Louis Southwestern Railroad Outfall: The flow is that which originates in the railyards and runoff that ponds at the toe of the levee.	32+80	88	42"	RCP	Sluice gate (RW) and Flap gate (RW)	To be determined in Phase 2	A. The conduit was installed by the railroad to drain the railyards in the 1980s. B. The pipe does not appear on the 1979 Operational Drawings. C. The missing information can be estimated if deemed necessary. However, there are no indications that significant changes have taken place in the surrounding area.
5A	KDOT Highway Drainage Outlet: The drainage is from Kansas Avenue.	64+71	***	42"	***	Sluice gate (LW) Flap gate (RW)	To be determined in Phase 2	The missing information can be estimated if deemed necessary. However, there are no indications that significant changes have taken place in the surrounding area.
6	Prospect Park and West Armourdale Sewer System / Osage Avenue Pumping Plant Outfall	76+83 (82+30[1])	***	72"	RCP	Sluice gate (LW)	To be determined in Phase 2	A. The operator allows the sluice gate to remain open as long as the river stage is below 26.2 feet. At this stage, water begins to flow out of the catch basins at the critical low point located at the intersection of 18th Street and Osage Avenue. B. The sewer system capacity is insufficient under gravity flow. At stage 18.5 feet, the system will gravity discharge a maximum of 194 cfs, yet the runo will be 532 cfs. This results in an average ponding of 9 acre-feet. However, this average ponding value for the total drainage area is not an accurate representation of what happens because the excess water from the uplands ponds in the lowlands. C. There has been a considerable amount of development in the area. Highway 69 has been built and a number of new businesses have been built near the levee.

***Not Found after reasonable search
Superscript 1 refers to 1948 levee stationing.
The "UE" designation in the levee stationing means "Upper End" in reference to a floodwall addition after initial levee construction.
The "LE" designation in the levee stationing means "Lower End" in reference to a floodwall addition after initial levee construction.

Armourdale Unit

STORM SEWERS

Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
10	18th Street and Argentine Boulevard Sewer Outlet	91+76 (98+20[1])	124	30"	CIP	Sluice gate (RW) Flap gate (RW)	To be determined in Phase 2	A. Conditions 1 and 2 do not portray a complete picture of the ponding situation. Seepage flow, which starts at stage 32.8 feet, ponds in the service area. The seepage flow rate is at its maximum at a stage 40.8 feet, causing the area inundated by seepage to be 10 acres with a maximum depth at the intersection of 2.8 feet. B. Seepage will pond in the depressed areas adjacent to the levee. C. There was no pump plant proposed by the COE due to the infrequent occurrence of the higher river stages and the small amounts of damage involved. D. No significant changes have taken place in the service area of this conduit since the time of design.
11	12th Street Sewer System Pump Plant Outfall	129+20 (136+40[1])	110	5'W x 6'H	RCB	Sluice gate (RW) and Flap gate (RW)	To be determined in Phase 2	A. Seepage will collect in the low areas between the levee and the first railroad track landward of the levee between station 97+00 (103+00[1]) and 129+00 (135+00[1]), inundating about 10 acres. These areas have been encroached upon by been encroached upon by development. The inundated area has most likely increased because of the increase in impervious area. In addition, the levee raise would increase the maximum seepage flow. B. Seepage will begin at about stage 32.9 and will reach a maximum flow of 3.2 cfs at stage 40.8 feet. The seepage at design flood stage will accumulate a total volume of 21 acre-feet. However, the depressions will store only about 10 acre-feet, to elevation 753.2 feet, and flow will move over the tracks and into the 12th Street sewer system. C. The system is insufficient under gravity flow. At stage 18.5 feet, the system will gravity discharge a maximum of 156 cfs. However, the runoff will be 381 cfs and results in an average ponding depth of 0.33 inches. While this is an average pondage value, the excess water from the uplands pushes water out of the inlets in the bottoms, thereby really only accumulating water in the bottoms. Specifically, this occurs at MH #32 (refer to "Supplement o Interior Drainage", plate 20) or 12th Street and Cheyenne Avenue.
12	Mill Street Pumping Plant Outfall	156+75 (163+00[1])	100	6'W x 8'H	RCB	Sluice gate (RW) and Flap gate (RW)	To be determined in Phase 2	A. There is an undrained area of 151 acres between the south limits of the tributary area and the levee, between levee stations 136+401 and 180+001. There are many depressed areas that will collect the runoff at the lower river stages. Some of this area has been filled in with development, thereby reducing the ponding area. B. Seepage between stations 136+40[1] and 180+00[1] will begin at a stage of 32.8 feet and reach a maximum flow of 4.5 cfs at the design flood stage (40.8 ft.). C. The system is insufficient under gravity flow. At stage 14.0 feet, the system will gravity discharge a maximum of 302 cfs, yet the runoff generated wil be 629 cfs. This results in an average ponding depth of 0.36 inches. Ponding will occur at Mill Street and Shawnee Avenue. D. Areas that were originally undrained are now serviced by the pump plant due to the development in the area. The outlet now drains more than the original 304 acres, and probably the total of 580 acres.

***Not Found after reasonable search

Superscript 1 refers to 1948 levee stationing.

The "UE" designation in the levee stationing means "Upper End" in reference to a floodwall addition after initial levee construction.

The "LE" designation in the levee stationing means "Lower End" in reference to a floodwall addition after initial levee construction.

Armourdale Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
13	5th Street Pump Plant (Armourdale Industrial Park Pump Plant) Outfall	185+70	124	72"	RCP	Sluice gate (RW) and Flap gate (RW)	To be determined in Phase 2	A. Backflow Stage is unknown because of the lack of design information for this pump plant. B. This outfall and pump plant became necessary when the land it services changed from undeveloped to developed. C. Originally, water was allowed to pond on the undeveloped area. The water, predominately seepage, would reach a control elevation and then overflow to the Shawnee Avenue Sewer System. Now the seepage water drains to this outfall and pump plant. D. Conditions of the conduit service area have not undergone significant changes since the time of design. As stated in the pump plant information, no problems were reported with the plant.
14	Midwest Cold Storage Pump Plant Outfall	194+60 (200+00[1])	83	18"	CIP	Sluice gate (RW) and Flap gate (RW)	To be determined in Phase 2	A. The Kaw Valley Drainage District has explained that the pump that used to service this small area is no longer in service. B. The small size of this area suggest that movable suction pumps will be used if ponding is severe in this area. C. No seepage will enter the system due to the fact that this area is higher then the area just to the northwest. This system was originally designed with pump during high river stages. Water was pumped out of 6" removable pipe. D. As noted in the pump plant information, the function of the pump plant may be unnecessary due to the Armourdale Pump Plant. No problems have been reported in the area of the Midwest Cold Storage Pump Plant.
15	New Developed Area: The flow is from surface parking lots for truck trailers and buildings for industry and offices.	212+76 (212+65[1])	125	24"	CIP	Sluice gate (LW) and Flap gate (RW)	To be determined in Phase 2	A. The packing plant that was present in the 1948 "Supplement on Interior Drainage" no longer exists. B. The pumps that used to service this area are no longer in operation according to the Kaw Valley Drainage District. C. The storm runoff is believed to drain to the 5th Street Pump Plant. D. The seepage that originally drained to this area is now picked up by Header System I. E. 100% impervious had been assumed due to the area being thoroughly covered with buildings, ramps, etc. The new development cannot show an increase in this value, so it was assumed to remain at the 100% value.
16	New Developed Area: The flow is from surface parking lots for truck trailers and buildings for industry and offices.	220+64 (220+60.6[1])	101	24"	CIP	Sluice gate (RW) & Flap gate (RW)	To be determined in Phase 2	A. The packing plant that was present in the 1948 "Supplement on Interior Drainage" no longer exists. B. The pumps that used to service this area are no longer in operation according to the Kaw Valley Drainage District. C. The storm runoff is believed to drain to the 5th Street Pump Plant. D. The seepage that originally drained to this area is now picked up by Header System I. E. 100% impervious had been assumed due to the area being thoroughly covered with buildings, ramps, etc. The new development cannot show an increase in this value, so it was assumed to remain at the 100% value.

***Not Found after reasonable search

Superscript 1 refers to 1948 levee stationing.

The "UE" designation in the levee stationing means "Upper End" in reference to a floodwall addition after initial levee construction.

The "LE" designation in the levee stationing means "Lower End" in reference to a floodwall addition after initial levee construction.

Armourdale Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
17	Shawnee Avenue Sewer Pump Plant Outfall: The flow is from the storm sewers draining to the pump plant and the seepage from Header Well System I.	230+77 (231+45[1])	160	7.5' W x 7.5' H	RCB	2 Sluice Gates (LW) and 2 Flap Gates (RW, on relief well headers)	To be determined in Phase 2	A. The average elevation of the area is about 14.0 feet below design flood elevation. The entire area has paved streets with curbs and inlets. B. At stage 16.0 feet, the backwater will begin to flow out of the lowest catch basins located in the underpass on Adams Street south of Shawnee Avenue. C. The time of concentration calculation is subject to change based upon the new sewer described in comment "E". D. This outfall and pump plant originally was not designed to handle all of the seepage from Header System I. This would explain the relocation of the pump and pump house in 1971. E. A new storm sewer along Shawnee Avenue was built close to the same time as the new pump station. It has increased the delivery of the storm flow to the outlet.
18	New Developed Area: The flow is from surface parking lots for truck trailers and buildings for industry and offices.	240+73 (240+61[1])	100	48"	RCP	Sluice gate (RW) and Flap gate (RW)	To be determined in Phase 2	A. Kaw Valley Drainage District has explained that the pump, which is described by the 1950 "Supplement on Interior Drainage", is no longer used. B. The area has changed from a packing plant, which had a large amount of pervious area due to the need of hay for the live stock, to an area filled in with surface parking and industrial buildings. C. Seepage that used to pond at the toe of the levee is now collected by the Header Well System I. D. Stormwater from the railyards is pumped to the 30" outfall located at 246+53. The pump is in the railyards just west of the intersection of 4th Street and Berger Avenue. E. 100% impervious had been assumed by the COE in the 1948 "Supplement on Interior Drainage" due to the area being thoroughly covered with buildings, ramps, etc. The new development cannot show an increase in this value, so it was assumed to remain at the 100% value.
19		244+70 (244+55[1])	64	24"	CIP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	
20		246+53 (246+37[1])	91	30"	CIP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	
21	Stockyard	250+31 (250+86[1])	90	12"	CIP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	A. As this area is about 9 feet higher then the Swift Company property, it was assumed that the seepage would drain to the Swift Sewer System. B. The conditions of the storm sewer drainage area for this conduit have not undergone significant changes since the time of design.
24	Depressed Area Sewer System: This system services an area found to be lower then the area near the toe of the levee.	260+00 (259+23[1])	77	30"	CIP	Gate Valve (LW) and Flap gate (RW)	To be determined in Phase 2	A. Swift & Company no longer exists. B. The gatewell has been relocated so that the surface parking lot is able to drain when the gate is closed. C. The area described to be higher than the serviced area in the description column is called the Stockyard in this table. The seepage that originates in this Stockyard area will flow to the lower area that this outfall drains. D. 100% impervious had been assumed because the drainage area only encompasses the former Swift and Company property that is filled with buildings and paved areas. E. The industrial flow contribution to the system is less than 5.3 cfs. F. The area draining to the conduit has not undergone any significant changes since the pipe design.

***Not Found after reasonable search

Superscript 1 refers to 1948 levee stationing.

The "UE" designation in the levee stationing means "Upper End" in reference to a floodwall addition after initial levee construction.

The "LE" designation in the levee stationing means "Lower End" in reference to a floodwall addition after initial levee construction.

Armourdale Unit

STORM SEWERS

Structure ID	Description	Location: Levee Station (ft)	Location: Offset to Outlet (ft)	Structure Information: Conduit Size	Structure Information: Conduit Composition	Structure Information: Control Structure Type LW = landward RW = riverward	Analysis	Comments
25	Stockyard	260+84 (260+05[1])	77	12"	CIP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	A. It was assumed that the seepage would drain to the Swift Sewer System. B. The conditions of the storm sewer drainage area for this conduit have not undergone significant changes since the time of design. C. The pipe has been abandoned.
26	Stockyard	262+89 (262+23[1])	77	12"	CIP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	A. It was assumed that the seepage would drain to the Swift Sewer System. B. The conditions of the storm sewer drainage area for this conduit have not undergone significant changes since the time of design.
27	Stockyard	266+76 (256+83.3[1])	77	16"	CIP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	A. It was assumed that the seepage would drain to the Swift Sewer System. B. The conditions of the storm sewer drainage area for this conduit have not undergone significant changes since the time of design.
28	KCS Railroad Pump Plant Outfall: The outfall handles seepage flow from the Header Well System II	276+79 (276+00[1])	77	42"	CIP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	A. This area is formed by the narrow tract of land used for a single railroad track of the Kansas City Southern Railroad (KCSRR). This same tract of land is what conveys seepage to the pump. B. As stated in the pump plant information, Wells #1 through #6 no longer discharge to the pump plant. However, the pump plant capacity is still likely inadequate and the same amount of flow will be outlet from the plant as in the original design.
28A	I-670 Drainage	281+50	***	42"	RCP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	There are no indications that significant changes have taken place in the surrounding area.
29	Private Brands Incorporated Property Sewer Outlets	286+59	70	24"	CIP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	A. The outfall located at 286+59 is for a private pump. B. The outfall at 290+52 appears to drain the ponded seepage which would occur due to the fact that there is not a pressure relief well system present. C. The conditions of the service area for these conduits has not changed significantly since the pipe design.
30		290+52	85	24"	CIP	Sluice gate (LW) and Flap (RW)		
31A	Unknown Outfall	295+45		18"	RCP	Sluice gate (LW)	To be determined in Phase 2	The structure with the sluice gate is the termination of a storm sewer system serving I-670 (KDOT). The KDOT system was constructed without prior COE approval; the gate and structure were placed to protect the area from a failure in the KDOT system.
31	National Beef Pump Plant: Riverside Sewer Outfall	295+52 (294+30[1])	80	24"	CIP	Sluice gate (LW) and Flap (RW)	To be determined in Phase 2	As noted in the pump plant information, the drainage characteristics of the area have not changed since original design. The pump capacity remains inadequate and the conduit is lacking capacity for the Design River Stage.
32 & 33	Central Avenue Pump Plant Outfall: The flow is delivered by the Header Well System III.	299+20	1	2-14" and 1-3"	CIP	3 Gate Valves (LW) and 2 Flap Gates (RW)	To be determined in Phase 2	A. This pump was constructed for the purpose of draining the Header Well System III. B. As noted in the pump plant information, the conditions have not changed since the pump plant or conduit design.
34	Splitlog Outfall: The flow is delivered by the Muncie/5th Street Sewer System and the Reynolds Avenue Sewer System.	311+11 (310+20[1])	100	7.5' W x 7.5' H	RCB	Sluice gate (RW)	To be determined in Phase 2	A. Time of concentration calculations were based upon the time that generated the greatest runoff. The two tributary areas do not peak at the same time. The greatest flow occurs when the Reynolds Sewer System peaks and the Muncie-5th Street Sewer has passed its peak. B. Pondage occurs at the first manhole on the street south of Central Avenue (5th Street) and in the vicinity of 8th Street and Muncie Boulevard. However, the majority of the area is above design flood elevation. C. Conditions of the service area for these conduits have not changed significantly since pipe design.

***Not Found after reasonable search

Superscript 1 refers to 1948 levee stationing.

The "UE" designation in the levee stationing means "Upper End" in reference to a floodwall addition after initial levee construction.

The "LE" designation in the levee stationing means "Lower End" in reference to a floodwall addition after initial levee construction.

Armourdale Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
	I-70 Stormwater	315+10	85	5 'W x 4' H	RCB	Sluice gate (RW)	To be determined in Phase 2	A. This stormwater system was constructed by KDOT to serve I-70 stormwater runoff.
36	Unknown outfall: It is believed that this outfall serves the purpose of the original Fowler Street Sewer outlet.	45+05 LE	60	42"	CMP	Sluice gate (RW)	To be determined in Phase 2	A. The area served by the Fowler Street Sewer System is not accounted for by any other outfall. The 1948 "Supplement on Interior Drainage" states that there should be a 48" outfall at station 333+38[1]. But the operational drawings do not show a 48" at that location. Therefore, through the process of elimination, it is believed that this outfall is one of two outfalls that probably serves the purpose of the Fowler Street Sewer outlet. B. The missing information can be estimated by referring to the Fowler Street Sewer System information. There are no indications that significant changes have taken place in the surrounding area.
37	Railroad Ditch Drainage	46+22 LE	10	24"	CMP	Flap gate (RW)	To be determined in Phase 2	A. The operational drawings show that this outfall does not have a gatewell. It appears that this pipe drains the area between the levee and the railroad tracks. Because the railroad tracks are high, there is no need for a gatewell structure. B. There are no indications that significant changes have taken place in the surrounding area.
38	Railroad Ditch Drainage Outlet: The flow comes from 4.08 acres of railroad ditch extending 1000 feet in each direction from the James Street Bridge.	50+95 LE (333+24[1])	10	24"	CMP	Flap gate (RW)	To be determined in Phase 2	A. Drains the area which is protected by the extension of the levee from 323+60[1] to 342+00[1]. B. This protected area consists of a single track of the MPRR. The low point is at the James Street Bridge. A pump was proposed but not built. C. The area extends about 1000 feet in both directions along the toe of the levee away form the James Street Bridge. D. There are no indications that significant changes have taken place in the surrounding area.
39	Railroad Track Area Drainage Outlets	56+41 LE	15	24"	CMP	Flap gate (RW)	To be determined in Phase 2	A. At some point after the 1948 "Supplement on Interior Drainage", the railroad raised the tracks. Consequently, the raised earth changed the drainage pattern of the land between the track and the levee. The railroad built three culverts to drain that area; two are still in operation. This drainage area is high ground, therefore the pipes do not require sluice gates. B. There are no indications that significant changes have taken place in the surrounding area.
41		60+45 LE	15	25" W x 16" H	CMP	Flap gate (RW)		

***Not Found after reasonable search

Superscript 1 refers to 1948 levee stationing.

The "UE" designation in the levee stationing means "Upper End" in reference to a floodwall addition after initial levee construction.

The "LE" designation in the levee stationing means "Lower End" in reference to a floodwall addition after initial levee construction.

Armourdale Unit

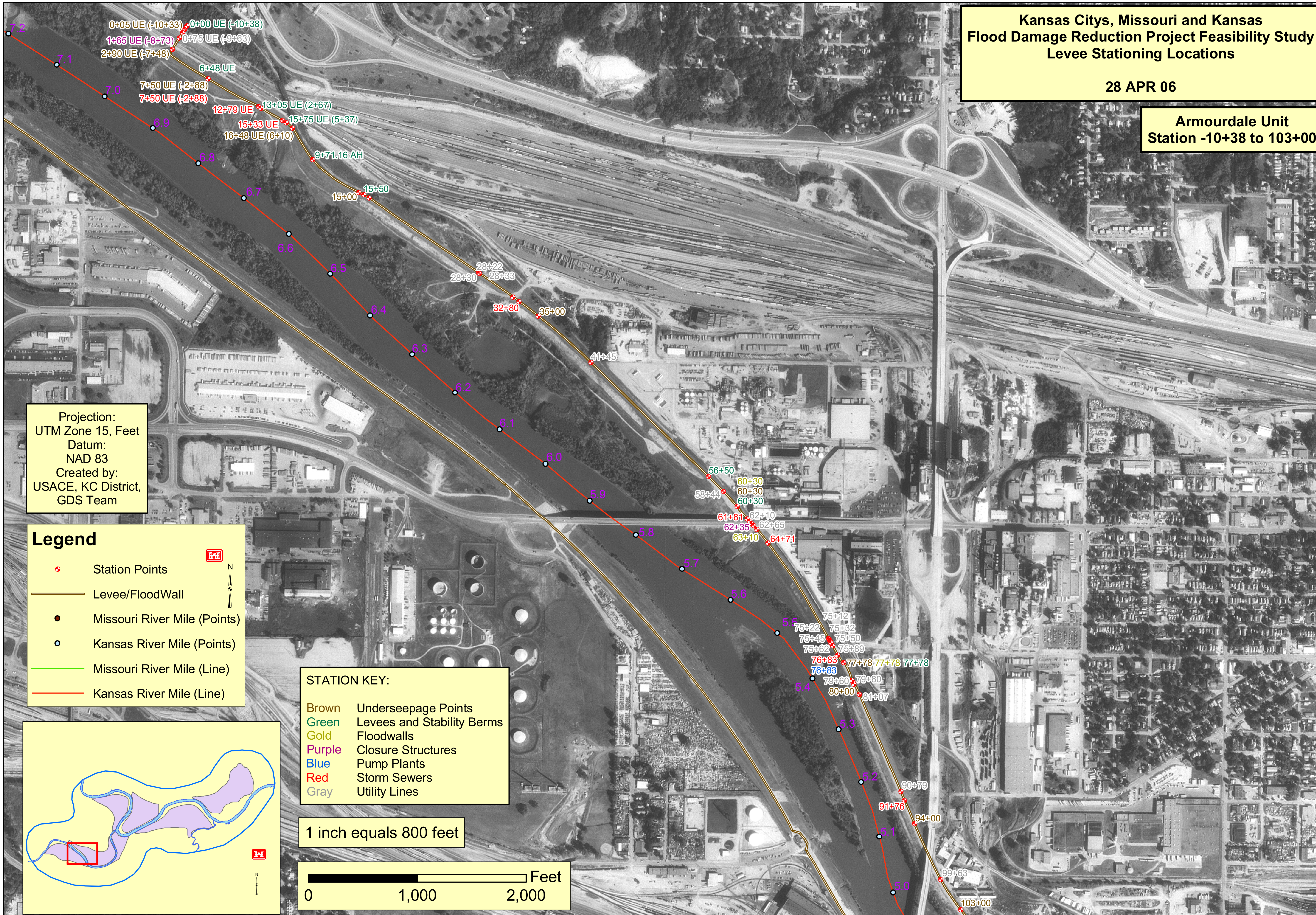
UTILITY LINES							
Station (ft.)	Function	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Analysis	Comments
-4+58 (5+80 UE)	Fiber Optic	*	*	200	*	To be determined in Phase 2	2 cables
-9+63 (0+75 UE)	Water Force Main	DIP	36"	160	Valve	To be determined in Phase 2	Closure Gap
28+22	Sand Pipe	SP	6"	*	None	To be determined in Phase 2	American Sand Company; abandoned
28+30	Sand Pipe	SP	18"	*	None	To be determined in Phase 2	
28+33	Sand Pipe	SP	6"	*	None	To be determined in Phase 2	Abandoned
52+45	Water	*	2"	*	*	To be determined in Phase 2	
58+44	Storm Sewer	RCP	36"	105	Gate and Flap	To be determined in Phase 2	Abandoned
61+81	Storm Sewer	CIP	36"	91	Gate and Flap	To be determined in Phase 2	Abandoned
62+10	Sanitary Sewer	SP	18"	*	*	To be determined in Phase 2	Abandoned
62+10	Gas	SP	24"	*	Gate	To be determined in Phase 2	Kansas Avenue Bridge
62+65	Water	SP	10"	*	*	To be determined in Phase 2	
75+12	Intake	RCP	48"	*	*	To be determined in Phase 2	KAW Power Plant
75+22	Intake	SP	6"	*	*	To be determined in Phase 2	
75+32	Intake	RCP	72"	*	*	To be determined in Phase 2	
75+45	Intake	SP	3"	*	*	To be determined in Phase 2	
75+50	Intake	SP	1"	*	*	To be determined in Phase 2	
75+62	Power Plant	DUCT	18"W X 48"H	*	*	To be determined in Phase 2	
75+89	Storm Sewer	RCP	72"	*	*	To be determined in Phase 2	
79+60	Storm Sewer	RCP	84"	182	Sluice Gate	To be determined in Phase 2	

* Information not found

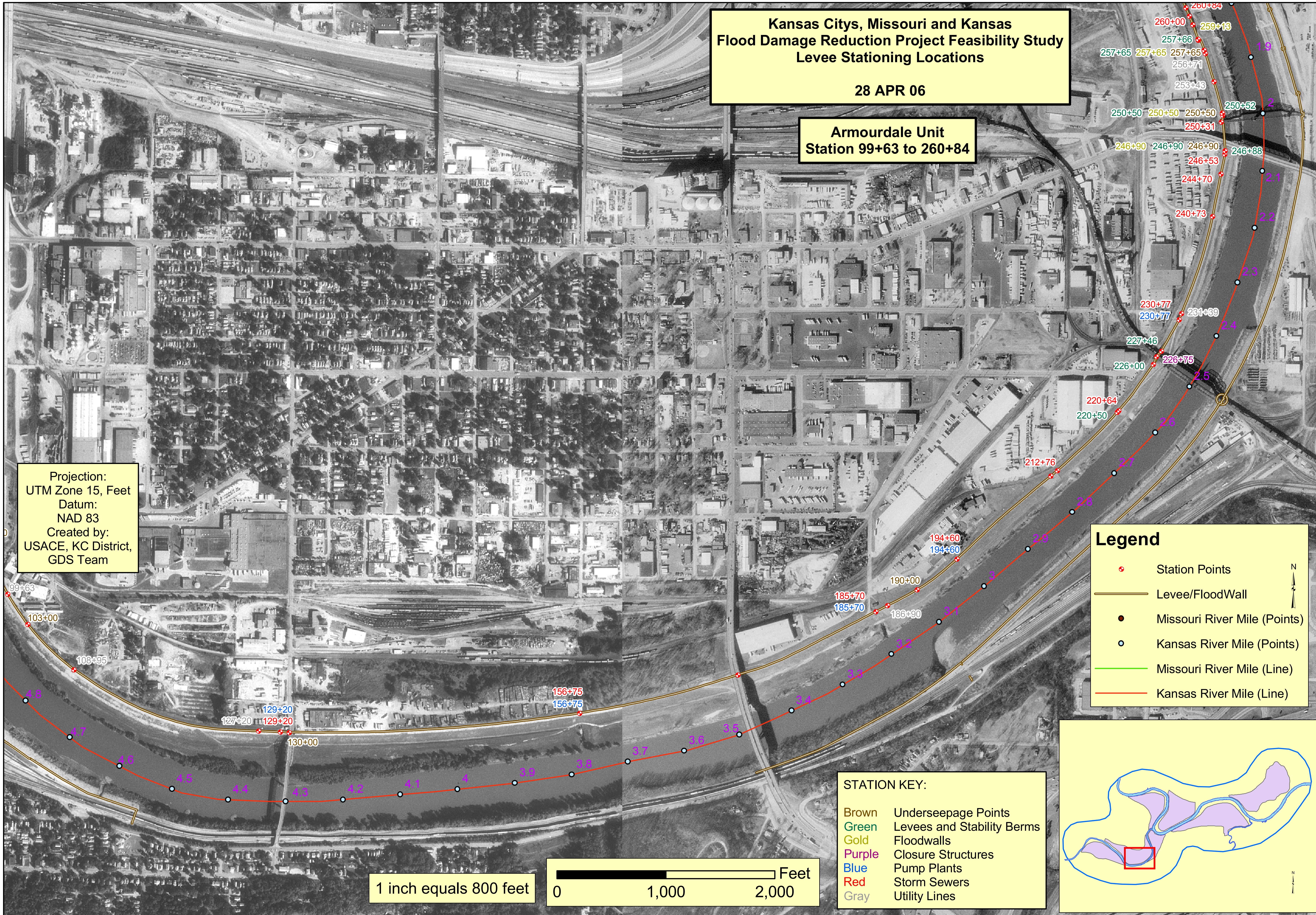
Armourdale Unit

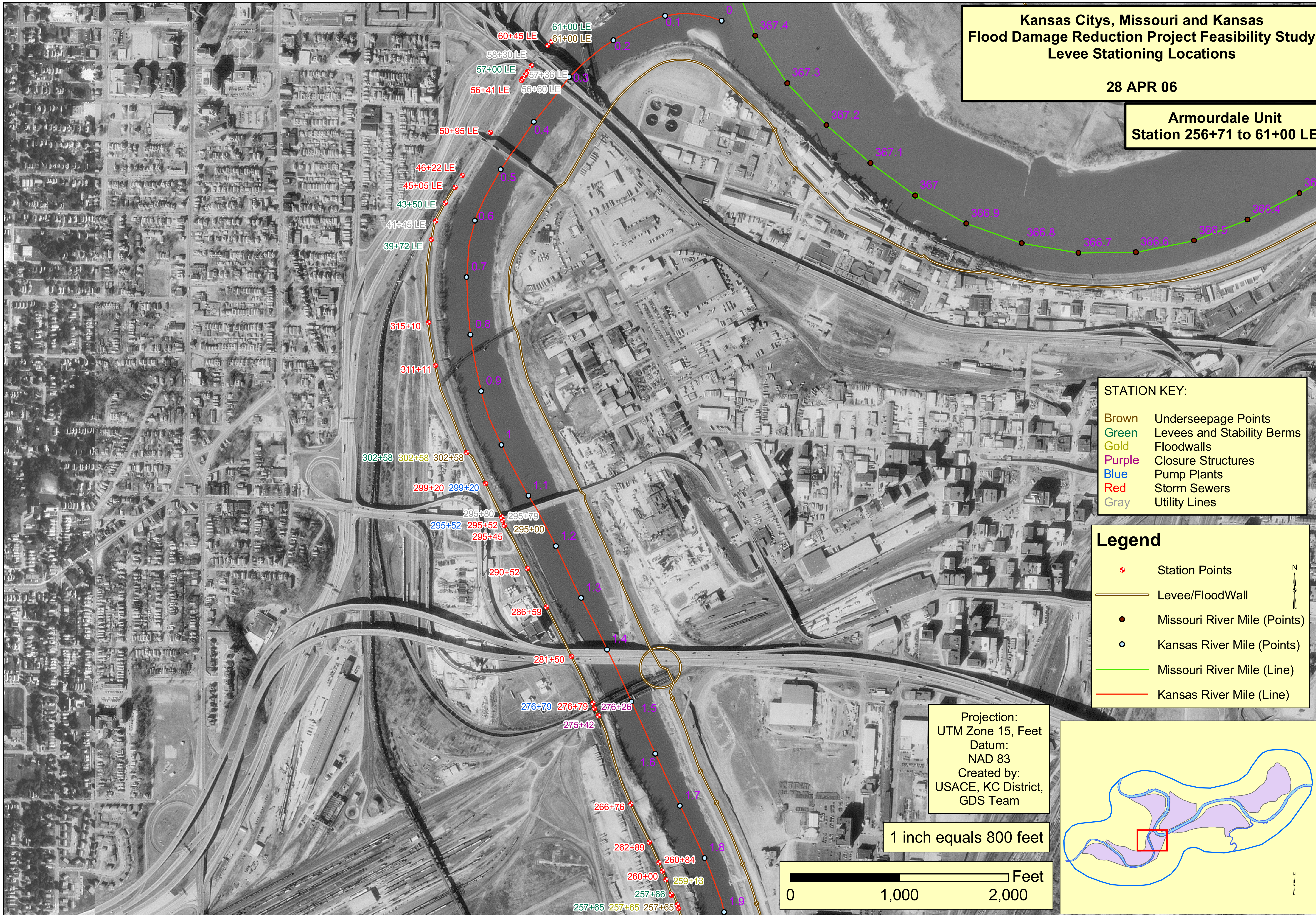
UTILITY LINES							
Station (ft.)	Function	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Analysis	Comments
79+80	Storm Sewer	RCP	60"	182	Sluice Gate	To be determined in Phase 2	
81+07	Storm Sewer	SP	4"	110	*	To be determined in Phase 2	Abandoned
90+79	Sanitary Sewer	DIP	30"	125	Sluice Gate	To be determined in Phase 2	
99+63	Storm Sewer	SP	4"	175	*	To be determined in Phase 2	
108+95	Sanitary Sewer	RCP	42"	100	Sluice Gate	To be determined in Phase 2	
127+20	Water	CIP	24"	110	Valve	To be determined in Phase 2	Abandoned
186+90 / (186+74)	Sanitary Sewer	DIP	30"	150	Sluice Gate	To be determined in Phase 2	
231+38.91	Storm Sewer	*	57"	100	None	To be determined in Phase 2	Abandoned
253+43	Storm Sewer	CIP	12"	118	Gate and Flap	To be determined in Phase 2	Abandoned
256+71	Storm Sewer	CIP	12"	120	Gate and Flap	To be determined in Phase 2	Abandoned
295+79	*	SP	2"	*	Valve	To be determined in Phase 2	
295+80	*	CIP	10"	*	Flap and Valve	To be determined in Phase 2	
324+58.58 (41+45 LE)	Sanitary Sewer	CIP	48"	*	Gate Valve	To be determined in Phase 2	Pressure Sewer
339+73.58 (56+60 LE)	Sanitary Sewer	DIP	2 - 36"	*	2 Gate Valves	To be determined in Phase 2	Force Main; river crossing
340+49.58 (57+36 LE)	Storm Sewer	CMP	12"	40	*	To be determined in Phase 2	
341+43.58 (58+30 LE)	Plugged	CMP	25"W X 16"H	50	Plugged	To be determined in Phase 2	

* Information not found



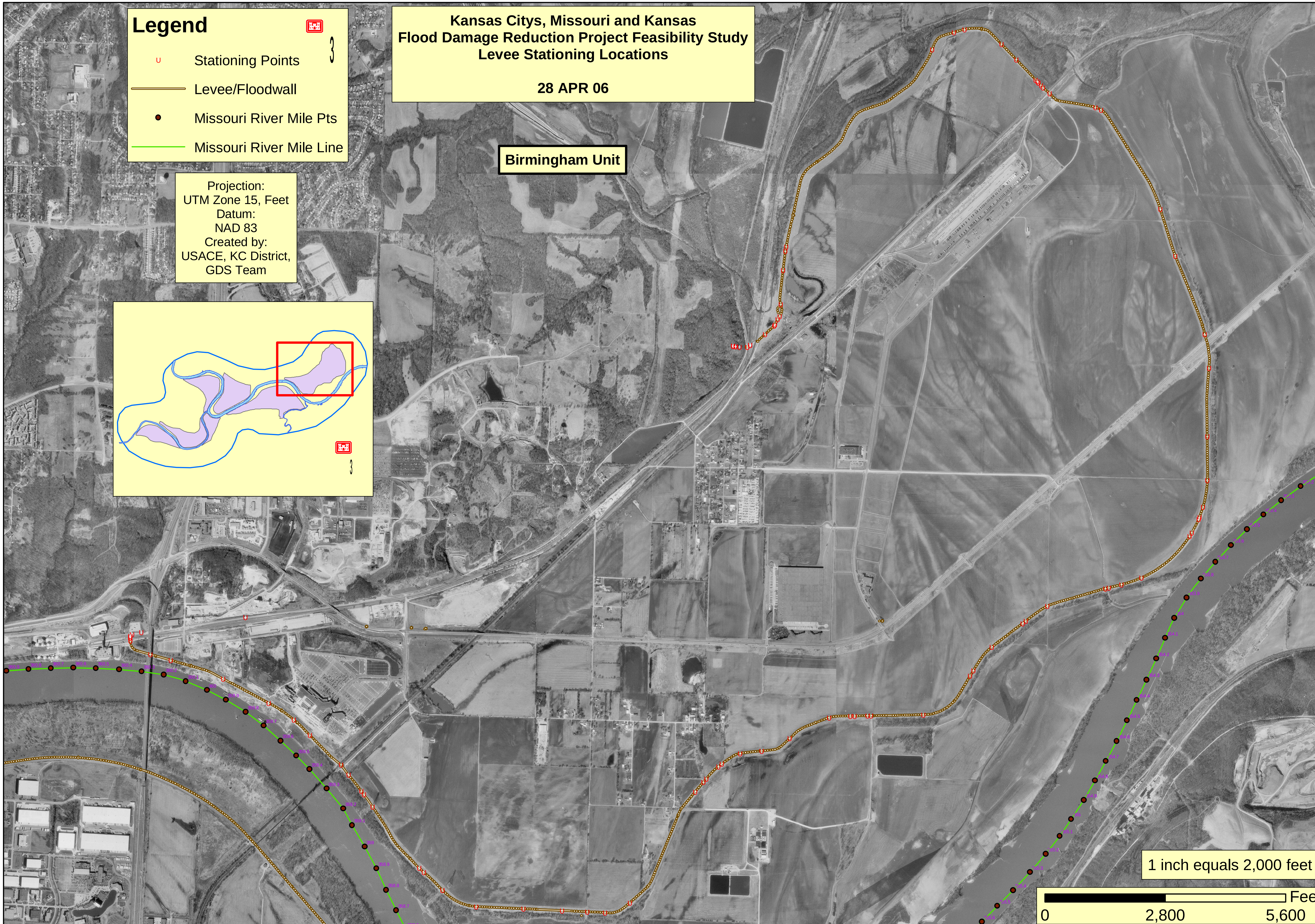
Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Armourdale Unit
Station -10+38 to 103+00
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
1 inch equals 800 feet
Feet
0
1,000
2,000


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Armourdale Unit
Station 99+63 to 260+84
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
1 inch equals 800 feet
Feet
0
1,000
2,000



Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Armourdale Unit
Station 256+71 to 61+00 LE
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 800 feet
Feet
0
1,000
2,000

EXHIBIT A-1.3
Birmingham Unit – Levee/Floodwall Features Inventory


Legend
Stationing Points
Levee/Floodwall
Missouri River Mile Pts
Missouri River Mile Line
Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Birmingham Unit
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 2,000 feet
Feet
0
2,800
5,600

Birmingham Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
-(24+32)	0+00	Cutoff Trench	5 to 10	N/A	To elevation 743
0+00	15+00	None	9 to 11	N/A	
15+00	40+00	None	6 to 12	N/A	
40+00	70+00	Long Berm from 52+25 to 65+15 (width = 0' to 400' variable) (Landside)	6 to 13	N/A	To elevation 739
70+00	92+50	None	6 to 12	N/A	
92+50	139+00	None	12 to 13	N/A	
139+00	145+50	Long Berm (max. width = 387') (Landside)	11	N/A	To elevation 734
145+50	176+00	None	10 to 12	N/A	
176+00	179+00	Long Berm (max. width = 244') (Landside)	11	N/A	To elevation 733.5 to 733.9; Field reconnaissance indicated that this seepage berm had been incorporated as part of the adjacent farm land.
179+00	180+00	Long Berm (max. width = 244' to 344') (Landside)	11	N/A	
180+00	184+00	Long Berm (max width = 344') (Landside)	13	N/A	To elevation 733.5 to 733.9; Field reconnaissance indicated that this seepage berm had been incorporated as part of the adjacent farm land.
184+00	185+00	Long Berm (max. width = 344' to 244') (Landside)	14	N/A	
185+00	190+00	Long Berm (max. width = 244') (Landside)	13	N/A	

* Information not found

Birmingham Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
190+00	202+50	None	14	N/A	The critical existing conditions section for the Birmingham Unit is located at approximately Station 200+00. Refer to the Geotechnical Chapter of this Appendix for more information.
202+50	218+00	Long Berm (max. width = 385') (Landside)	15	N/A	To elevation 732.6 to 732.2; Field reconnaissance indicated that this berm had been incorporated as part of farm land.
218+00	219+00	Long Berm (max. width = 385' to 245') (Landside)	14	N/A	
219+00	222+00	Long Berm (max. width = 245') (Landside)	13	N/A	
222+00	258+50	Cutoff Trench 256+00 to 257+50	13	N/A	To elevation 719
258+50	267+50	Long Berm (max. width = 295')	14 to 16	N/A	To elevation 728.7
267+50	297+50	Cutoff Trench 269+00 to 279+00	12	N/A	To elevation 719
297+50	312+50	Long Berm (max. width = 266')	15	N/A	To elevation 731.9
312+50	317+50	Long Berm (max. width = 266' to 35')	13	N/A	To elevation 731.9 to 728
317+50	380+00	None	10 to 13	N/A	
380+00	436+00	None	11 to 16	N/A	
436+00	460+00	None	14	N/A	
460+00	558+35	Seepage Berm 467+00 to 527+50 (width = 150')	17	N/A	To elevation 728

* Information not found

Birmingham Unit

LEVEES AND STABILITY BERMS					
Reach		Stability Berm		Analysis	Comments
Station	Station	Spring Point (ft.)	Width (ft.)		
LEVEES					
-24+30	0+00	N/A	N/A	N/A	
0+00	3+18	N/A	N/A	N/A	
3+86	71+00	N/A	N/A	N/A	
71+00	250+00	N/A	N/A	N/A	
250+00	558+35	N/A	N/A	N/A	
STABILITY BERMS					
28+00	52+25	7.5	30	N/A	Landside Stability Berm
52+25	65+16	5	50	N/A	Landside Stability Berm
94+00	109+00	8	20	N/A	Landside Stability Berm
109+00	120+00	9	50	N/A	Landside Stability Berm
129+00	139+00	7	50	N/A	Landside Stability Berm
213+00	235+00	8	50	N/A	Landside Stability Berm
251+50	258+50	8	30	N/A	Landside Stability Berm
258+50	268+50	8	83	N/A	Landside Stability Berm
268+50	289+50	8	30	N/A	Landside Stability Berm
289+50	297+50	9	30	N/A	Landside Stability Berm
297+50	313+50	9	30	N/A	Landside Stability Berm
313+50	317+00	9	50	N/A	Landside Stability Berm

* Information not found

Birmingham Unit

LEVEES AND STABILITY BERMS					
Reach		Stability Berm		Analysis	Comments
Station	Station	Spring Point (ft.)	Width (ft.)		
STABILITY BERMS					
317+00	336+50	9	35	N/A	Landside Stability Berm
336+50	352+50	7	35	N/A	Landside Stability Berm
352+50	360+50	8	35	N/A	Landside Stability Berm
360+50	418+50	9	25	N/A	Landside Stability Berm
418+50	431+50	9	45	N/A	Landside Stability Berm
431+50	435+50	11	40	N/A	Landside Stability Berm
435+50	442+50	13	20	N/A	Landside Stability Berm
442+50	447+50	12	20	N/A	Landside Stability Berm
447+50	457+50	11	20	N/A	Landside Stability Berm
457+50	467+00	9	30	N/A	Landside Stability Berm
467+00	527+50	15	150	N/A	Landside Stability Berm
528+50	541+00	8	25	N/A	Landside Stability Berm
533+00	541+00	9	6:1	N/A	Riverside Stability Berm
541+00	544+00	15	45	N/A	Landside Stability Berm
546+50	554+00	15	45	N/A	Landside Stability Berm

* Information not found

Birmingham Unit

FLOODWALLS

Reach		Wall Type	Foundation Type	Piles		Cutoff		Analysis	Comments
Station	Station			Type	Length (ft.)	Type	Length (ft.)		
544+76	546+19	Inverted T- Type	Spread	*	*	*	*	N/A	
555+53	557+90	Inverted T- Type	Spread	*	*	*	*	N/A	This floodwall connects the stoplog gap at Station 555+13 and the sandbag gap at Station 557+89. It was found during the field check.
558+05	558+50	Inverted T- Type	Spread	*	*	*	*	N/A	

*Information not found

Birmingham Unit

CLOSURE STRUCTURES								
Station (ft.)	Function	Type	Gap Height (ft.)	Width (ft.)	Foundation Type	Closure Materials	Analysis	Comments
3+41	Railroad	Sandbag	5.5	70	Spread (concrete sill)	Sandbags	N/A	
435+05	Railroad	Sandbag	4.1	78	Spread (1' wide, 3' deep concrete sill)	Sandbags	N/A	Impervious earth cutoff wall
555+27	Railroad	Stoplog	10.8	42	Spread	Stoplogs	N/A	Built with the floodwall associated with Northland Park
557+95	Railroad	Stoplog	12.5	20.5	Spread	Stoplogs	N/A	Built with the floodwall associated with Northland Park

*Information not found

Birmingham Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Auxiliary Birmingham Pump Plant / Approx. Sta. 433+50	***	Seepage flow Storm runoff	***	N/A	A. The pump plant was built and is owned by the Mormon Church of Jesus Christ of Latter Day Saints. They own the land to the north of the COE levee and had the plant built for added protection. B. The pump plant is only operated as a back-up to the original Birmingham Pump Plant and has a separate outlet to the Big Shoal Creek. C. The project team attempted to obtain more information on the pump plant design, but could not locate detailed information in a reasonable amount of time. As conditions in the area of the original Birmingham Pump Plant have not significantly changed since its construction, it is reasonable to say that conditions have not changed for the Auxiliary Birmingham Pump Plant.
Birmingham Pump Plant / Sta. 434+21	734.0	Seepage flow: The water is contributed from levee underseepage, which flows by nature of topography to the plant. Storm runoff: The flow is collected in a series of ditches running throughout the northeast and central portion of the drainage district.	4' x 4' RCB	N/A	A. The tributary area is served by a main ditch extending westward along the toe of the railroad fill, and numerous lateral ditches serving most of the Birmingham Levee District area. B. The peak runoff at the pump plant is limited by road crossings in the main ditch. However, there is no greater ponding than under gravity flow conditions at the Design River Stage. A ponding volume of 480 acre-ft with an area of 480 acres is present at stage 18.2 feet. A ponding volume of 1080 acre-ft with an area of 770 acres is present at stage 40.8 feet. C. The stationing of seepage along the levee could not be found. It is implied to occur generally throughout the surface runoff drainage area. Some areas have underseepage control berms, and others are adequate without them. D. Percent impervious was estimated from visual inspection of 1996 aerial photographs. The conditions of the area have not significantly changed since pump plant design. The majority of the land is agricultural.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
2A	Station Casino: The flow is contributed by the land owned by Station Casino, which is the easternmost portion of the drainage district.	47+07	250	108"	RCP	Upper Sluice Gate (LW), Lower Sluice Gate (LW), and Flap Gate (RW)	N/A	A. The conduit was constructed in the Fall of 1995 for the purpose of connecting the Riverboat Basin to the Missouri River, as well as for use in discharging storm drainage from the area. Portable pumps were used and can be used to pump river water to the Riverboat Basin when necessary. The use of the pipe for stormwater drainage is accomplished by gravity flow. B. Before Station Casino's existence, drainage from the area went eastward under Eldon Avenue. However, much of the water was stored in a wetlands area in the northeast part before it was discharged under the roadway. Inadequate culverts control the rate of flow under Eldon Avenue. The elevation of the disturbed area was raised during construction of the casino, and a large amount of the flow was diverted to the outfall pipe. The design of the pipe was based on not only the original development, but future impervious areas also. A portion of flow from the overall Station Casino land still goes under Eldon Avenu C. A design stage was not specifically used for the pipe; a 25-year, 24-hour storm was used for determining flows. D. The design of retention ponds was also based on future impervious areas. It was calculated that 66.9 acre-ft of storage would be required at Conduit Condition 2. One pond has a storage capacity of 34.9 acre-ft and the other (which is part of the wetlands) is 64.8 acre-ft. E. As mentioned above, the design of the pipe was based on future development of the Station Casino land. Currently, 43 acres has yet to be developed and is shown by information from the designers. The decreased percent impervious is a representation of this fact.
3	Southeastern Drainage: The flow is from open ditches in the southeastern portion of the Birmingham Drainage District.	288+70	58	4' x 4'	RCB	Sluice Gate (RW) and Flap Gate (RW)	N/A	A. The conduit was installed for removal of surface water runoff from the southeastern portion of the protected area, as well as some underseepage. An underseepage blanket exists in the area. Long-berm blanket material was placed from Sta. 258+50 to 267+50 and from Sta. 297+50 to Sta. 317+50. B. There is a 200 foot long 48" RCP leading to the gatewell from the main ditch. The 4' x 4' discharge conduit outlets to a ditch leading to the river. C. Ponded water above elevation 723.0 in the drainage area will tend to flow to the pumping plant at sta. 434+21. D. Percent impervious was estimated from visual inspection of 1996 aerial photographs. The conditions of the area have not significantly changed since conduit design. The majority of the land is agricultural.
4	Birmingham Pump Plant outfall: The flow is mostly from the bottoms area, with some contributing from the hillside.	434+21	58	4' x 4'	RCB	Sluice Gate (LW) and Flap Gate (LW)	N/A	A. The pump plant associated with this pipe replaced a structurally inadequate pump plant and pipe at Sta. 434+11. B. Of the total contributing drainage area, 206 acres is hillside. There was 750 undrained acres in the southeast portion of the drainage district which was not included in the analysis of the Sta. 434+21 conduit because it was planned to go to the outlet at Sta. 288+70. C. The conduit discharges into the Big Shoal Creek. D. Percent impervious was estimated from visual inspection of 1996 aerial photographs. The conditions of the area have not significantly changed since conduit design. The majority of the land is agricultural.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

STORM SEWERS

Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
7	Northern Hillside Drainage: The flow is mostly hillside area runoff, with some bottom area contributions.	556+72	36	6' x 5'	RCB	Sluice Gate (RW) and Flap Gate (RW)	N/A	A. The conduit replaced a structurally inadequate 6' x 5' RCB at the same location. B. The hillside drainage area is 480 acres out of the total 513 acres. C. The outfall box discharges to a ditch which conveys the stormwater to Big Shoal Creek. D. At stages above 28 feet, the design rainfall will produce negligible runoff from the area tributary to the outle E. The decrease in drainage area is a result of the Station Casino drainage system. The effect is probably not large because the previous water coming from this area was controlled by the lack of capacity in culverts under Eldon Avenue. F. If Eldon Avenue culverts are ever improved (which has been studied by the designers of the Station Casino drainage), more flow would reach the Northern Hillside Drainage conduit. G. Percent impervious was estimated from visual inspection of 1996 aerial photographs. The conditions of the area have not significantly changed since conduit design.

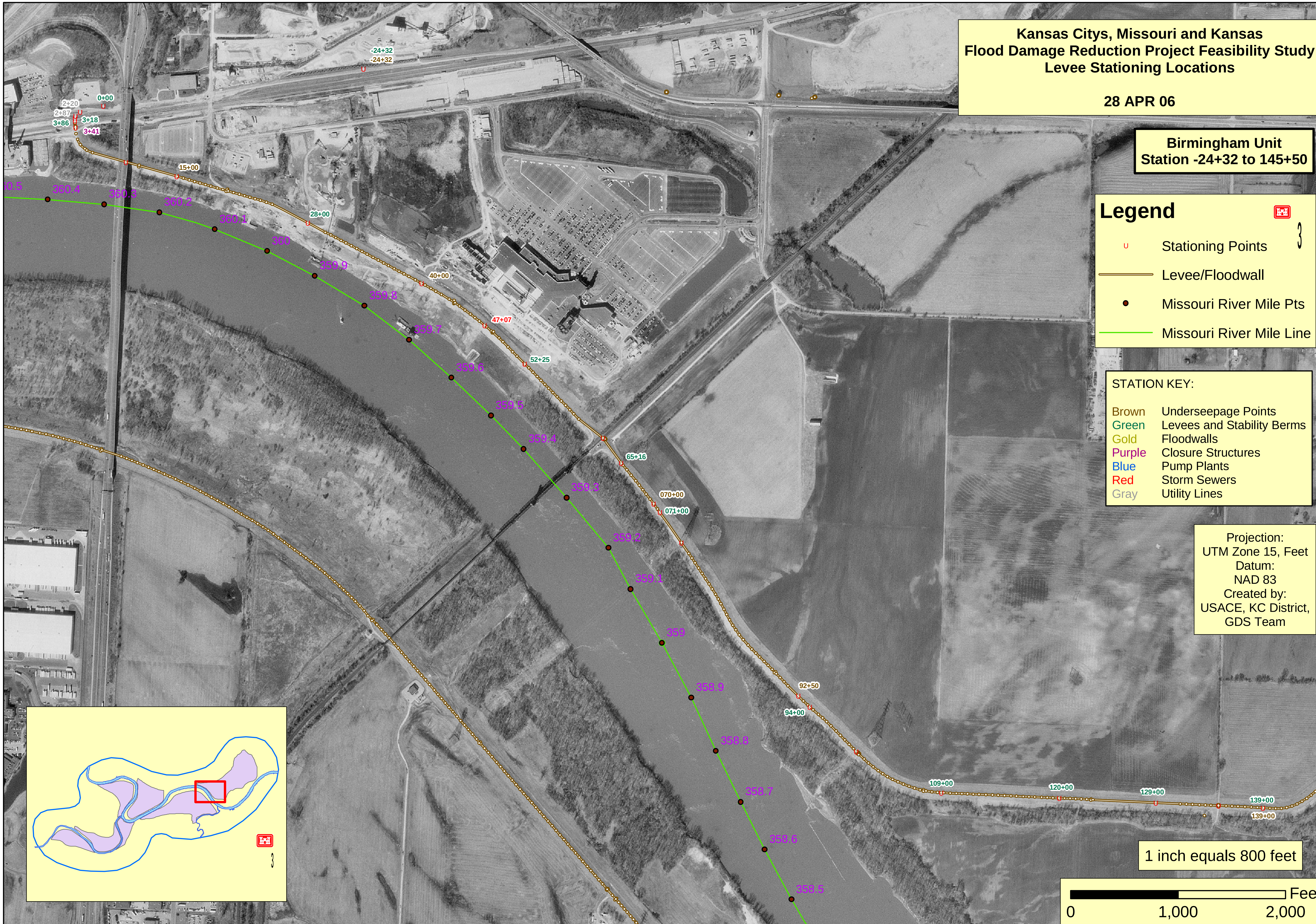
***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

Birmingham Unit

UTILITY LINES								
Station (ft.)	Function	Flow Type	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Analysis	Comments
2+20	Water Main	*	DIP	12"	*	Screw Type Valve	N/A	
2+87	Sanitary Sewer	Pressure	DIP	4"	*	*	N/A	Force Main
Approx. 195+00	KCMO Sewer	Gravity	*	*	*	Gatewell	N/A	Found during field visit

*Information not found



Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Birmingham Unit
Station -24+32 to 145+50
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile Pts
Missouri River Mile Line
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 800 feet
Feet
0
1,000
2,000
-24+32
-24+32
0+00
2+20
2+87
3+18
3+86
3+41
15+00
28+00
40+00
47+07
52+25
65+16
070+00
071+00
92+50
94+00
109+00
120+00
129+00
139+00
139+00
360.4
360.3
360.2
360.1
360
359.9
359.8
359.7
359.6
359.5
359.4
359.3
359.2
359.1
359
358.9
358.8
358.7
358.6
358.5

Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Birmingham Unit
Station 139+00 to 289+50
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
1 inch equals 800 feet
0 1,000 2,000 Feet
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile Pts
Missouri River Mile Line
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
139+00
145+50
176+00
180+00
184+00
185+00
190+00
195+00
202+50
213+00
218+00
219+00
222+00
235+00
250+00
251+50
258+50
267+50
268+50
288+70
289+50
354.7
354.8
354.9
355
355.1
355.2
355.3
355.4
355.5
355.6
355.7

Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Birmingham Unit
Station 288+70 to 380+00
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile Pts
Missouri River Mile Line
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 800 feet
Feet
0
1,100
2,200
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
380+00
360+50
352+50
336+50
317+50
317+00
313+50
312+50
297+50
297+50
288+70
289+50
352.9
353
353.1
353.2
353.3
353.4
353.5
353.6
353.7
353.8
353.9

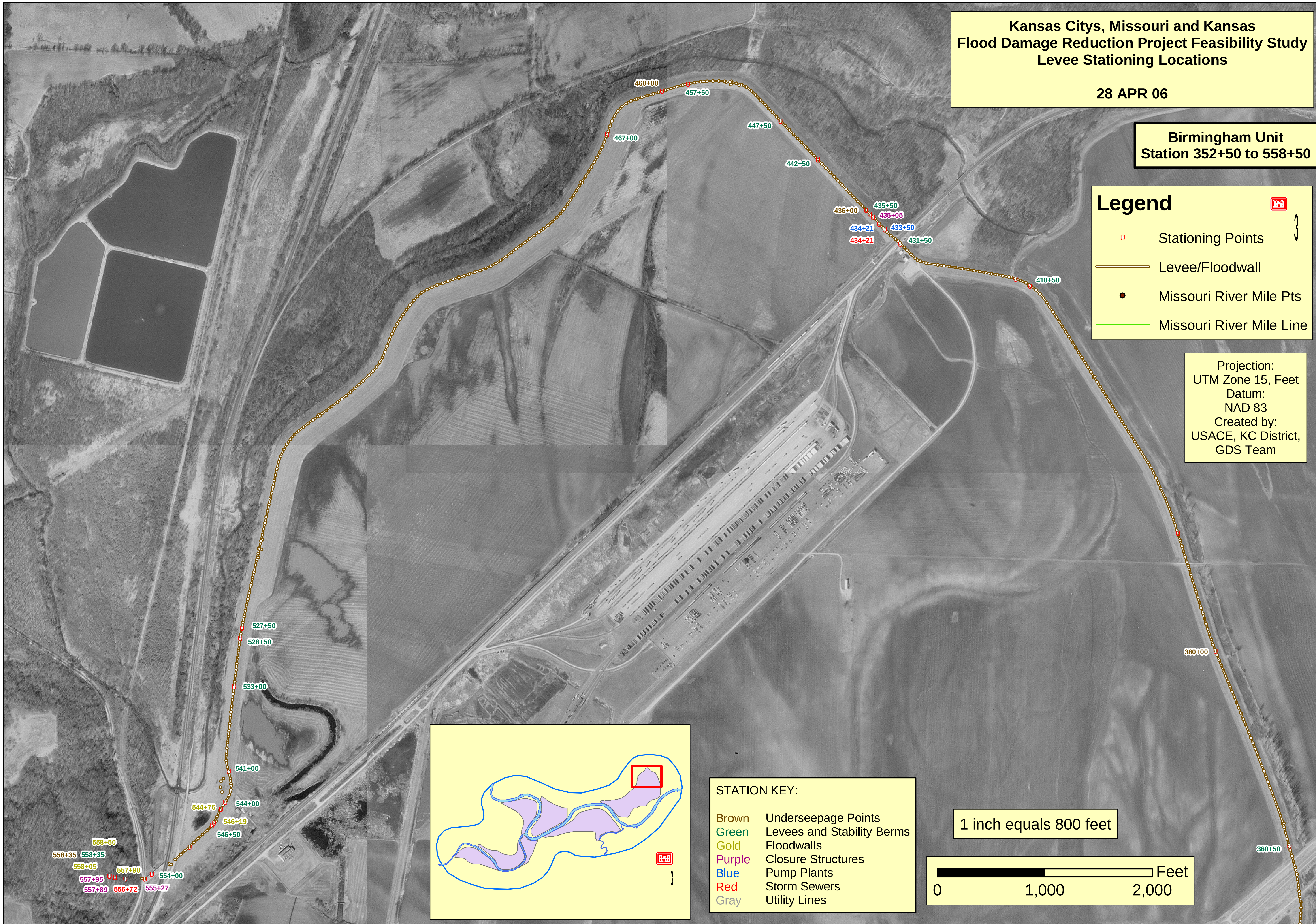
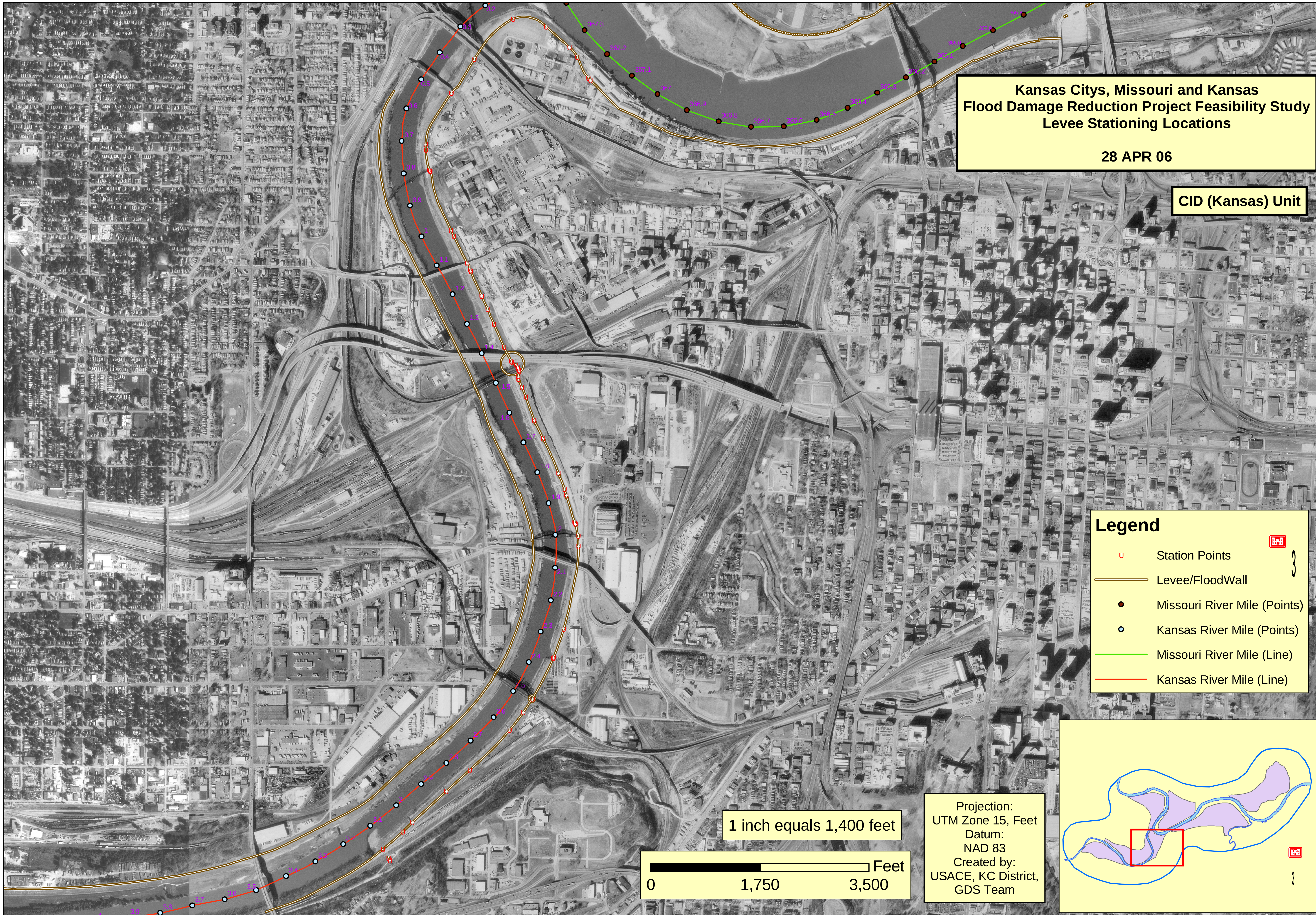

Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Birmingham Unit
Station 352+50 to 558+50
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile Pts
Missouri River Mile Line
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
1 inch equals 800 feet
Feet
0
1,000
2,000
460+00
457+50
447+50
467+00
442+50
436+00
435+50
435+05
434+21
433+50
434+21
431+50
418+50
380+00
360+50
352+50
527+50
528+50
533+00
541+00
544+00
544+76
546+19
546+50
558+50
558+35
558+35
558+05
557+90
557+95
557+89
556+72
555+27
554+00

EXHIBIT A-1.4
CID (Kansas) Unit – Levee/Floodwall Features Inventory


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
CID (Kansas) Unit
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
1 inch equals 1,400 feet
Feet
0
1,750
3,500
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team

CID (Kansas) Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
-6+36 (83+01 CID-MO)	5+00	Collector Pipe	10	To be determined in Phase 2	1180 feet of 15" corrugated metal collector pipe. Discharge manholes at 84+00 CID-MO and 0+12, inspection manhole at 5+03.75
5+00	26+70	None	2	To be determined in Phase 2	
26+70	40+50	Toe drain and concrete sheet piling along wall	5	To be determined in Phase 2	Sheet piling to approximate elevation 731.
40+50	65+00	None	5 to 12	To be determined in Phase 2	
65+00	79+30	Area fill in old railroad slot and relief wells plugged	18	To be determined in Phase 2	The critical section for seepage and slope stability for existing conditions (approximately Station 70+75) used a blanket thickness of 17.5 feet of silt or (ML) material. The CID-KS O&M Volume I discusses area fill on pg. 4-2, but fill is not shown on plan and profile sheets; The DM#4 for the Unit states on pg. 12 that fill to elevation 744.0 would be required to replace the existing and previously proposed new wells.
79+30	97+00	10 Relief Wells	20 to 13	To be determined in Phase 2	See attached chart for details and locations of wells.
97+00	103+00	None	3 to 5	To be determined in Phase 2	
103+00	148+00	Toe drain along wall	10	To be determined in Phase 2	
148+00	168+35	Toe drain along wall	10	To be determined in Phase 2	

* Information not found

CID (Kansas) Unit

Relief Well Details

Existing Relief Locations

Well Number	Station
8	79+30
9	80+50
10	81+80
11	83+30
12	85+70
13	87+75
14	89+80
15	92+00
16	94+35
17	97+00

Plugged Relief Well Locations

Well Number	Station
1	68+75
2	70+75
3	72+55
4	73+80
5	74+85
6	75+80
7	77+35

The 10 existing relief wells are variably spaced and penetrate the entire pervious foundation to bedrock based on the typical drawings from CID KS-2. The wells consist of lower and middle screened sections, surrounded by a gravel pack filter, as well as middle and upper riser sections. The screens are slotted fiberglass pipe and the riser sections are 12-inch fiberglass pipe with a cast-in-place rectangular manhole. A corrugated metal header pipe enters at the bottom of the manhole and the discharge from the relief well flows into the header pipe which then carries the flow to the Stockyards Pumping Plant #3

CID (Kansas) Unit

LEVEES			
Reach		Analysis	Comments
Station	Station		
-6+36 (83+01 CID-MO)	26+73	To be determined in Phase 2	Riverside berm located near top of levee
40+92	74+36	To be determined in Phase 2	
77+28	102+74	To be determined in Phase 2	

CID (Kansas) Unit

FLOODWALLS										
Reach		Wall Type	Foundation Type	Piles			Cutoff		Analysis	Comments
				Type	Length (ft.)					
Station	Station				Tension	Compression	Type	Length (ft.)		
26+73	40+31	Inverted T-type cantilever wall	Piles	Creosoted wood bearing piles on 4' centers	19'	32'	Concrete sheet pile	15'	To be determined in Phase 2	There was a relatively recent failure and subsequent repair of the floodwall at station 40+00. Future analysis requires type of timber, diameter, and length.
74+36	75+26	Inverted T-type cantilever wall	Piles	Concrete bearing piles on 5' centers	19'	34'	Concrete sheet pile	*	To be determined in Phase 2	
75+76	75+92	Earth bearing cantilever wall	Spread	NA	N/A	N/A	No	N/A	To be determined in Phase 2	
76+42	77+28	Inverted T-type cantilever wall	Piles	Concrete bearing piles on 5' centers	19'	34'	Concrete sheet pile	*	To be determined in Phase 2	
102+73	120+01	Inverted T-type cantilever wall	Piles	Timber	19'	34'	Concrete sheet pile	12'	To be determined in Phase 2	Future analysis requires type of timber, diameter, and length.
120+01	162+91	Inverted T-type cantilever wall	Piles	Timber	19'	34'	Concrete sheet pile	12'	To be determined in Phase 2	Future analysis requires type of timber, diameter, and length. Buttresses are every 8' on the landside.
162+91	166+25	Inverted T-type cantilever wall	Piles	Timber	19'	34'	Concrete sheet pile	12'	To be determined in Phase 2	Future analysis requires type of timber, diameter, and length.

* Information not found

CID (Kansas) Unit

CLOSURE STRUCTURES								
Station (ft.)	Function	Type	Gap Height (ft.)	Width (ft.)	Foundation Type	Closure Materials	Analysis	Comments
76+20	Railroad	Sandbag	3.8	29	Spread	Sandbags	To be determined in Phase 2	Union Pacific Railroad
132+19	Railroad	Stoplog	5.8	28.3	Concrete Abutment	Timber	To be determined in Phase 2	KC Terminal Railroad
168+00	Railroad	Stoplog	11.8	133.5	Spread	Timber	To be determined in Phase 2	Santa Fe Railroad Yards; 7 removable posts at the gap

CID (Kansas) Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Ohio Avenue Pump Station / Sta. -5+85 CID KS, 83+52 CID MO	758.0	(1) Seepage flow: The seepage is from the area between sta. 00+00 and approx. sta. 26+00, plus the seepage from approx. sta. 46+00 to approx. sta. 65+00. (2) Storm sewer system flow: The flow is contributed by the area just south and southwest of the junction of the Missouri and Kansas Rivers.	42" RCP	To be determined in Phase 2	A. Approximately half of the topography is very flat, with the remainder having moderate slopes. There is one small depression located near the state line available for surface storage. B. The outlet is located at mile 378.43 on the Missouri River. Critical stage is 22.0 feet (where the river begins to back up into the pipe), but the pumps are not started until 28.0 feet. C. As noted in the 1948 "Supplement on Interior Drainage", one of the stormwater pumps cannot be depended on for any discharge in the Design Flood Condition as the total dynamic head is in excess of the maximum head for which it is rated. D. The City of Kansas City, Kansas owns and operates the pump plant. They call it Flood Pump Station #1. The equipment listed for the plant includes the original pumps, although some rehabilitation work may have been done in recent years. E. Sanitary flow now goes to the treatment plant and is, therefore, not included here. There is a minor reduction with respect to total flow contributing to the plant as a result. F. Commercial development has contributed to a greater amount of impervious area within the service area. The greater impervious area would result in an increase in runoff fr G. The total flow reaching the plant remains the same in the Design River Condition because the sewer system capacity controls. E. Sanitary flow now goes to the treatment plant and is, therefore, not included here. There is a minor reduction with respect to total flow contributing to the plant as a result. F. Commercial development has contributed to a greater amount of impervious area within the service area. The estimated percent impervious is from visual inspection of 1996 aerial photography. The greater impervious area would result in an increase in runoff from the area. G. The total flow reaching the plant remains the same in the Design River Condition because the sewer system capacity controls.
Mistletoe Yards Pump Station / Sta. 37+09 CID KS	758.3	(1) Seepage flow: The seepage is from the area between approx. sta 26+00 and approx. sta. 46+00. (2) Storm runoff: The flow is contributed by the area immediately adjacent to the pump station.	18" CIP	To be determined in Phase 2	A. The ponding that would occur in the plant at the design flood stage should not be damaging. It should be about 17 minutes in duration and cover about .003 acre-feet. B. The plant is owned and operated by KAW Valley Drainage District. Larry Brennan, manager of the district, stated that the only time the Mistletoe Plant ever ran was in 1993. C. The only change with respect to plant design is that the sanitary flow has been diverted to the treatment plant. This will decrease the total flow draining to the pump plant. There have been no significant changes with regard to the stormwater contributing area of the pump plant. Estimated percent impervious was determined from visual inspection of 1996 aerial photography.
Central Avenue Pump Station / Sta. 58+12 CID KS	758.3	Storm sewer system flow	84" RCP	To be determined in Phase 2	A. The plant was built in 1987 and is owned and operated by Kansas City, Kansas. B. When the Kansas River stage is low enough to permit gravity flow, the Central Avenue Pump Plant is on standby. Water entering the stormwater collection system flows through the station inlet to the river by gravity. However, once the critical stage is reached, the gatewell sluice gate is closed and stormwater is pumped to the riverside of the gatewell sluice gate. This creates a high enough head in the wetwell to permit gravity flow to the river (going through the same outlet pipe as in the former gravity flow case). C. The City of Kansas City, Kansas calls this Flood Pump Station #16. D. The plant has a sump pump rated at 200 gpm for 19 feet of head. E. The pump plant was designed for certain flows at total dynamic head conditions. Therefore, the information missing from the table did not directly apply to the design and could not be found in a reasonable amount of time. However, it is not thought that the drainage area conditions have not changed in the past 15 years.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Kansas) Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Stockyards Pump Plant / Sta. 74+21 CID KS	758.4	(1) Seepage flow: The seepage is for the area between station 65+00 and station 82+00 coming through relief wells. (2) Storm runoff: This is drainage from the west side of the Central Industrial District (Kansas).	24" CIP	To be determined in Phase 2	A. It was found by the COE that excessive damage occurs from the extended duration of ponding caused by high seepage rates over long periods and not by ponding of short duration caused by storm runoff. The designed pumping capacity was based upon this finding. B. KAW Valley calls this pump plant the Stockyards Pump Plant (used to be called Stockyards #3 Pump Plant). C. The Stockyards Pump Plant used to take relief well seepage flow, along with storm drainage, from the stockyards area. The construction of the Gateway 2000 facility cut off some of that storm drainage area, so the overall flow to the plant has decreased. In addition, the sanitary flow was diverted to the treatment plant. The estimated percent impervious is from visual inspection of 1996 aerial photography. D. The pump capacities are noted because they were previously inadequate. It is not currently known if the decreased drainage area and runoff will be enough to nullify that inadequacy.
Gateway 2000 Pump Plant/ Sta. 80+90 CID KS	759.8	Storm sewer system flow: The flow is contributed by the Gateway 2000 property.	60" RCP	To be determined in Phase 2	A. The Gateway 2000 Pump Plant was constructed in 1994 to serve the area surrounding the Gateway 2000 facilities. B. The pump plant is located in Kansas and discharge through the CID Kansas Unit. However, a portion of the contributing service area is located in Missouri. C. The pump plant was designed to have certain pumping capacities at the given river stages. Therefore, the exact service area information was not obtainable in a reasonable amount of time. It was estimated from drainage area mapping provided by the designer of the plant. The estimated percent impervious shown in the table was determined by visual inspection of 1996 aerial photographs. However, the conditions of the approximate service area have not changed since the pump plant construction.
Field Pump House / Sta. 98+05 CID KS	758.5	Storm sewer system flow: This is drainage from the west side of the Central Industrial District (Kansas).	24" CIP	To be determined in Phase 2	A. The capacity of the pump is actually 4.23 cfs, but the lack of power from the motor brings that down to the 1.47 cfs. B. There is a total storage of 0.44 acre-feet required for ponding, with a maximum duration of 110 minutes. Part of this flow would drain to Valve No. 7. The ponding should not cause damage. C. The outlet for the pump plant is at Kansas River Mile 1.92. D. KAW Valley Drainage District calls this plant the Field Pump House (formerly called the Stockyards Pump House #1). Larry Brennan said that the pumps have not needed to run for over 20 years. E. Part of the drainage area contributing flow to the pump plant was cut off by Kemper Arena. The percent impervious estimated by visual inspection of 1996 aerial photographs shows no significant change, but the total flow from the smaller drainage area must be significantly less judging from the fact that it does not run very often. F. The pump is likely still inadequate.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Kansas) Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Kemper Arena Pump Plant / Sta. 106+49 CID KS	762.2	Storm runoff: The flow is from the Kemper Arena and American Royal area.	6' x 6' RCB	To be determined in Phase 2	A. The pump plant is located in Missouri, with almost all of the drainage area in Missouri also. However, the discharge eventually goes through the Central Industrial District levee unit in Kansas. B. A representative of the City of Kansas City, Missouri noted that the pump plant was built in 1975 and has never had more than two pumps running. There are a total of four pumps at the plant. C. The project team has been in contact with the designers in charge of runoff disposal from the new Butler Manufacturing building which will be constructed to the north of Kemper Arena. The runoff totals shown are preliminary estimates from the designers. Information is not readily available on the original design of the plant, but it is known that there are four vertical turbine pumps rated at 31,000 gpm each at 37 feet of head. There is a low river condition at which water is pumped to a point to be gravity discharged and a high river condition at the elevation noted. D. Current conditions are similar to design conditions for the Kemper Arena Pump Plant. However, the Butler Manufacturing building area may drain to the Kemper Pump Plant upon construction. The designers' preliminary estimate is an increase of 12.65 acres with a percent impervious of 87. The estimated percent impervious shown in the table for present conditions was determined by visual inspection of 1996 aerial photographs.
Twenty-Fifth and Fairmont Station - high level / approx. Sta. 125+00 CID KS	758.6	Storm runoff: This is flow from the southern part of the Central Industrial District. The high level station receives the runoff from the hillside area.	48"	To be determined in Phase 2	A. The entire drainage area is located on the bluff land overlooking the Kansas River. B. Pumping facilities are more than adequate. C. Each pump has a 30" discharge pipe going into an outlet chamber to a 48" pipe. The 25th and Fairmont Station empties into the OK Creek Sewer which, in turn, flows into the double 17' x 18' RCB Turkey Creek Sewer. All of the flow is then carried to the sewer outlet at mile 2.39 on the Kansas River. D. According to the City of Kansas City, Missouri, the pump plant was rehabilitated after the 1993 flood. The two pumps were pulled and rehabbed, new controls were added with automation, the motors were replaced, and some work was done on the sewer line just upstream of the station. E. The pump plant is located in Missouri, with most of the drainage area in Missouri also. However, the discharge eventually goes through the Central Industrial District levee unit in Kansas. F. The sanitary flow that used to contribute to the plant for pumping to the river is now diverted to the treatment plant. This causes a relatively minimal decrease in the total flow reaching the plant. G. The conditions of the service area for this pump plant have not gone through any significant changes since the design of the plant. The estimated percent impervious is from visual inspection of 1996 aerial photographs.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Kansas) Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Twenty-Fifth and Fairmont Station - low level / approx. Sta. 125+00 CID KS	758.6	Storm runoff: The flow is from the southern part of the Central Industrial District. The low level station receives runoff from the valley area.	48"	To be determined in Phase 2	A. The topography of the area is generally quite flat and contains 4 large shallow depressions available for storage, one of which is without a drainage outlet except by infiltration. B. Pumping facilities are more than adequate. C. Each pump has a 30" discharge pipe going into an outlet chamber to a 48" pipe. The 25th and Fairmont Station empties into the OK Creek Sewer which, in turn, flows into the double 17' x 18' RCB Turkey Creek Sewer. All of the flow is then carried to the sewer outlet at mile 2.39 on the Kansas River. D. According to the City of Kansas City, Missouri, the pump plant was rehabilitated after the 1993 flood. The two pumps were pulled and rehabbed, new controls were added with automation, the motors were replaced, and some work was done on the sewer line just upstream of the station. F. The sanitary flow that used to contribute to the plant for pumping to the river is now diverted to the treatment plant. This causes a relatively minimal decrease in the total flow reaching the plant. G. The service area for this pump plant has experienced some development since the time of design, which has increased the percent impervious. The estimated percent impervious reflecting this current condition is from visual inspection of 1996 aerial photographs. H. The pump plant service area used to receive flow from a portion of the Kemper Arena area. The storm drainage for this area now goes to the Kemper Arena Pump Plant and will, therefore, decrease the total runoff to the Twenty-Fifth and Fairmont Station. It is estimated that the decreased drainage area will outweigh the adverse effects of the increased percent impervious.
Southwest Boulevard Pumping Station / approx. Sta. 135+00 CID KS	758.8	Storm sewer system flow: The flow is from sewer systems in the southern part of the Central Industrial District to the east and west of Southwest Boulevard.	60"	To be determined in Phase 2	A. There is one large shallow depression located in the St. Louis and San Francisco Railroad right-of-way, which is capable of storing surface runoff with removal by infiltration through the cinder ballast. B. The pumps discharge into a chamber which, in turn, discharges through a short 60-inch pipe into a 12-foot 10-inch horseshoe sewer known as the Turkey Creek Sewer. The Turkey Creek Sewer empties into a double 17' x 18' box, where it is combined with the flow from the 25th and Fairmont Station (high and low level pumps) and the OK Creek pressure sewer. All of this flow is then carried to the sewer outlet at mile 2.39 on the Kansas River. C. Each storm pump has a 30" discharge pipe and the sanitary pump has a 10" discharge pipe. All three pipes go into the 60" pipe leading to the river. D. The plant was originally built in the 1920's, according to the City of Kansas City, Missouri. After the 1993 flood, the entire plant was rehabilitated. A new building was constructed, the motors were replaced, the motor and control floor was raised, controls were automated, and the pumps were rehabilitated. However, no pumps were added or replaced, so the capacities remained the same. E. The pump plant is located in Missouri, with most of the drainage area in Missouri also. However, the discharge eventually goes through the Central Industrial District levee unit in Kansas. F. The sanitary flow that used to contribute to the plant for pumping to the river is now diverted to the treatment plant. This causes a relatively minimal decrease in the total flow reaching the plant. G. The service area for the pump plant has become more developed since the time of design. The increased percent impervious, reflected in the table, was estimated from visual inspection of 1996 aerial photographs. As the pump capacities have never been increased, the pump capacities are even more inadequate.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Kansas) Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
1	Ohio Avenue Pump Plant outfall	-(5+85) (83+52 CID MO)	360	42"	RCP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The outlet is located at mile 378.43 on the Missouri River. B. As noted in the pump plant information, sanitary flow no longer contributes to the plant and the percent impervious has increased. However, the total flow reaching the plant remains the same in the Design River Condition because the sewer capacity controls.
3	Mistletoe Yards Pump Plant outfall	37+07	50	18"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The pipe serves as the outlet for a pump plant which drains the area immediately adjacent to the pump station. B. As noted in the pump plant information, the sanitary flow has been diverted to the treatment plant. No other significant changes have occurred.
4	S-G Metals Industries: The flow is coming from the property surrounding the industrial buildings in the immediate area.	50+98	92	10"	CIP	Gate Valve (LW) and Flap Gate (RW)	To be determined in Phase 2	A. There is an inlet for this pipe just upstream of the levee. B. No information was given pertaining to the drainage area of this gravity flow pipe. The missing information can be estimated if deemed necessary. There are no indications that significant changes have taken place in the surrounding area.
5	Area north of Central Avenue: The flow is contributed by the low area north of the Central Avenue Bridge.	52+07	91	10"	CIP	Gate Valve (LW) and Flap Gate (RW)	To be determined in Phase 2	A. There is an inlet for this pipe just upstream of the levee. B. No information was given pertaining to the drainage area of this gravity flow pipe. The missing information can be estimated if deemed necessary. There are no indications that significant changes have taken place in the surrounding area.
6	Area immediately north of Central Avenue: The flow is contributed by the area just north of the Central Avenue Bridge.	56+92	90	10"	CIP	Gate Valve (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The conduit is just on the north side of the Central Avenue Bridge. B. No information was given pertaining to the drainage area of this gravity flow pipe. The missing information can be estimated if deemed necessary. It is likely that this pipe does not receive much runoff presently because of the Central Avenue Pump Plant.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Kansas) Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
6A	Central Avenue Pump Plant outfall	58+35	***	84"	RCP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The conduit is just on the south side of the Central Avenue Bridge. B. The outfall is not on the Operational Drawing from July, 1980 that the team had in the original research. The KAW Valley Drainage District provided the team with an Operational Drawing set from July, 1980 that has this outlet drawn in at its location. C. As noted in the pump plant information, design data is limited. The length of the outlet pipe is estimated to be 170 feet from the KAW Valley operational drawings. However, it is not thought that the drainage area has changed in the past 15 years.
7	Concrete Plant: The flow drains from an area containing a concrete plant and related structures.	62+78	104	12"	CIP	Gate Valve (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The conduit drains the stockyards area south of the Central Avenue Bridge, which now contains a concrete plant. B. No information was given pertaining to the drainage area of this gravity flow pipe. The missing information can be estimated if deemed necessary. C. The existance of the concrete plant has increased the percent impervious, although no estimates can be made.
8	North Stockyards Conduit 1: The pipe drains the central portion of the north stockyards area.	67+65	107	18"	CIP	Gate Valve (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The conduit drains the stockyards area south of the Central Avenue Bridge and north of the Missouri Pacific Railroad Bridge. B. No information was given pertaining to the drainage area of this gravity flow pipe. The missing information can be estimated if deemed necessary. There are no indications that significant changes have taken place in the surrounding area.
9	North Stockyards Conduit 2: The pipe drains the southern portion of the north stockyards area.	71+70	107	18"	CIP	Gate Valve (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The conduit drains the stockyards area south of the Central Avenue Bridge and just north of the Missouri Pacific Railroad Bridge. B. No information was given pertaining to the drainage area of this gravity flow pipe. The missing information can be estimated if deemed necessary. There are no indications that significant changes have taken place in the surrounding area.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Kansas) Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
10	Stockyards Pump Plant outfall	74+22	115	24"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The outfall is just north of the Missouri Pacific Railway Bridge. B. As noted in the pump plant information, the sanitary flow no longer goes to the pump plant and the Gateway 2000 Pump Plant cut off some of the drainage area to the Stockyards Pump Plant (formerly called Stockyards #3 Pump Plant).
10A	I-670 stormwater drainage conduit	77+80	120	42"	RCP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	I-670 has a stand-alone stormwater drainage system and is conveyed through the floodwall. Conditions have not changed with respect to this drainage contribution and disposal.
11	Gateway 2000 Pump Plant outfall	80+90	120	60"	RCP	Sluice Gate (RW) and Flap Gate (RW)	To be determined in Phase 2	A. The Gateway 2000 Pump Plant outfall conduit replaced the Stockyards #2 Pump Plant outfall. B. The pump plant was designed to have certain pumping capacities at the given river stages. Therefore, the exact service area information was not obtainable in a reasonable amount of time. It was estimated from drainage area mapping provided by the designer of the plant. The estimated percent impervious was determined by visual inspection of 1996 aerial photographs. The contributing area to the conduit should not have changed since the design of the pipe.
12	South Stockyards Conduit 1: The pipe drains the central portion of the south stockyards area immediately adjacent to the levee.	84+90	121	18"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. There is an 18" VCP coming into the gatewell on the landside. B. No information was given pertaining to the drainage area of this gravity flow pipe. There are no indications that significant changes have taken place in the surrounding area.
13	South Stockyards Conduit 2: The pipe drains the south-central portion of the south stockyards area immediately adjacent to the levee.	88+19	143	24"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. There is a 24" VCP coming into the gatewell on the landside and two drop inlets upstream. B. No information was given pertaining to the drainage area of this gravity flow pipe. There are no indications that significant changes have taken place in the surrounding area.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Kansas) Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
14	South Stockyards Conduit 3: The pipe drains the southern portion of the south stockyards area immediately adjacent to the levee.	94+32	102	18"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. There is an 18" VCP coming into the gatewell on the landside and inlets just upstream. B. No information was given pertaining to the drainage area of this gravity flow pipe. There are no indications that significant changes have taken place in the surrounding area.
15	Field Pump House outfall	98+05	121	24"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. There is a 24" VCP coming into the gatewell on the landside. B. As noted in the pump plant information, part of the contributing flow was cut off by Kemper Arena Pump Plant. However, the pump is likely still inadequate.
16	American Royal Drive: The flow drains off of the road along the American Royal area.	102+52	115	12"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. There is a 12" VCP coming into the gatewell on the landside from American Royal Drive. B. No information was given pertaining to the drainage area of this gravity flow pipe. The drainage area has not changed, as it is a roadway.
17	Kemper Arena Pump Plant outfall	106+49	120	6'x6'	RCB	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The city of Kansas City, Missouri has very little information on the pump plant. The project team contacted the designers in charge of runoff disposal from the new Butler Manufacturing building which will be constructed to the north of Kemper Arena. The percent impervious shown is an estimate from the designers. B. As noted in the pump plant information, the Butler Manufacturing building area may drain to the Kemper Arena Pump Plant upon construction.
18	Turkey Creek sewer outlet	124+83	24	Double 17' x 18'	RCB	Sluice Gate (LW) and Flap Gates (RW)	To be determined in Phase 2	A. The 25th and Fairmont Pump Station, as well as the Southwest Boulevard Pump Station discharge into this pressure sewer. B. As noted in the pump plant information, sanitary flow has been diverted from contributing pump plants. However, impervious area has increased in the pump plant service areas which has created increased runoff.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Kansas) Unit

STORM SEWERS

Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
19	Railroad Yards Conduit 1: The flow is from the railroad tracks area immediately adjacent to the levee.	138+29	30	36"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The KAW Valley Drainage District indicated that the conduit drains the railroad tracks along the levee. B. No information was given pertaining to the drainage area of this gravity flow pipe. There are no indications that significant changes have taken place in the surrounding area.
20	Railroad Yards Conduit 2: The flow is from the railroad tracks area immediately adjacent to the levee.	152+28	19	24"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The KAW Valley Drainage District indicated that the conduit drains the railroad tracks along the levee. B. No information was given pertaining to the drainage area of this gravity flow pipe. There are no indications that significant changes have taken place in the surrounding area.
21	Railroad Yards Conduit 3: The flow is from the railroad tracks area immediately adjacent to the levee.	159+70	44	42"	CIP	Sluice Gate (LW) and Flap Gate (RW)	To be determined in Phase 2	A. The KAW Valley Drainage District indicated that the conduit drains the railroad tracks along the levee. B. No information was given pertaining to the drainage area of this gravity flow pipe. There are no indications that significant changes have taken place in the surrounding area.
22	Southern end of levee unit	167+95	***	10"	CIP	Sluice Gate (LW)	To be determined in Phase 2	A. The pipe discharges through the floodwall just on the east side of a stoplog gap. B. The KAW Valley Drainage District does not have any information on this pipe and considers it insignificant.

***Not found after reasonable search

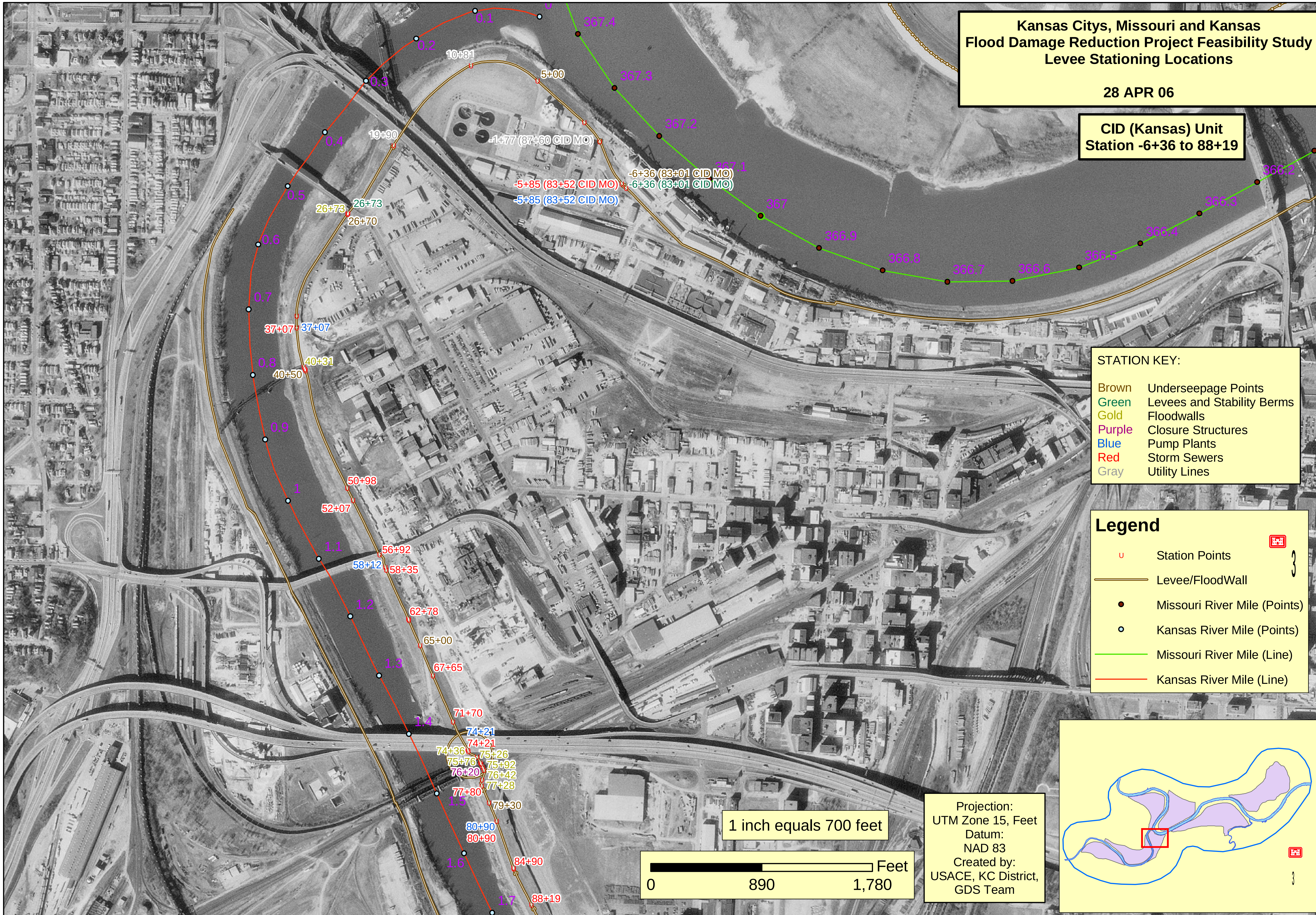
Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Kansas) Unit

UTILITY LINES

Station (ft.)	Function	Flow Type	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Analysis	Comments
-1+77 (87+60 CID MO)	Treated Effluent	Gravity	RCP	66"	220'	Sluice Gate	To be determined in Phase 2	Treatment Plant Outfall
10+81	Treatment Plant Water	Gravity	RCP	*	*	Sluice Gate	To be determined in Phase 2	Treatment Plant Diversion
19+85	Fiber Optic and Railroad Communication	N/A	RCP	3"	*	*	To be determined in Phase 2	on Lewis and Clark Viaduct
19+90	Sanitary Force Main	Pressure	RCP	66"	50'	Sluice Gate	To be determined in Phase 2	Sanitary sewer siphon consists of 2-36" CIP on R.S.
57+00	Water	*	*	12"	*	*	To be determined in Phase 2	on Central Avenue Bridge

* Information not found


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
CID (Kansas) Unit
Station -6+36 to 88+19
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
1 inch equals 700 feet
Feet
0
890
1,780
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
367.4
367.3
367.2
367.1
367
366.9
366.8
366.7
366.6
366.5
366.4
366.3
366.2
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
10+31
5+00
19+90
-1+77 (87+60 CID MO)
-6+36 (83+01 CID MO)
-5+85 (83+52 CID MO)
26+73
26+70
37+07
40+31
40+50
50+98
52+07
56+92
58+12
58+35
62+78
65+00
67+65
71+70
74+21
74+36
75+26
75+76
75+92
76+20
76+42
77+28
77+80
79+30
80+90
84+90
88+19

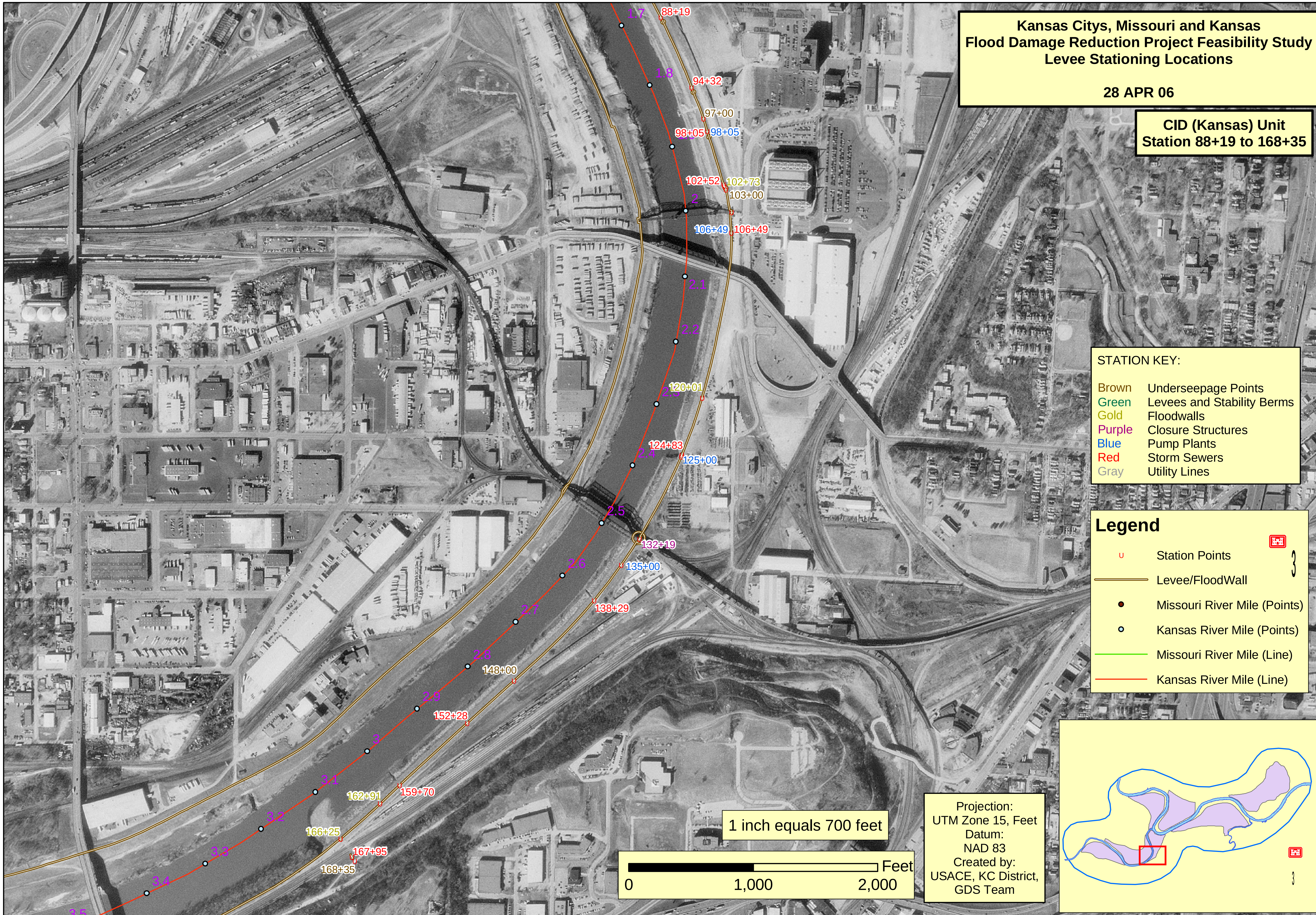
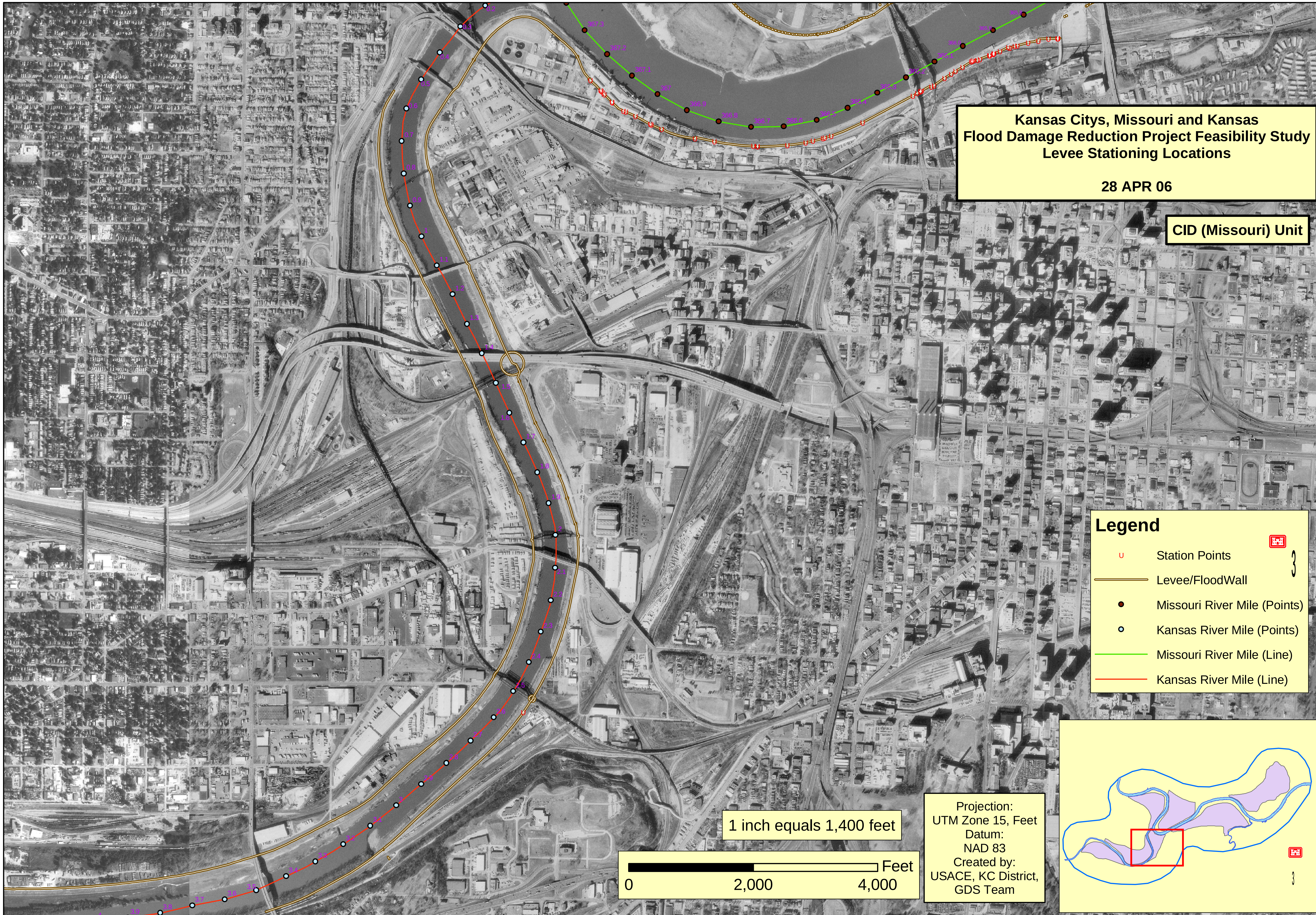

Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
CID (Kansas) Unit
Station 88+19 to 168+35
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 700 feet
Feet
0
1,000
2,000
1.7
88+19
1.8
94+32
97+00
98+05
98+05
102+52
102+73
103+00
2
106+49
106+49
2.1
2.2
120+01
124+83
2.4
125+00
2.5
132+19
135+00
2.6
138+29
2.7
2.8
148+00
2.9
152+28
3
3.1
162+91
159+70
3.2
166+25
167+95
168+35
3.3
3.4
3.5

EXHIBIT A-1.5
CID (Missouri) Unit – Levee/Floodwall Features Inventory


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
CID (Missouri) Unit
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
1 inch equals 1,400 feet
Feet
0
2,000
4,000
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team

CID (Missouri) Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
0+00	12+00	Toe drain along floodwall	5 to 13	N/A	Toe drains consist of 12" perforated, corrugated metal collector pipes
12+00	22+81	Toe drain along floodwall	14	N/A	Floodwall is set on bedrock
22+81	78+00	Toe drain along and concrete sheet piles under floodwall	8 to 11	N/A	The critical section for the CID-MO Unit is located at approximately Station 78+00. Sheet piles extend to approximately elevation 730; blanket thickness is from bottom of sheet pile to ground surface
78+00	83+01	Collector pipe along landside toe of levee	7 to 10	N/A	460 ft of 15" corregated metal collector pipe with inspection manhole at 78+00

CID (Missouri) Unit

LEVEES			
Reach		Analysis	Comments
Station	Station		
78+00	79+83	N/A	Flood wall extends 12' at beginning of levee
80+54	83+01	N/A	

CID (Missouri) Unit

FLOODWALLS									
Reach		Wall Type	Foundation Type	Piles		Cutoff		Analysis	Comments
Station	Station			Type	Length (ft.)	Type	Length (ft.)		
0+00	3+49	Cantilever wall	Spread (earth)	N/A	N/A	N/A	N/A	N/A	
3+49	7+04	Cantilever wall	Spread (earth)	N/A	N/A	N/A	N/A	N/A	
7+04	7+46	Cantilever wall	Spread (earth)	N/A	N/A	N/A	N/A	N/A	
7+46	8+30	Cantilever wall	Spread (earth)	N/A	N/A	N/A	N/A	N/A	
8+30	11+94	Cantilever wall	Spread (earth)	N/A	N/A	N/A	N/A	N/A	
11+94	13+62	Cantilever wall	Spread (rock)	N/A	N/A	N/A	N/A	N/A	
13+62	15+20	Cantilever wall	Spread (rock)	N/A	N/A	N/A	N/A	N/A	
15+20	16+88	Cantilever wall	Spread (rock)	N/A	N/A	N/A	N/A	N/A	
16+88	18+14	Cantilever wall	Spread (rock)	N/A	N/A	N/A	N/A	N/A	

CID (Missouri) Unit

FLOODWALLS									
Reach		Wall Type	Foundation Type	Piles		Cutoff		Analysis	Comments
Station	Station			Type	Length (ft.)	Type	Length (ft.)		
18+14	18+98	Cantilever wall	Spread (rock)	N/A	N/A	N/A	N/A	N/A	
18+98	20+24	Cantilever wall	Spread (rock)	N/A	N/A	N/A	N/A	N/A	
20+24	22+32	Cantilever wall	Spread (rock)	N/A	N/A	N/A	N/A	N/A	
22+81	24+55	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
24+55	25+39	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
25+39	26+23	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
26+23	42+19	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
42+19	43+87	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
43+87	48+07	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	

CID (Missouri) Unit

FLOODWALLS									
Reach		Wall Type	Foundation Type	Piles		Cutoff		Analysis	Comments
Station	Station			Type	Length (ft.)	Type	Length (ft.)		
48+07	53+53	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
53+53	59+83	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
59+83	73+62	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
73+62	75+30	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
75+30	75+72	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	
75+72	78+12	Cantilever wall	Piles	Concrete piles	20' min.	Steel sheet pile	15'	N/A	On top of levee for last 12'

CID (Missouri) Unit

CLOSURE STRUCTURES								
Station (ft.)	Function	Type	Gap Height (ft.)	Width (ft.)	Foundation Type	Closure Materials	Analysis	Comments
1+53	Vehicle	Sandbag	4.0	30	Spread	Sandbags	N/A	
5+24	Railroad	Stoplog	6.6	20	*	Timber	N/A	
8+68	Railroad	Stoplog	8.6	17.5	*	Timber	N/A	
14+80	Railroad	Stoplog	11.9	17.5	*	Timber	N/A	
63+15	Railroad	Stoplog	11.0	17.5	*	Timber	N/A	
68+90	Railroad	Stoplog	9.8	17.5	*	Timber	N/A	
70+71	Vehicle	Stoplog	9.1	30	*	Timber	N/A	
80+19	Vehicle	Stoplog	6.9	24	*	Timber	N/A	

* Information not found

CID (Missouri) Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Broadway Pumping Station / approx. Sta. 24+75 CID MO	756.3	(1) Seepage flow: The flow is from the seepage system between Sta. 22+82 and Sta. 0+00. (2) Storm runoff: The flow is contributed by the railroad yards area in the northeastern part of the Central Industrial District.	54" RCP	N/A	A. There is a floodwall at the pump plant location. B. The floodplain contains one small depression available for storage of surface runoff and seepage. The area which is protected by the floodwall is occupied by the Missouri Pacific Railroad yards and the Missouri Produce Company's railroad yards. C. Seepage begins at 29.5 and is, therefore, negligible at design river stage. D. The storm runoff is greater in design flood stage because there would be no infiltration over approximately one-half of the normally pervious area. E. The City of Kansas City, Missouri stated that the Broadway Pump Station drains the hillside area and the railroad tracks, so there is almost always flow going through the station. However, the only time that the pumps were needed was in 1993. The pumps are the original pumps. F. There were plans to rehabilitate the pump station a few years ago, but the work was cancelled. The City did note, though, that new flap gates were installed because they had already been ordered. The City does not know if the remainder of the plans will be carried out in the future. G. The conditions of the service area for this pump plant have not gone through any significant changes since the design of the plant. The estimated percent impervious is from visual inspection of 1996 aerial photographs.
Santa Fe Pump Station / 1200 Woodsweather Road (approx. Sta. 52+85 CID MO)	757.2	(1) Seepage flow: The flow is from the seepage system between Sta. 78+00 to Sta. 22+82. (2) Storm sewer system flow: The flow is contributed by a bottoms area and a high bluff area in the northern portion of the Central Industrial District.	10' RCP	N/A	A. There is a floodwall at this pump plant location. B. The Armour Packing Plant area has a pump plant that is adequate, but the sewer surcharges in the area where the flow would head to the Santa Fe Pump Plant. Therefore, the Armour Packing Plant area is considered undrained. C. In 1962, modifications were done to divert the sanitary flow to the West Side Sewage Treatment Plant. In doing so, the capacity of the stormwater side of the pump plant was decreased to that shown in the table. Two of the pumps which were used previously for stormwater pumping became dedicated to sanitary flow pumping. D. HNTB performed a study on the Santa Fe Pump Station in 1994, which was followed by some renovation of the plant in about 1995. Pumps were rehabilitated, but capacities were not increased. E. The drainage area determined for the 1994 HNTB report is slightly larger than that originally estimated by the COE. It was assumed in the report that the lesser area may have deducted non-contributing depressed areas that were present at the time. F. A small amount of additional development has taken place in the Santa Fe Pump Station service area which is reflected in the percent impervious. The estimated percent impervious was determined by visual inspection of 1996 aerial photographs. As the capacities of the pump station were not increased in 1994, the deficiencies still exist. G. The pumping capacity may or may not be adequate based on the impacts of the increased percent impervious.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Missouri) Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Gateway 2000 Pump Plant/ Sta. 80+90 CID KS	759.8	Storm sewer system flow: The flow is contributed by the Gateway 2000 property.	60" RCP	N/A	A. The Gateway 2000 Pump Plant was constructed in 1994 to serve the area surrounding the Gateway 2000 facilities. B. The pump plant is located in Kansas and discharge through the CID Kansas Unit. However, a portion of the contributing service area is located in Missouri. C. The pump plant was designed to have certain pumping capacities at the given river stages. Therefore, the exact service area information was not obtainable in a reasonable amount of time. It was estimated from drainage area mapping provided by the designer of the plant. The estimated percent impervious shown in the table was determined by visual inspection of 1996 aerial photographs. However, the conditions of the approximate service area have not changed since the pump plant construction.
Kemper Arena Pump Plant / Sta. 106+49 CID KS	762.2	Storm runoff: The flow is from the Kemper Arena and American Royal area.	6' x 6' RCB	N/A	A. The pump plant is located in Missouri, with almost all of the drainage area in Missouri also. However, the discharge eventually goes through the Central Industrial District levee unit in Kansas. B. A representative of the City of Kansas City, Missouri noted that the pump plant was built in 1975 and has never had more than two pumps running. There are a total of four pumps at the plant. C. The project team has been in contact with the designers in charge of runoff disposal from the new Butler Manufacturing building which will be constructed to the north of Kemper Arena. The runoff totals shown are preliminary estimates from the designers. Information is not readily available on the original design of the plant, but it is known that there are four vertical turbine pumps rated at 31,000 gpm each at 37 feet of head. There is a low river condition at which water is pumped to a point to be gravity discharged and a high river condition at the elevation noted. D. Current conditions are similar to design conditions for the Kemper Arena Pump Plant, with one exception. When the Butler Manufacturing building was constructed in the early 2000's, north of Kemper Arena, additional drainage was routed to the pump plant. A new 48" line from the site ties into the 6'x6' box between Kemper Arena and American Royal which feeds into the Kemper pump plant. With the exception of the Golden Ox parking lot, most of the area from Genessee Street and I-670 drains southward to the new pipe. An existing stormwater discharge pipe at the Livestock Exchange building was relocated around the new parking garage east of the Exchange building. The pipe was routed back to its original outlet location on the river. The project caused an approximate increase of flow to Kemper Pump Plant of 12.65 acres with a percent impervious of 87. The estimated percent impervious shown in the table for present conditions was determined by visual inspection of 1996 aerial photographs.
Twenty-Fifth and Fairmont Station - high level / approx. 125+00 CID KS	758.6	Storm runoff: This is flow from the southern part of the Central Industrial District. The high level station receives the runoff from the hillside area.	48"	N/A	A. The entire drainage area is located on the bluff land overlooking the Kansas River. B. Pumping facilities are more than adequate. C. Each pump has a 30" discharge pipe going into an outlet chamber to a 48" pipe. The 25th and Fairmont Station empties into the OK Creek Sewer which, in turn, flows into the double 17' x 18' RCB Turkey Creek Sewer. All of the flow is then carried to the sewer outlet at mile 2.39 on the Kansas River. D. According to the City of Kansas City, Missouri, the pump plant was rehabilitated after the 1993 flood. The two pumps were pulled and rehabbed, new controls were added with automation, the motors were replaced, and some work was done on the sewer line just upstream of the station. E. The pump plant is located in Missouri, with most of the drainage area in Missouri also. However, the discharge eventually goes through the Central Industrial District levee unit in Kansas. F. The sanitary flow that used to contribute to the plant for pumping to the river is now diverted to the treatment plant. This causes a relatively minimal decrease in the total flow reaching the plant. G. The conditions of the service area for this pump plant have not gone through any significant changes since the design of the plant. The estimated percent impervious is from visual inspection of 1996 aerial photographs.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Missouri) Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Twenty-Fifth and Fairmont Station - low level / approx. 125+00 CID KS	758.6	Storm runoff: The flow is from the southern part of the Central Industrial District. The low level station receives runoff from the valley area.	48"	N/A	A. The topography of the area is generally quite flat and contains 4 large shallow depressions available for storage, one of which is without a drainage outlet except by infiltration. B. Pumping facilities are more than adequate. C. Each pump has a 30" discharge pipe going into an outlet chamber to a 48" pipe. The 25th and Fairmont Station empties into the OK Creek Sewer which, in turn, flows into the double 17' x 18' RCB Turkey Creek Sewer. All of the flow is then carried to the sewer outlet at mile 2.39 on the Kansas River. D. According to the City of Kansas City, Missouri, the pump plant was rehabilitated after the 1993 flood. The two pumps were pulled and rehabbed, new controls were added with automation, the motors were replaced, and some work was done on the sewer line just upstream of the station. F. The sanitary flow that used to contribute to the plant for pumping to the river is now diverted to the treatment plant. This causes a relatively minimal decrease in the total flow reaching the plant. G. The service area for this pump plant has experienced some development since the time of design, which has increased the percent impervious. The estimated percent impervious reflecting this current condition is from visual inspection of 1996 aerial photographs. H. The pump plant service area used to receive flow from a portion of the Kemper Arena area. The storm drainage for this area now goes to the Kemper Arena Pump Plant and will, therefore, decrease the total runoff to the Twenty-Fifth and Fairmont Station. It is estimated that the decreased drainage area will outweigh the adverse effects of the increased percent impervious.
Southwest Boulevard Pumping Station / approx. Sta. 135+00 CID KS	758.8	Storm sewer system flow: The flow is from sewer systems in the southern part of the Central Industrial District to the east and west of Southwest Boulevard.	60"	N/A	A. There is one large shallow depression located in the St. Louis and San Francisco Railroad right-of-way, which is capable of storing surface runoff with removal by infiltration through the cinder ballast. B. The pumps discharge into a chamber which, in turn, discharges through a short 60-inch pipe into a 12-foot 10-inch horseshoe sewer known as the Turkey Creek Sewer. The Turkey Creek Sewer empties into a double 17' x 18' box, where it is combined with the flow from the 25th and Fairmont Station (high and low level pumps) and the OK Creek pressure sewer. All of this flow is then carried to the sewer outlet at mile 2.39 on the Kansas River. C. Each storm pump has a 30" discharge pipe and the sanitary pump has a 10" discharge pipe. All three pipes go into the 60" pipe leading to the river. D. The plant was originally built in the 1920's, according to the City of Kansas City, Missouri. After the 1993 flood, the entire plant was rehabilitated. A new building was constructed, the motors were replaced, the motor and control floor was raised, controls were automated, and the pumps were rehabilitated. However, no pumps were added or replaced, so the capacities remained the same. E. The pump plant is located in Missouri, with most of the drainage area in Missouri also. However, the discharge eventually goes through the Central Industrial District levee unit in Kansas. F. The sanitary flow that used to contribute to the plant for pumping to the river is now diverted to the treatment plant. This causes a relatively minimal decrease in the total flow reaching the plant. G. The service area for the pump plant has become more developed since the time of design. The increased percent impervious, reflected in the table, was estimated from visual inspection of 1996 aerial photographs. As the pump capacities have never been increased, the pump capacities are even more inadequate.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location. In reference to the stationing shown in the table, Sta. 89+37 CID MO (Central Industrial District Missouri) = Sta. 0+00 CID KS (Central Industrial District Kansas).

CID (Missouri) Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Description	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
1	Missouri Pacific Railroad: The flow is draining from the railroads immediately south of the outlet.	14+97	40	18"	CIP	Gate Valve (LW) and Flap Gate (RW)	N/A	A. The conduit drains the railroad area in the immediate vicinity. B. No information was given pertaining to the drainage area of this gravity flow pipe. There are no indications that significant changes have taken place in the surrounding area.
2	Toe Drain outlet: The flow is from a portion of the toe drain which runs the entire length of the floodwall.	14+99	40	12"	CMP	Gate Valve (LW) and Flap Gate (RW)	N/A	A. The pipe is used to discharge the toe drain for the floodwall. The maximum discharge given is 0.59 cfs. No other information is available on the design of the pipe. B. KAW Valley Drainage District did not recall any changes to the seepage system in the area.
3	Broadway Pump Plant outfall	24+77	50	54"	RCP	Sluice Gate (LW) and Flap Gate (RW)	N/A	A. The pipe is for the Broadway Pump Plant which discharges to a ditch leading to the river. B. As noted in the pump plant information, the conditions of the service area for the pump plant have not gone through any significant changes since the design of the plant.
4	Missouri Pacific Warehouses: The flow drains from the area now containing warehouses and railroad tracks.	41+89	115	12"	CIP	Gate Valve (LW) and Flap Gate (RW)	N/A	A. This used to be a private conduit draining the KC Hay Press Company area. There is a catch basin about 450 feet upstream of the CIP. The area now contains warehouses and railroad tracks for the Missouri Pacific Railroad. The percent impervious may have increased, but did not likely have a significant effect. B. No information was given pertaining to the drainage area or flow for this gravity flow pipe. The flow is decreased with respect to the fact that sanitary flow no longer drains through the pipe, but the benefit is likely minimal.
5	Santa Fe Pump Plant outfall	52+87	75	120"	RCP	Sluice Gate (LW) and Flap Gate (RW)	N/A	A. HNTB completed a study on this pump plant in 1994, which was followed by some renovation of the plant in about 1995. Pumps were rehabilitated, but capacities were not increased. B. The drainage area determined for the 1994 HNTB report is slightly larger than that originally estimated by the COE. It was assumed in the report that the lesser area may have deducted non-contributing depressed areas that were present at the time. C. As noted in the pump plant information, some additional development has taken place in the Santa Fe Pump Station service area. As the capacities of the pump station were not increased in 1994, the deficiencies still exist.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

CID (Missouri) Unit

UTILITY LINES

Station (ft.)	Function	Flow Type	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Analysis	Comments
0+04	Water Line	Pressure	CIP	6"	11.5	N/A	N/A	
0+09	Electric Line	N/A	RCB	1.5'x4.0'	11.5	N/A	N/A	
11+15	Water Line	Pressure	DIP	6"	18.5	N/A	N/A	
11+25	Electric Line	N/A	*	*	18.5	N/A	N/A	Western Union
11+30	Telephone Line	N/A	*	*	18.5	N/A	N/A	
14+01	Electric Line	N/A	RCB	1.5'x4.0'	25.6	N/A	N/A	
70+93	Effluent from Sewage Plant	Gravity	CIP	42"	13	Butterfly Valve	N/A	
80+72	Water Line	Pressure	CIP	8"	60	N/A	N/A	

* Information not found

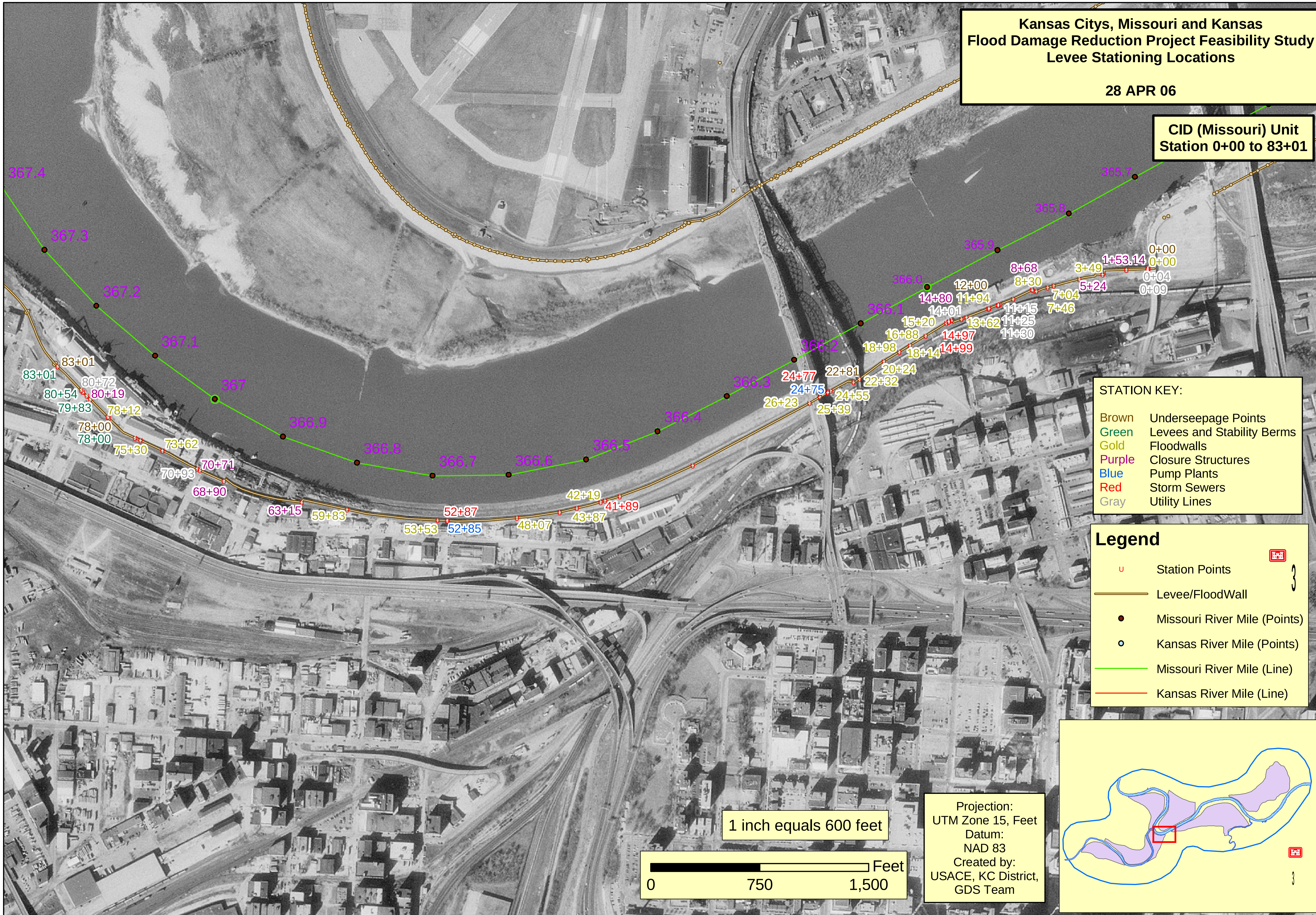
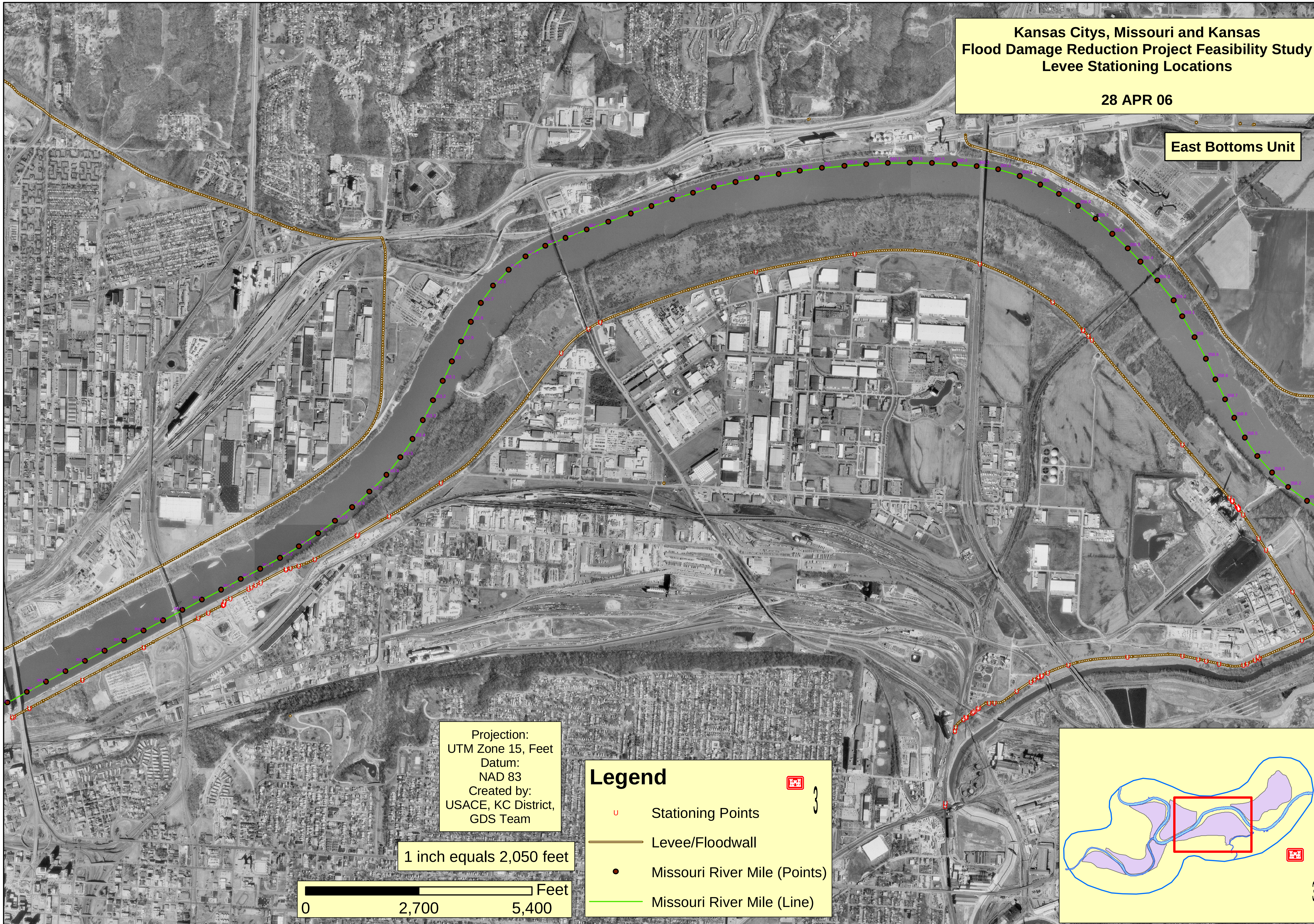

Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
CID (Missouri) Unit
Station 0+00 to 83+01
367.4
367.3
367.2
367.1
367
366.9
366.8
366.7
366.6
366.5
366.4
366.3
366.2
366.1
366.0
365.9
365.8
365.7
83+01
83+01
80+72
80+54
80+19
79+83
78+12
78+00
78+00
75+30
73+62
70+71
70+93
68+90
63+15
59+83
53+53
52+87
52+85
48+07
43+87
42+19
41+89
26+23
25+39
24+77
24+75
24+55
22+81
22+32
20+24
18+98
18+14
16+88
15+20
14+99
14+97
14+80
14+01
13+62
12+00
11+94
11+30
11+25
11+15
8+68
8+30
7+46
7+04
5+24
3+49
1+53.14
0+00
0+00
0+04
0+09
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Station Points
Levee/FloodWall
Missouri River Mile (Points)
Kansas River Mile (Points)
Missouri River Mile (Line)
Kansas River Mile (Line)
1 inch equals 600 feet
Feet
0 750 1,500
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team

EXHIBIT A-1.6
East Bottoms Unit – Levee/Floodwall Features Inventory



Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
East Bottoms Unit
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 2,050 feet
Feet
0
2,700
5,400
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
Missouri River Mile (Line)

East Bottoms Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
0+50	57+00	Levee; Buried collector	8	N/A	Abandoned; Landside backfilled to top of levee except at pump plants
57+00	74+50	Floodwall with excavated and backfilled cutoff trench	10	N/A	Cutoff trenches to elevation 738 until Sta. 64+50, then to elevation 740
74+50	93+65	Riverside impervious slope extended through top 5 to 10 feet of blanket to form cutoff	18	N/A	5 to 10 feet of sand overlying impervious blanket
93+65	117+00	Buried collector pipe	18	N/A	2 discharge and 4 access manholes, pipe size: 15" to 30" (Collector System No. 2).
117+00	160+00	None	18	N/A	
160+00	285+00	Buried collector pipe	18	N/A	21 discharge and 5 access manholes, pipe size: 15" to 30" (Collector System No. 3)
285+00	298+05	Buried collector pipe	18	N/A	Collector Pipe System abandoned due to landside landfill; No details of landside fill found.
298+05	347+96	28 relief wells	18	N/A	Replaced Collector Pipe System due to clogging; See attached chart for relief well details.
347+96	385+00	None	18	Refer to the Geotechnical Chapters of this Appendix	Transition from Missouri River protection to Blue River Protection; Cutoff trench recommended for 357+28 (EAST-9 PG.5) but not shown on any plans
385+00	404+00	None	17	Refer to the Geotechnical Chapters of this Appendix	The critical existing conditions section for the East Bottoms Unit is located at approximately Station 389+54. Bayer Corporation has three relief wells installed near Sta. 401+00, but no details were found.
404+00	410+85	Collector pipe	17	Refer to the Geotechnical Chapters of this Appendix	1 discharge and 1 access manhole
410+85	414+00	None	17	Refer to the Geotechnical Chapters of this Appendix	
414+00	433+00	Collector pipe	17	Refer to the Geotechnical Chapters of this Appendix	4 discharge and 1 access manhole
433+00	479+67	None	17	Refer to the Geotechnical Chapters of this Appendix	
479+67	501+00	None	*	N/A	Levee ties into RR embankment; no subsurface data found

* Information not found

East Bottoms Unit

Existing Relief Well Details

Well No.	*Station*
W-8	298+05
W-9	300+50
W-10	302+99
W-11	305+50
W-12	307+99
W-13	310+60
W-14	313+00
W-15	315+49
W-16	317+00
W-17	318+46
W-18	320+07
W-19	321+51
W-20	323+05
W-21	324+62

Well No.	*Station*
W-22	326+27
W-23	327+70
W-24	329+22
W-25	330+97
W-26	332+49
W-27	333+97
W-28	345+48
W-29	336+98
W-30	338+74
W-31	340+49
W-32	342+26
W-33	344+01
W-34	345+76
W-35	347+96

The 28 existing relief wells are variably spaced and penetrate the entire pervious foundation to bedrock based on Plate 19 of the Periodic General Inspection Report of March 1976. The wells consist of lower and middle screened sections, surrounded by a gravel pack filter, as well as middle and upper riser sections. The screens and risers are 12-inch diameter but a description of the material was not found. The typical section indicates that the seepage is discharged to the ground surface and not to a pumping plant.

East Bottoms Unit

LEVEES, STABILITY BERMS, AND RETAINING WALLS					
Reach		Stability Berm		Analysis	Comments
Station	Station	Spring Point (ft.)	Width (ft.)		
LEVEES					
0+00	57+ 26	N/A	N/A	N/A	
74+44	375+00	N/A	N/A	N/A	
375+00	479+67	N/A	N/A	N/A	
479+67	501+00	N/A	N/A	N/A	Railroad fill to levee elevation
STABILITY BERMS					
375+00	410+00	10	50	N/A	Landside Stability Berm
375+00	405+00	9	55	N/A	Riverside Stability Berm
416+00	454+00	9	55	N/A	Riverside Stability Berm
433+00	454+00	10	50	N/A	Landside Stability Berm
454+90	479+74	7	30	N/A	Riverside Stability Berm
		7	20	N/A	Landside Stability Berm
RETAINING WALLS					
19+00 / Gillis Pump Plant		N/A	N/A	N/A	Recent improvement
35+54 / Lydia Pump Plant		N/A	N/A	N/A	Recent improvement

East Bottoms Unit

FLOODWALLS									
Reach		Wall Type	Foundation Type	Piles		Cutoff		Analysis	Comments
Station	Station			Type	Length (ft.)	Type	Length (ft.)		
57+14	64+48	Inverted-T	Spread	None	N/A	N/A	N/A	N/A	Overlaps Levee
64+48	74+56	Inverted-T	Spread	None	N/A	N/A	N/A	N/A	
472+55	473+35	Inverted-T	Spread	None	N/A	N/A	N/A	N/A	Incorporates a stoplog closure structure at the Kansas City Terminal railroad
475+08	478+78	Inverted-T	Spread	None	N/A	N/A	N/A	N/A	Incorporates a stoplog closure structure at the Kansas City Southern railroad

East Bottoms Unit

CLOSURE STRUCTURES								
Station (ft.)	Function	Type	Gap Height (ft.)	Width (ft.)	Foundation Type	Closure Materials	Analysis	Comments
65+13	KCP&L Power Plant intake gates	Stoplog	5.2	12.0	Spread	11- 6" X 6" Timbers	N/A	Stoplogs are stored inside a floodwall compartment
472+98	KCT Railroad	Stoplog	3.8	33.3	Spread	12- Timbers	N/A	Concrete floodwall sections on either side of the closure
475+40	KCS Railroad	Stoplog	6.0	20.0	Spread	13- Timbers	N/A	Concrete floodwall sections on either side of the closure

East Bottoms Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Gillis Street Pump Station/ Sta. 19+00	755.2	(1) Storm Sewer System Flow: The flow is from an area that lies north of Tenth St. between Holmes and Charlotte St. (on the west) and Troost Ave. (on the east). (2) Seepage flow: The seepage is for the levee between station 0+50 and station 27+50.	72" RCP	N/A	A. This was a combined sewer system with a sanitary flow estimated at 2.7 cfs. However, separate pumps were designated for the sanitary flow and were therefore not considered in the contributing flows. B. The pumping plant revisions prescribed by the 1948 "Supplement on Interior Drainage" are the result of the need to handle the maximum combined seepage of both the Holmes and Gillis Street areas. Seepage will begin at stage 30.3 feet and is collected between levee stations 0+50 and 27+50. C. The pump station was designed to limit ponding to 0.25 inches, which is equal to the ponding that occurs unavoidably under gravity flow at a stage of 14.0 feet. D. A diversion chamber (at the entrance of the 42" sewer to the pumping plant) is gated so that flows may discharge through the 72" trunk sewer during non-flood periods, when the plant is not pumping. E. The laterals on First Street and the Produce Yard sewers are the only collection facilities in the area below the design flood elevation. F. At design flood stage of 40.8 feet, there are 17 more acres tributary to the pump plant due to the diversion of runoff from the Holmes Street sewer systems. G. The current design of the pump plant is the same as the original design. H. The toe drain system is now connected to the pump plant. Previously, the seepage would reach the plant by overland flow from collector system risers. I. The percent impervious was estimated by visual inspection of 1996 aerial photographs. The increase from original design is, in part, due to the Riverfront park area which covers an area a few hundred feet landward of the levee. Also, fill has been added in the drainage areas between approximately station 0+00 and 0+50. The elevations are generally higher and the pump plant is essentially in a depression. For these reasons, there could be a potential increase in flow rate to the pump plant. J. If the inadequate sewer capacities were ever improved, there is potential for a higher flow rate at the pump plant. K. The pumping capacity remains less than the incoming flow rate.
Lydia Avenue Pump Station/ Sta. 35+54	755.0	(1) Storm Sewer System Flow: The flow is from an area that lies north of Tenth Street between Troost Avenue(on the west) and Woodland Avenue(on the east). This area also encompasses the western portion of North Terrace Park. (2) Seepage flow: The seepage is for the levee between station 27+50 and station 57+00.	114" RCP	N/A	A. This was a combined sewer system with a sanitary flow estimated at 3.6 cfs. However, separate pumps are designated for the sanitary flow and were therefore not considered in the contributing flows. B. Of the 509 total acres serviced by the pump plant, 422 acres drain to the system leading to the plant. The other 87 acres goes to undrained depressions. A portion of the 87 acres of undrained area adjacent to the levee is now developed (Isle of Capri Casino) and, therefore, causes a potentially higher runoff rate. Also, the lowlands area north of the railroad tracks has experienced an increase in percent impervious. The estimated percent impervious is from visual inspection of 1996 aerial photographs. C. The pump station was designed to limit ponding to 0.12 inches, which is equal to the ponding that occurs unavoidably under gravity flow at stage 15.6 feet. D. A 30" CMP drainage system collects seepage between levee stations 27+50 and 57+00. Seepage begins at stage 30.8. E. Gates are located at the junction of an upstream 72" sewer and the 114" sewer that directly leads to the pump station. These gates control the flow. The flow will either gravity discharge through the 114" or be pumped through the 72" conduit. F. The current design of the pump plant is the same as the original design. G. An increase in percent impervious is noted above. In addition to those reasons mentioned, the increase from original design is, in part, due to the Riverfront park area which covers an area a few hundred feet landward of the levee. Also, fill has been added in the drainage areas between approximately station 0+00 and 0+50. The elevations are generally higher and the pump plant is essentially in a depression. For these reasons, there could be a potential increase in flow rate to the pump plant. I. If the inadequate sewer capacities were ever improved, there is potential for a higher flow rate at the pump plant. J. The pumping capacity remains less than the incoming flow rate.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

East Bottoms Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Isle of Capri (formerly Flamingo) Casino/ Approx. 53+00	***	Storm Sewer System Flow: The flow is contributed from the area surrounding the Casino land.	20"	N/A	A. Water in the detention pond, which houses the casino boat, is controlled by portable pumps. Water from the river is pumped to a certain elevation and then allowed to flow down the decorative "terraced drop" into the detention pond. B. A pressure relief system surrounding the detention pond discharges water by gravity to the river. C. Storm water is collected in the detention pond and pumped to the river when the level is too high by the permanent pump station. D. There are no known drainage problems in the casino area and the conditions have not changed since the time of construction.
Kansas City Power and Light Co. / Sta. 67+71	753.4	(1) Storm Sewer System Flow: The flow is from the area that is adjacent to the levee within the KCP&L Auxiliary Power Plant property. (2) Seepage flow: The seepage is from the area between station 57+00 and station 75+00.	24" CIP	N/A	A. Only 1.9 acres of the total 24.4 are drained to the river by the 24"pipe. The majority of KCP&L property drains to a large depression south of the power plant property where the water will be disposed of by evaporation and infiltration. B. The contributing sewer was designed to handle the normal plant drainage by gravity flow, from stages of 37.0 feet and below. Stages higher then 37.0 feet would require pumping for discharge to the River. C. The lowest basements within the power plant require pumping at all times. These basement pumps discharge into a closed system that eventually empties into the river through the 24" outfall. D. A seepage collector system was not considered necessary as stated in the 1948 "Supplement on Interior Drainage". Seepage in this area begins at stage 24.8 feet and reaches a maximum at stage 40.8 feet. The majority of the seepage will drain to the depression just south of the power plant. E. During the Design Flood Stage, seepage water will inundate the railroad spur supplying coal to the plant. Pumping to drain the railroad spur was not economically justified by the COE per the 1948 "Supplement on Interior Drainage". F. The manhole on the discharge tunnel needs to be sandbagged at stages greater then 39.1 feet. G. The area serviced by this pump plant has not undergone any significant changes since the time of the pump plant design. The percent impervious was estimated by visual inspection of 1996 aerial photographs.
National Distillers Products Corp./ Sta. 75+62	753.8	(1) Storm Sewer System Flow: The flow is from the area that is serviced by a lateral within the National Distillers property. (2) Industrial Flow: The flow is contributed from the National Distillers Products Corporation plant processes.	42" RCP	N/A	A. The drainage district personnel are not aware of this pump and it is not shown on the current O&M manual. However, a pump was described to service this area in the 1948 "Supplement on Interior Drainage". B. The contribution to the industrial flow is from various parts of the distillery plant processes and cannot be quantified to an area. C. The area serviced by this pump plant has not undergone any significant changes since the time of the pump plant design. The percent impervious was estimated by visual inspection of 1996 aerial photographs.
Prospect Pump Station/ Sta. 93+36	753.4	(1) Storm Sewer System Flow: The flow is from an area that lies north of Sixth Street encompassing the eastern portion of North Terrace Park, The General Mills property, and the lowlands north of the tracks between Park Avenue and Indiana Avenue. (2) Seepage flow The seepage is for the levee between station 75+00 and station 118+00.	84" RCP	N/A	A. This was a combined sewer system with a sanitary flow estimated at 4.3 cfs. However, separate pumps were designated for the sanitary flow and were therefore not considered in the contributing flows. B. Of the total drainage area, 332 acres is serviced by a sewer which flows to the outfall. The other 28 cfs flows to depressions and does not contribute to the outfall. C. The pump station was designed to limit ponding to 0.52 inches, which is equal to the ponding that occurs unavoidably under gravity flow at stage 14.0 feet. D. A small amount of runoff is collected between the levee and the Kansas City Southern tracks. This area acts as storage with a capacity of 5.9 acre-feet up to elevation 740.0 feet. Once the water in the storage area obtains an elevation of 740.0 feet, the drainage overflows across the tracks to an area serviced by sewers. E. At stage 40.8 feet, pumping capacity would be 52 cfs and ponding would be equivalent to 0.04 inches over the area. F. The current design of the pump plant is the same as the original design. G. The percent impervious was estimated by visual inspection of 1996 aerial photographs. The increase from original design is due to increased development in the lowlands area, although original ponding areas still exist. H. If the inadequate sewer capacities were ever improved, there is potential for a higher flow rate at the pump plant.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

East Bottoms Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Milwaukee Pump Station/ 172+00	751.5	(1) Storm runoff: The flow is from the northern part of the drainage district, on either side of the Chicago, Milwaukee, and St. Paul Railroad Bridge. (2) Seepage flow The seepage is for the area between station 118+00 and station 217+50 from a collection system.	Double 6' x 8' RCB	N/A	A. The contributing area drains runoff in undeveloped bottoms land noted as 0% impervious in the 1948 "Supplement on Interior Drainage". This land was anticipated to become a valuable industrial property. B. The pumping plant utilizes the borrow pit near the outlet for temporary ponding of runoff over an area of 12 acres. The borrow pit provides 31.9 acre-feet of storage. C. The required outlet capacity for gravity discharge at non-flood stages is a 60" conduit for 148 cfs. D. It was suggested by the 1948 "Supplement on Interior Drainage" that when area is to be ultimately developed, the city will need to construct a double 6'x8' box to permit gravity discharge of storm water, industrial wastewater and sanitary sewage . E. It was planned that the City would add another 29,500 gpm pump at a future time when development began. F. The current design of the pump plant is the same as the original design, but industrial development has taken place over the years. The estimated percent impervious is from visual inspection of 1996 aerial photography and would result in an increased runoff rate. G. The pump capacities were, and are still, apparently inadequate. The land near the pump plant that is used for temporary ponding of runoff now has buildings nearby. H. A strip of land about 60' wide (longitudinally from about the Milwaukee bridge to the Truman Bridge) off of the landward toe of the levee was used as a landfill and is now fenced off. The effect to the overall runoff is likely insignificant. I. The toe drain system is now connected to the pump plant. Previously, the seepage would reach the plant by overland flow from collector system risers.
Universal Ave. Pump Station / approx. 235+00	***	Storm sewer system flow: The flow will be from the area south of the landfill zone for the Executive Hills development.	***	N/A	The Universal Avenue Pump Plant (serves the Executive Hill area) was constructed in conjunction with current and future development. It is estimated that the drainage area is bordered on the north by the landfill zone and on the south by the railroad yards. Design details were not gathered for this study.
Truman Pump Station/ 295+00	746.5	Seepage flow: The seepage is from the area between station 217+50 and station 297+50 from a collection system.	52" RCP	N/A	A. The pump plant is for seepage which is collected in a system provided with discharge manholes in the area. B. Flow from discharge manholes in the collector system would have gone to the storage area for the Milwaukee Pump Station, which was not desirable. Therefore, the Truman Pump Station was built. C. The levee collector system from sta. 285+00 to sta. 297+00 was abandoned due to a landside landfill. The effect of this change is likely a relatively minor impact.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

East Bottoms Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Hawthorne Pump Station/ 401+00	744.5	Storm runoff: The flow is contributed by land in the eastern part of the drainage district. Seepage flow: The seepage is from the area between station 297+50 and station 479+66 from a collection system.	Double 6' x 8' RCB	N/A	A. The contributing area drained runoff in agricultural bottoms land noted as 0% impervious in the 1948 "Supplement on Interior Drainage". This land was anticipated to become a valuable industrial property. Development did occur in the service area of the Hawthorne Pump Plant, which is indicated in the current percent impervious. The Hawthorne Power Plant and the Bayer facilities are the major industrialization components. The percent impervious was estimated from visual inspection of 1996 aerial photographs and should cause higher runoff rates. B. As mentioned, the City anticipated widespread commercial and industrial development upon completion of the protection works. City officials agreed with landowners to provide temporary ponding area to minimize the size of the pumping plant. If development did eventually occur, the City would provide additional pumping capacity. The specifics of this agreement are not known, but the pumping capacity of the plant remains the same. C. Utilizing ponding available up to elevation 729.6 in the low areas in the vicinity of the pumping plant, an area of 213 acres would be inundated at the design flood stage. This would give 245 acre-feet of storage, reducing the required pumping capacity to 101 cfs. Construction of the Bayer Company facilities in the area near the pumping plant have encroached upon the temporary ponding storage area. D. There was a toe drain levee collector system installed since the original design of the plant. However, the levee collector system was abandoned and replaced with a system of 28 pressure relief wells between sta. 297+00 and sta. 346+00 in more recent years. The overall effect on seepage flows should be insignificant. F. The pumping capacities are currently inadequate for the Design Flood Stage, and possibly for the Design River Stage.
Blue Banks Pump Station/ 452+50	***	See Comment A.	42" RCP	N/A	A. According to the Kansas City Pollution Control Department (KCPCD), the Blue Banks Pump Station is rarely used. There is an interceptor sewer for transporting dry-weather (sanitary) flow from the combined sewers in the western portion of the Drainage District that leads to the Blue River Treatment Plant. In the unlikely case that a high river stage and high intensity rainfall event cause combined flow to travel through the interceptor sewer, the Blue Banks Pump Plant is used to dispose of the excess interceptor flow. B. A small area in the immediate vicinity of the Blue Banks Pump Plant contributes stormwater which will be discharged by gravity the majority of the time. C. The plant contains 2 pumps rated at 2,500 gpm each and 1 pump rated at 5,000 gpm. D. The current operations of the Gillis Street, Lydia Avenue, and Prospect Avenue Pump Stations could potentially impact the Blue Banks Pump Station because of their shared interceptor sewer.

***Not found after reasonable search

Notes: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

East Bottoms Unit

STORM SEWERS

Structure ID	Description	Location		Structure Information			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW - riverward		
1	Holmes Street Sewer System: The system is in the western most part of the East Bottoms Drainage District. Its drainage area is located north of 10th Street and between Oak Street (on the west) and Charlotte and Holmes Streets (on the east).	4+66	130	52"	RCP	Flap Gate (RW) and Sluice Gate (LW)	N/A	A. All inlets to the system are above the design flood elevation of 755.2 feet, except those on the lateral serving what was once the Missouri Produce Yards entering manhole #1 and the lateral on 1st Street entering manhole 2-A (see 1948 "Supplement on Interior Drainage", plate 13). B. The Produce Yard laterals connected to the inlets below the design flood elevation are valved off when the river reaches a stage of 34.4 feet to prevent backflow. The rainfall that is collected in the valved-off area will pond and overland flow to the Gillis Pump Station. The valves on the Produce Yard laterals are located at the junction with the Holmes Street trunk sewer. C. The sewer servicing the area above the design flood elevation becomes a pressure sewer at stage 34.4 feet and discharges directly to the river. D. Seepage in this area is collected by a 30" header well system and drains to the Gillis Pump Station. E. The sanitary flow to the sewer system is estimated to be a constant 1.4 cfs. F. The conditions of the contributing drainage area have not changed significantly since the design of the conduit.
2	Gillis Street Pump Station Outfall	19+00	135	72"	RCP	Upper Sluice Gate (LW) and Lower Sluice Gate (RW)	N/A	A. The seepage of the combined Holmes Street and Gillis Street areas will begin at stage 30.3 feet. Seepage flow is collected between levee stations 0+50 and 27+50 and drained to the main pump suction chamber. B. It is shown in the 1948 "Supplement on Interior Drainage" that the tributary area lies north of Tenth Street between Holmes and Charlotte Street (on the west) and Troost Avenue (on the east). C. The laterals on First Street and the Produce Yard sewers are the only collection facilities in the area below the design flood elevation. D. At the design flood stage of 40.8 feet, there are 17 more acres tributary to the pump plant due to the diversion of runoff from the Holmes Street sewer systems. E. At a stage of 13.8 feet, the greatest flow rate will contribute to the pipe as it flows by gravity. For that stage, there will be a total runoff of 851 cfs and a rate at the pipe inlet of 384 cfs. The excess water will cause an average of 0.25 inches of ponding throughout the drainage area. F. The percent impervious was estimated by visual inspection of 1996 aerial photographs. The increase from original design is, in part, due to the Riverfront park area which covers an area a few hundred feet landward of the levee. Also, fill has been added in the drainage areas between approximately station 0+00 and 0+50. The elevations are generally higher and the pump plant is essentially in a depression. For these reasons, there could be a potential increase in flow rate to the pump plant.
3	Lydia Avenue Pump Station Outfall	35+54	130	114"	RCP	3 Upper Sluice Gates (LW) and 1 Lower Sluice gate (RW)	N/A	A. This sewer system includes three main laterals with the Dora Avenue branch discharging into a 48" brick sewer. The brick sewer also collects all of the runoff tributary to a ravine extending southeastward through North Terrace Park. B. The 48" outlet for Dora Avenue and Lexington Avenue are brought together at Guinotte Avenue and Vine Street and connected by a single outlet to the 114" main trunk sewer (see 1948 "Supplement on Interior Drainage", plate 21). C. A long lateral in Guinotte Avenue collects runoff between Garfield and Alton Avenue. This lateral is of considerable significance in the system because all of the street intersections drained by this lateral are at the same elevation (742.3 feet.), which is well below the design flood elevation. D. At stage 26.0 feet, discharge from the sewer system begins to be impaired by the surcharge from the river. E. A collector system drains seepage that starts at a stage of 30.8 ft. F. At a stage of 15.6 feet, the greatest flow rate will contribute to the pipe as it flows by gravity. For that stage, there will be a total runoff of 1285 cfs and a rate at the pipe inlet of 813 cfs. The excess water will cause an average of 0.12 inches of ponding throughout the drainage area. G. A portion of the 87 acres of undrained area adjacent to the levee is now developed (Isle of Capri Casino) and, therefore, causes a potentially higher runoff rate. Also, the lowlands area north of the railroad tracks has experienced an increase in percent impervious. The estimated percent impervious is from visual inspection of 1996 aerial photographs. In addition to those reasons mentioned, the increase from original design is, in part, due to the Riverfront park area which covers an are a few hundred feet landlord of the levee. Also, fill has been added in the drainage areas between approximately station 0+00 and 0+50. The elevations are generally higher and the pump plant is essentially in a depression. For these reasons, there could be a potential increase in flow rate to the pump plant.

***Not found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

STORM SEWERS

Structure ID	Description	Location		Structure Information			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW - riverward		
3A	Isle of Capri (formerly Flamingo) Casino Area Outfall	50+30	***	20"	***	***	N/A	A. Water in the detention pond, which houses the casino boat, is controlled by portable pumps. Water from the river is pumped to a certain elevation and the allowed to flow down the decorative "terraced drop" into the detention pond. B. A pressure relief system surrounding the detention pond discharges water by gravity to the river. C. Storm water is collected in the detention pond and pumped to the river when the level is too high by the permanent pump station. D. There are no known drainage problems in the casino area and the conditions have not changed since the time of construction.
4	Kansas City Power & Light Company Pump Plant Outfall	67+71	57	24"	CIP	Sluice Gate (LW) and Flap Gate (RW)	N/A	A. Only 1.9 acres of the total 24.4 are drained to the river by the 24"pipe. The majority of KCP&L property drains to a large depression south of the power plant property where the water will be disposed of by evaporation and infiltration. B. The contributing sewer was designed to handle the normal plant drainage by gravity flow, from stages of 37.0 feet and below. Stages higher then 37.0 feet would require pumping for discharge to the River. C. The lowest basements within the power plant require pumping at all times. These basement pumps discharge into a closed system that eventually empties into the river through the 24" outfall. D. A seepage collector system was not considered necessary as stated in the 1948 "Supplement on Interior Drainage". Seepage in this area begins at stage 24.8 feet and reaches a maximum at stage 40.8 feet. The majority of the seepage will drain to the depression just south of the power plant. E. During the Design Flood Stage, seepage water will inundate the railroad spur supplying coal to the plant. Pumping to drain the railroad spur was not economically justified by the COE per the 1948 "Supplement on Interior Drainage". F. The manhole on the discharge tunnel needs to be sandbagged at stages greater then 39.1 feet. G. The area serviced by this conduit has not undergone any significant changes since the time of design.
5	National Distillers Products Corporation Pump Plant Outfall	75+62	89.1	42"	RCP with VCP liner	Sluice Gate (LW) and Flap Gate (RW)	N/A	A. The drainage district personnel are not aware of the pump that discharges to this outfall. The pump is not shown on the current O&M manual. However, a pump was described to service this area in the 1948 "Supplement on Interior Drainage". B. The area that services the outfall has not undergone any significant changes since design.
6	Prospect Avenue Pump Station Outfall	93+36	78	84"	RCP	2 Sluice Gates (LW)	N/A	A. Seepage in this area begins at a stage of 22.8 feet and is drained by a collector system between stations 75+00 and 118+00. Seepage enters the pump house suction chamber through a 36" corrugated metal pipe. B. Runoff south of Lexington Avenue is collected by a separate 24" storm sewer that discharges into the lake in North Terrace Park (this lake ultimately drains to the 60" sewer). C. The General Mills, Inc. property is drained by sewers to a sump in the northeast corner of the property where a pump receives water through an 8" pipe and discharges into the 60" trunk. D. The General Mills plant was not considered in determining maximum flows to the Prospect Avenue sewer because the runoff from the General Mills plant was pumped at relatively low rates. E. The lowest point is at MH 670 (see 1948 "Supplement on Interior Drainage", plate 28 and 29) on the proposed sewer system where the street grade elevation is at stage 22.9 feet. F. At a stage of 14.0 feet, the greatest flow rate will contribute to the pipe as it flows by gravity. For that stage, there will be a total runoff of 896 cfs and a rate at the pipe inlet of 270 cfs. The excess water will cause an average of 0.52 inches of ponding throughout the drainage area. G. The percent impervious was estimated by visual inspection of 1996 aerial photographs. The increase from original design is due to increased development in the lowlands area, although original ponding areas still exist.

***Not found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

STORM SEWERS

Structure ID	Description	Location		Structure Information			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW - riverward		
7	Water Department Sewer Outlet	102+27	92.5	24"	CIP	Sluice Gate (LW) and Flap Gate (RW)	N/A	A. This outlet provides drainage for the overflow from the 20,000,000 gallon reservoir, drainage from the roof and impervious area around the building, leakage of pump glands, and sanitary sewage from the building on the Kansas City Water Department property. B. Between the Water Department property and the sewer outfall, there are possibly three or four sanitary sewer connections and catch basins. C. With the proposed addition to the Prospect Avenue sewer system, the sanitary sewers and catch basins that are now connected to the Water Department sewer will be taken care of by Prospect Avenue sewer system. D. In the event of flood stages, the Water Department could operate without this 24" sewer, so a pumping plant is not justified. E. At times of high river stages, the Water Department closes a valve on the 24" sewer and pumps from a manhole near Gardner Street, discharging over the railraod embankment. F. No critical or design flood stage information is given in the 1948 "Supplement on Interior Drainage". As the primary purpose of this pipe is for the reservoir overflow, "Condition 1" and "Condition 2" information is not pertinent. G. Conditions relating to the use of this conduit have not undergone any significant changes since the pipe's design.
8	Milwaukee Pump Station Outfall	172+00	78	Double 6' x 8'	RCB	2 Sluice gates	N/A	A. The contributing area drains runoff in undeveloped bottoms land noted as 0% impervious in the 1948 "Supplement on Interior Drainage". This land was anticipated to become a valuable industrial property. B. The pumping plant utilizes the borrow pit near the outlet for temporary ponding of runoff over an area of 12 acres. The borrow pit provides 31.9 acre-feet of storage. C. The required outlet capacity for gravity discharge at non-flood stages is a 60" conduit for 148 cfs. D. It was suggested by the 1948 "Supplement on Interior Drainage" that when area is to be ultimately developed, the city will need to construct a double 6'x8' box to permit gravity discharge of storm water, industrial wastewater and sanitary sewage. F. Industrial development has taken place over the years. The estimated percent impervious is from visual inspection of 1996 aerial photography and would result in an increased runoff rate.
9	Truman Pump Station Outfall	295+00	67	52"	RCP	Sluice gate	N/A	A. The conduit is the outfall from a pump plant and is for seepage which is collected in a system provided with discharge manholes. B. The levee collector system from sta. 285+00 to sta. 297+00 was abandoned due to a landside landfill. The effect of this change is likely a relatively minor impact.
UL 9	KCP&L Storm Waste Water Outlet	349+14	***	12"	RCP	Slide Gate and Flap Gate	N/A	A. The outlet is possibly for stormwater flow. This is suggested by the interpretation of a table in the 1976 O&M manual (see operational drawing sheet No. 11). B. The drainage district personal are not responsible for the operation and maintenance of this outfall, therefore they could not inform the project team of its purpose. However, no problems or recent changes were reported.
UL 19	KCP&L Storm Waste Water Outlet	351+44	***	20"	RCP	Sluice Gate and Flap Gate	N/A	A. The outlet is possibly for stormwater flow. This is suggested by the interpretation of a table in the 1976 O&M manual (see operational drawing sheet No. 11). B. The drainage district personal are not responsible for the operation and maintenance of this outfall, therefore they could not inform the project team of its purpose. However, no problems or recent changes were reported.
UL 20	KCP&L Storm Waste Water Outlet	351+50	***	20"	RCP	Sluice Gate and Flap Gate	N/A	A. The outlet is possibly for stormwater flow. This is suggested by the interpretation of a table in the 1976 O&M manual (see operational drawing sheet No. 11). B. The drainage district personal are not responsible for the operation and maintenance of this outfall, therefore they could not inform the project team of its purpose. However, no problems or recent changes were reported.

***Not found after reasonable search

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

STORM SEWERS

Structure ID	Description	Location		Structure Information			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW - riverward		
10	Hawthorne Pump Station Outfall	401+00	60	Double 6' x 8'	RCB	2 Sluice gates	N/A	A. The contributing area drains runoff in agricultural bottoms land noted as 0% impervious in the 1948 "Supplement on Interior Drainage". This land was anticipated to become a valuable industrial property. Development did occur in the service area of the Hawthorne Pump Plant, which is indicated in the current percent impervious. The Hawthorne Power Plant and the Bayer facilities are the major industrialization components. The percent impervious was estimated from visual inspection of 1996 aerial photographs and should cause higher runoff rates. B. Seepage from station 297+50 to station 479+66 will start at a stage of 25.8 feet and will be collected at station 401+00. C. Outlet also collects runoff for area M and A6 (see 1948 "Supplement on Interior Drainage", paragraph m to q) by way of existing swales. In order for the area to contribute to the proposed outlet at station 401+00, a culvert will be constructed under the railroad embankment at point "n".
11	Blue Banks Pump Station Outfall	452+50	60	42"	RCP	Bulkhead Gate and Flap Gate	N/A	A. According to the Kansas City Pollution Control Department (KCPCD), the Blue Banks Pump Station is rarely used. There is an interceptor sewer for transporting dry-weather (sanitary) flow from the combined sewers in the western portion of the Drainage District that leads to the Blue River Treatment Plant. In the unlikely case that a high river stage and high intensity rainfall event cause combined flow to travel through the interceptor sewer, the Blue Banks Pump Plant is used to dispose of the excess interceptor flow. B. A small area in the immediate vicinity of the Blue Banks Pump Plant contributes stormwater which will be discharged by gravity the majority of the time. C. The plant contains 2 pumps rated at 2,500 gpm each and 1 pump rated at 5,000 gpm. D. Conditions of the area contributing flow to the outfall conduit have not undergone significant change since the time of pipe design.
13	Kansas City Pollution Control Storm Sewer	476+10	115	24"	CIP	Sluice Gate (LW) and Flap Gate (RW)	N/A	A. The design of this outlet was not dependant upon the size and type of drainage area. This outlet was designed to provide drainage, at low river stages, to the Big Blue River equivalent to the amount of drainage possible through the 24" culvert adjacent to it which passes under the Missouri Pacific Railroad trunk lines. B. Water ponds in a large sump between the K.C. Terminal and Mo. Pacific tracks in the Southeast portion of the railyards. When the gate is closed the water will back up and pond in this large sump. C. During low river stages the water will discharge by gravity. D. Conditions of the area have not changed, but the flow is really controlled by a culvert just upstream. If that culvert were ever increased in size, there could be an effect on the Kansas City Pollution Control Storm Sewer.
14	Kansas City Pollution Control Storm Sewer	500+25	20	54"	CMP	Sluice Gate (LW)	N/A	A. The area contributing to this conduit is located in the south portion of the railyards on the eastern side of the protected area, where the K.C. Terminal, St. Louis, Mo. Pacific railroads are adjacent to each other. B. It also receives drainage from the adjacent hillside and Montgomery Ward property. C. While some ponding is allowed in the railyards, the conditions of the conduit service area have not changed since pipe design.

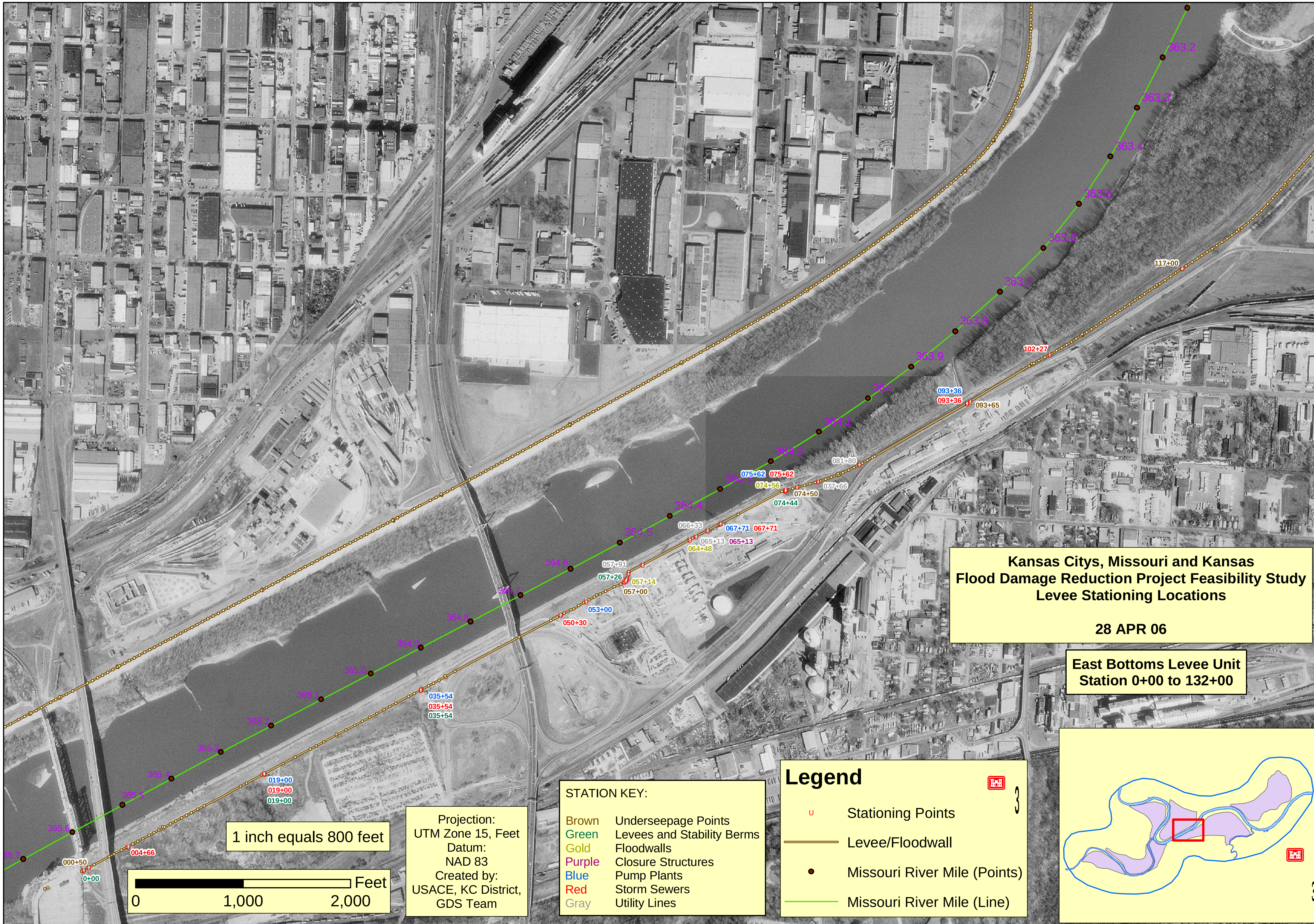
***Not found after reasonable search

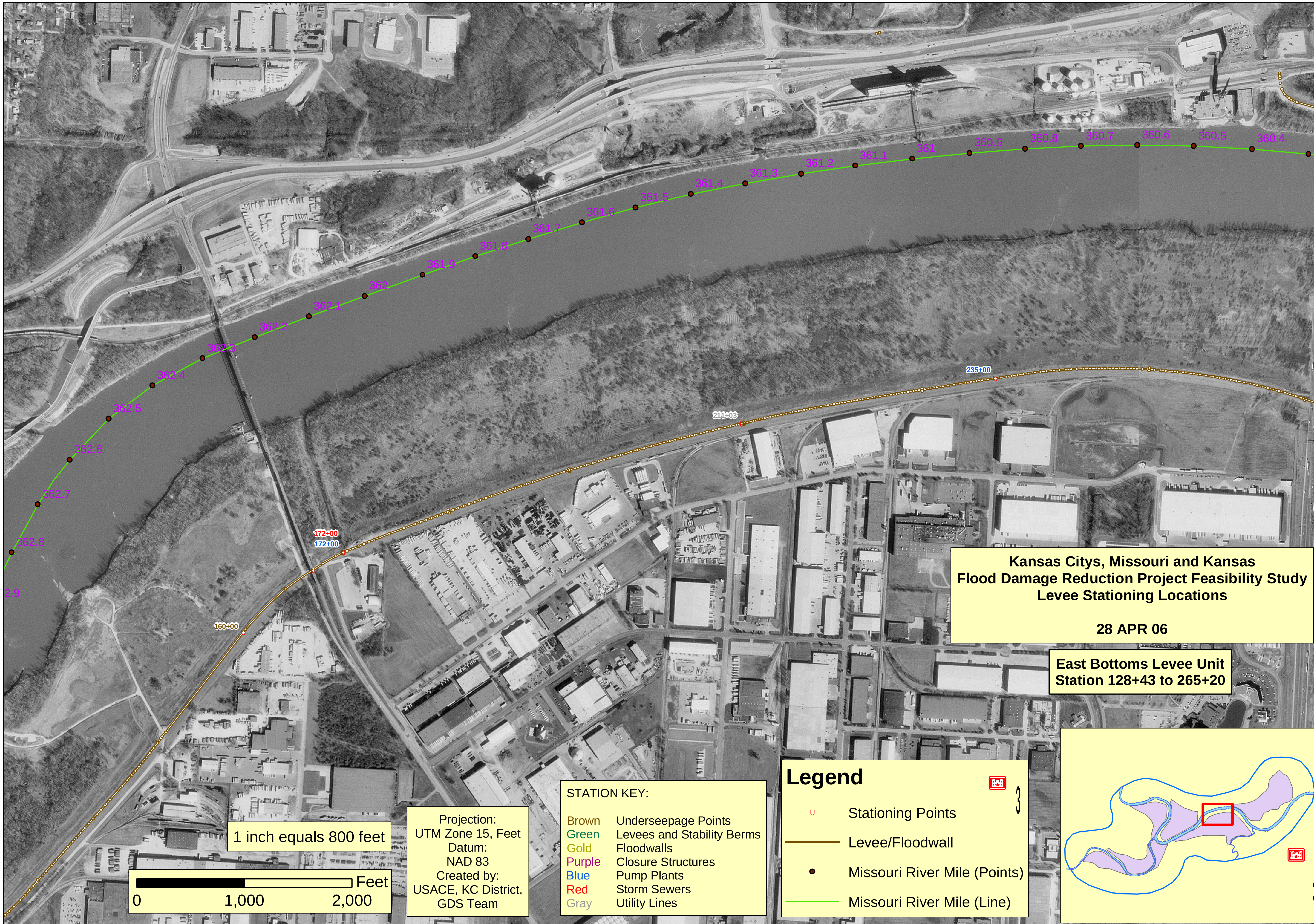
Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

East Bottoms Unit

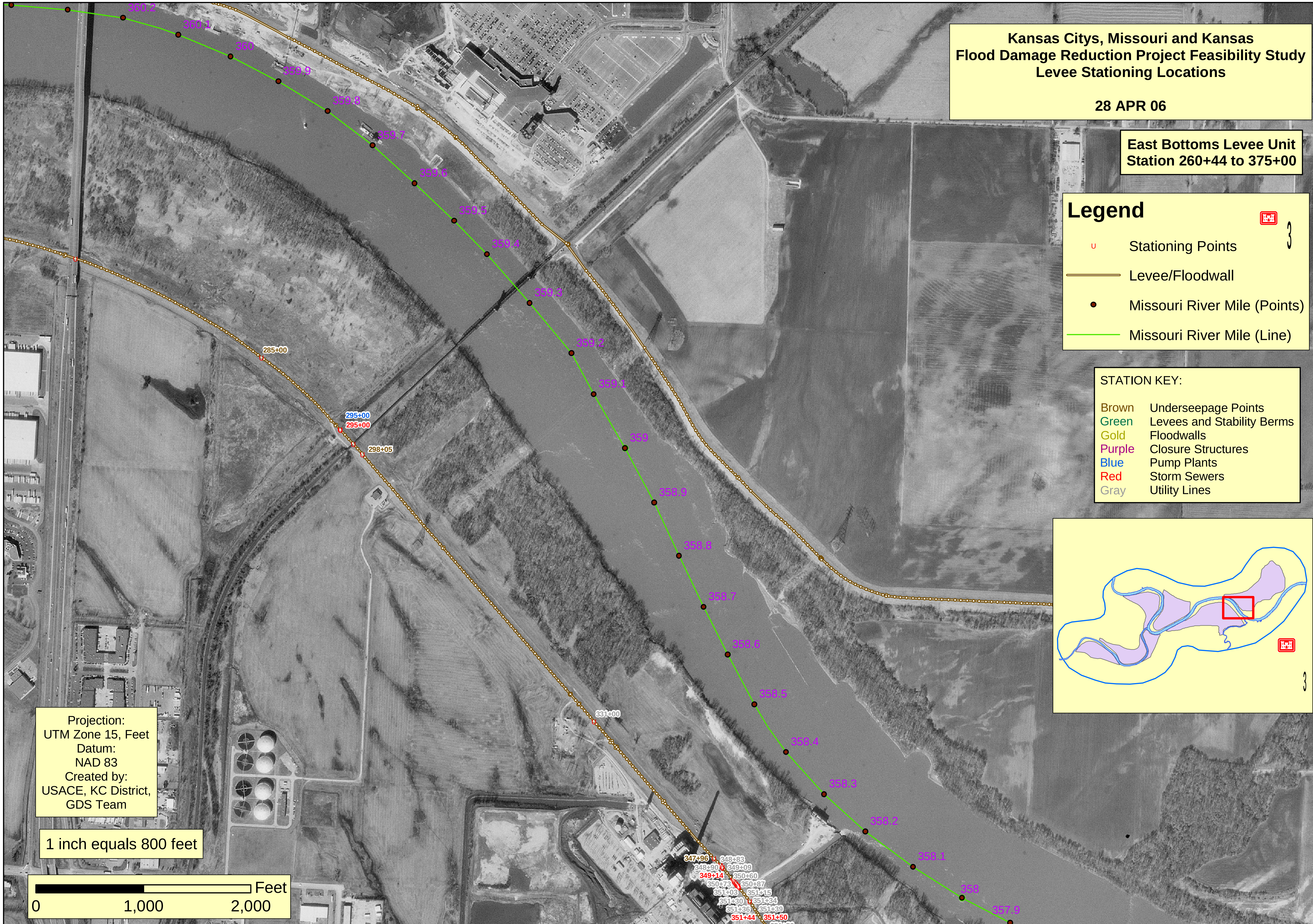
UTILITY LINES							
Station (ft.)	Function	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Analysis	Comments
57+91	Electrical Duct	DIP	12"	*	None	N/A	
65+13	Intake	RCB	10' W X 20.5'H	160	Sluice Gate	N/A	KCPL Power Plant
66+33	Outlet	RCB	15.5'W X 12'H	185	Flap Gate	N/A	KCPL Power Plant
77+66	Oil Pipeline	SP	4"	159.1	Gate	N/A	MO River Oil Company
81.+80	Water Line	CIP	4"	159.1	*	N/A	MO River Oil Company
211+03	Sanitary Sewer	CIP	2-24"	136	2-Valves	N/A	
331+00	Proposed Buried Cable	*	*	*	*	N/A	Parallels levee to station 336+00
348+83	Electrical Duct	*	*	125	*	N/A	KCPL Power Plant
348+90	Intake	RCP	78"	125	Flap Gate	N/A	
349+09	Sanitary Sewer	CIP	6"	125	Slide and Flap Gate	N/A	
350+60	Discharge	RCP	78"	125	Butterfly Valve	N/A	
350+73	Intake	RCP	78"	125	Butterfly Valve	N/A	
350+87	Electrical Duct	*	*	125	None	N/A	
351+03	Intake	RCP	78"	125	Butterfly Valve	N/A	
351+15	Discharge	RCP	78"	125	Butterfly Valve	N/A	
351+30	Gas Line	SP	2"	125	None	N/A	
351+34	Water Line	GI	4"	125	None	N/A	
351+36	Capped	*	4"	125	N/A	N/A	
351+39	Capped	*	8"	125	N/A	N/A	
351+53	Sanitary Sewer	WIP	8"	125	Sluice and Flap Gate	N/A	
363+20	Gas Line	CIP	3"	80	Valve	N/A	
402+00	Natural Gas Line	SP	20"	130	N/A	N/A	
456+02	Ash Disposal	CIP	6"	90	Air Relief	N/A	
457+10	Sanitary Sewer	RCP	30"	90	Inversted Siphon	N/A	Northeast sewage plant
461+11	Overflow Sanitary	RCP	48"	310	Sluice Gate	N/A	
467+35	Ash Disposal	CIP	6"	*	Air Relief	N/A	
468+65	Drainage	RCB	2-7.5'W X 6.0'H	*	2-Sluice Gates	N/A	
471+70	Sanitary Sewer	RCB	2-8.5'W X 7.0'H	*	3- Sluice Gates	N/A	

*Information not found


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
East Bottoms Levee Unit
Station 0+00 to 132+00
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
Missouri River Mile (Line)
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 800 feet
Feet
0
1,000
2,000



Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
East Bottoms Levee Unit
Station 128+43 to 265+20
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
Missouri River Mile (Line)
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 800 feet
Feet
0 1,000 2,000
360.4
360.5
360.6
360.7
360.8
360.9
361
361.1
361.2
361.3
361.4
361.5
361.6
361.7
361.8
361.9
362
362.1
362.2
362.3
362.4
362.5
362.6
362.7
362.8
235+00
211+03
172+00
172+00
160+00


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
East Bottoms Levee Unit
Station 260+44 to 375+00
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
Missouri River Mile (Line)
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 800 feet
Feet
0 1,000 2,000
360.2
360.1
360
359.9
359.8
359.7
359.6
359.5
359.4
359.3
359.2
359.1
359
358.9
358.8
358.7
358.6
358.5
358.4
358.3
358.2
358.1
358
357.9
285+00
295+00
295+00
298+05
331+00

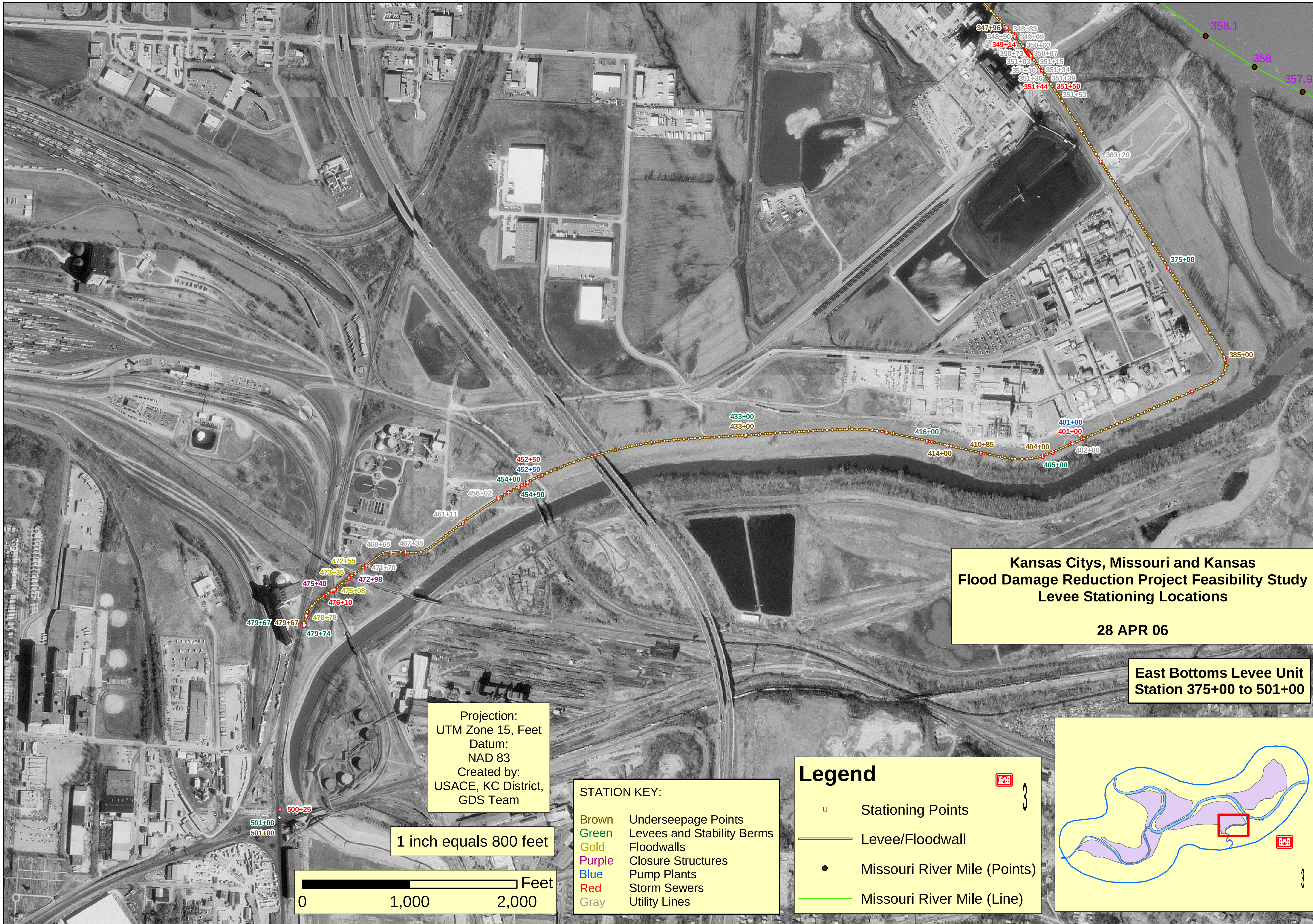
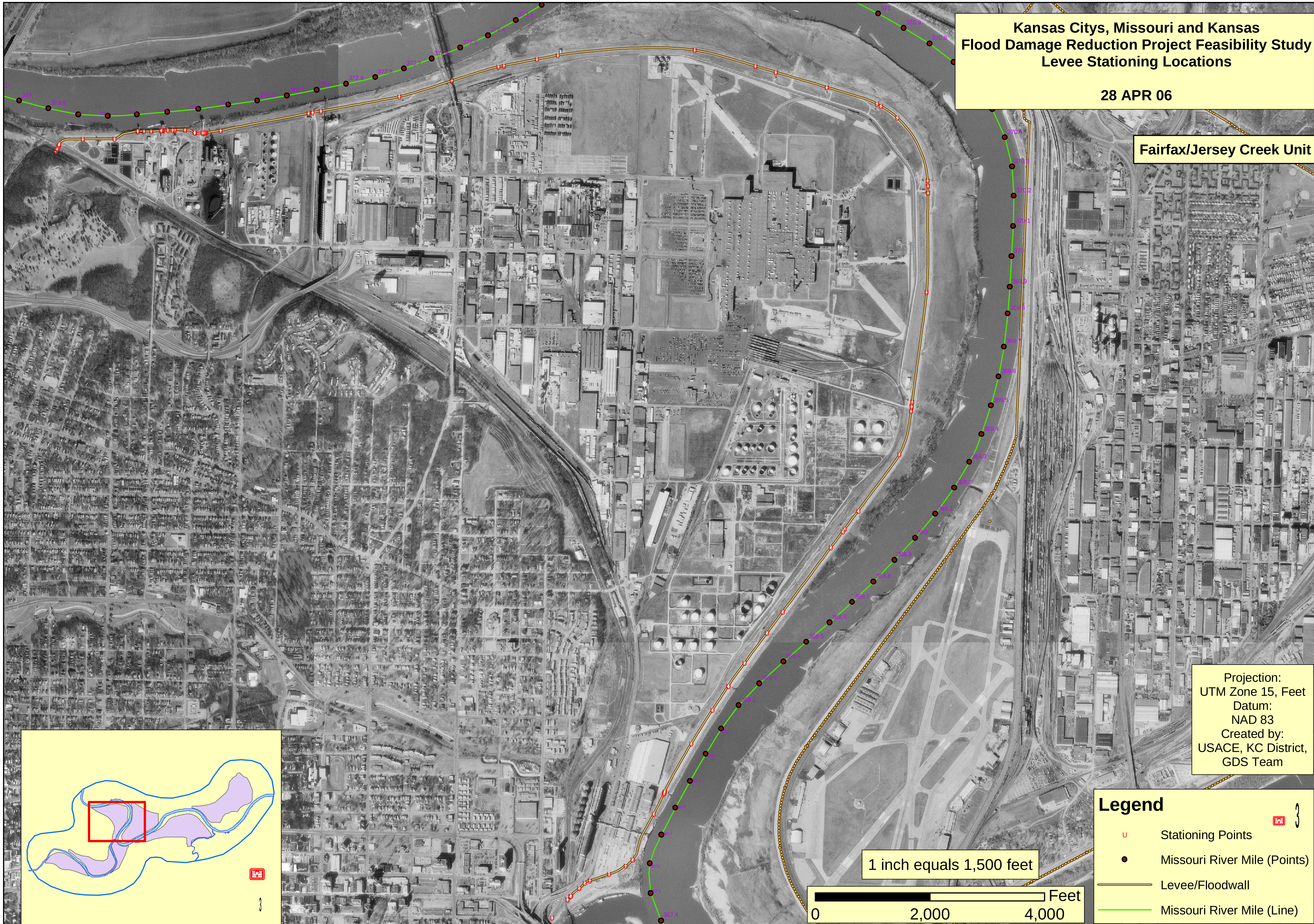

Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
East Bottoms Levee Unit
Station 375+00 to 501+00
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 800 feet
Feet
0
1,000
2,000
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
Missouri River Mile (Line)
358.1
358
357.9
375+00
385+00
433+00
501+00

EXHIBIT A-1.7
Fairfax-Jersey Creek Unit – Levee/Floodwall Features Inventory



Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Fairfax/Jersey Creek Unit
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
Legend
Stationing Points
Missouri River Mile (Points)
Levee/Floodwall
Missouri River Mile (Line)
1 inch equals 1,500 feet
Feet
0
2,000
4,000

Fairfax-Jersey Creek Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
-5+59	2+58	None	0	N/A	
2+58	4+58	Sheet piling under floodwall	5	N/A	Sheet piling to 731.5 ft.
4+58	15+64	Sheet piling under floodwall	7	N/A	Sheet piling to approximately 730 ft.
15+64	28+51	Sheet piling under floodwall	5	N/A	Sheet piling to approximately 730 ft.
28+51	38+50	Collector pipe	15	N/A	
38+50	50+50	Relief wells(6) and collector pipe	16.8	N/A	
50+50	66+50	Relief wells(10) and collector pipe	16	N/A	
66+50	80+50	Relief wells(8) and collector pipe	18.5	N/A	
80+50	88+50	Relief wells(5) and collector pipe	18.8	N/A	
88+50	100+70	Relief wells(7) and collector pipe	20	N/A	
100+70	109+50	Relief wells(3) and collector pipe	20.2	N/A	

* Information Not Found

Fairfax-Jersey Creek Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
109+50	129+50	Relief Well (1) and collector pipe	19	N/A	
129+50	148+00	Relief wells(4) and collector pipe	19	N/A	
148+00	161+50	Relief wells(11) and collector pipe	21	N/A	
161+50	165+00	Relief well(1) and collector pipe	21.2	N/A	
165+00	188+00	Relief wells(15) and collector pipe	22	N/A	
188+00	199+00	Relief wells(5) and collector pipe	20.5	N/A	
199+00	226+70	Relief Wells (4) and collector pipe	19.5	N/A	
226+70	265+50	Relief wells(19) and collector pipe	19.5	N/A	
265+50	287+86	Relief wells(14) and collector pipe	18.5	N/A	
287+86	302+32	Sheet piling under floodwall	17	N/A	Sheet piling to approximately 728 ft. Riser pipes repaired that restored the collector system along floodwall.
302+32	313+72	None	17	N/A	The critical section at Station 310+00 for existing conditions uses an average blanket thickness of 21 feet of Silt or (ML) Material.

* Information Not Found

Fairfax-Jersey Creek Unit

Relief Well Locations *

Original Well Number	New Well Number (10/3/94)	Station
1A	1-86	40+60.49
2A	2-93	43+04.02
3A	3-93	45+02.90
4A	4-93	46+59.48
5A	5-86	47+57.06
6A	6-93	48+43.49
7AA	7-93	50+51.90
7B	8-86	52+24.20
8A	9-93	54+23.43
9AA	10-93	55+46.29
9A	11-86	56+73.76
10A	12-93	58+32.85
11A	13-93	59+41.40
12A	14-93	60+91.09
13A	15-93	62+86.87
14A	16-93	65+39.65
15A	17-86	67+95.89
16A	18-86	70+56.10
17A	19-93	71+95.83
18A	20-93	73+69.68
18B	21-93	74+89.08
19A	22-93	75+70.52
19B	23-93	76+70.28
20A	24-86	78+14.16
21A	25-93	81+00.00
22A	26-93	82+29.11
23A	27-86	83+59.60
25A	28-93	86+04.67
26A	29-93	87+34.00
28A	30-93	89+32.84

Original Well Number	New Well Number (10/3/94)	Station
30A	31-86	92+36.03
32A	32-86	94+39.60
34A	33-86	96+19.97
36A	34-86	97+94.56
37A	35-93	98+92.33
38A	36-86	100+46.57
39B	37-86	101+92.53
41A	38-93	105+19.27
42A	39-86	108+31.39
44A	40-86	128+83.66
45A	41-86	130+91.13
48A	42-86	136+55.31
51A	43-86	143+41.67
54A	44-86	147+85.89
55A	45-93	148+64.95
57A	46-93	149+96.21
59A	47-93	151+76.29
61A	48-93	153+61.64
62A	49-86	153+94.19
64A	50-93	155+55.06
67A	51-93	157+94.59
68A	52-86	158+64.70
69A	53-93	159+49.30
71A	54-93	161+37.71
72A	55-86	161+09.56
76A	56-93	164+29.58
79A	57-93	165+66.34
80A	58-86	166+96.91
81A	59-86	167+85.52
84A	60-86	169+71.80

Original Well Number	New Well Number (10/3/94)	Station
87A	61-86	172+01.52
88A	62-86	176+05.49
90A	63-86	173+64.34
92A	64-86	175+23.12
93A	65-86	175+86.71
98A	66-86	176+28.88
100A	67-86	180+64.00
102A	68-86	182+00.70
104A	69-86	183+06.61
105A	70-93	183+97.95
108A	71-93	186+52.48
111A	72-93	189+49.26
111B	73-93	189+32.91
112A	74-86	193+74.92
112A	75-93	196+08.77
112A	76-93	198+33.21
112A	77-93	220+96.81
112A	78-93	222+47.61
112A	79-93	223+82.31
112A	80-93	225+34.59
112A	81-93	226+99.02
112A	82-86	230+41.93
112A	83-93	233+49.01
112A	84-93	235+34.85
112A	85-86	236+92.04
112A	86-93	240+00.10
112A	87-93	242+22.37
112A	88-86	245+04.55
112A	89-93	246+49.34
112A	90-86	248+64.54

Original Well Number	New Well Number (10/3/94)	Station
121A	91-93	250+09.36
123A	92-93	252+28.57
124A	93-93	254+24.88
125A	94-93	256+03.96
126A	95-86	258+49.00
127A	96-93	259+74.20
128A	97-93	260+89.31
129A	98-93	263+33.87
130A	99-86	264+97.15
130B	100-93	265+83.50
132E	101-93	267+39.16
132C	102-52	267+51.71
131A	103-93	267+35.83
132D	104-86	268+91.76
133A	105-86	270+45.43
134A	106-93	272+44.81
134B	107-93	273+47.76
135A	108-86	274+67.04
136A	109-93	277+14.31
137A	110-86	279+65.66
138A	111-93	280+69.33
139A	112-86	282+85.35
140A	113-86	285+26.75

*Details of the relief well construction were not found. However, a contact point has been identified for information gathering.

Fairfax-Jersey Creek Unit

LEVEES					
Reach		Stability Berm		Analysis	Comments
Station	Station	Spring Point (ft.)	Width (ft.)		
-5+59	2+58	N/A	N/A	N/A	Retaining wall before levee
28+51	267+00	10'	30'	N/A	Landside Stability Berm
267+00	287+98	10'	40'	N/A	Floodwall on levee for last 12'
302+32	313+72	N/A	N/A	N/A	

Fairfax-Jersey Creek Unit

FLOODWALLS									
Reach		Wall Type	Foundation Type	Piles		Cutoff		Analysis	Comments
Station	Station			Type	Length (ft.)	Type	Length (ft.)		
2+58	4+58	Reinforced concrete "I" type floodwall	Sheet Piling	Sheet Piling	21.5	N/A	N/A	N/A	
4+58	15+64		Sheet Piling	Sheet Piling	21.0'	N/A	N/A	N/A	
15+64	28+51		Sheet Piling	Sheet Piling	24.5'	N/A	N/A	N/A	
287+86	302+32	Reinforced concrete inverted-T cantilever	Piles	Concrete bearing	*	Steel sheet	*	Refer to the Structural Chapter of this Appendix	The first 12' is on top of levee. Future analysis required the length and diameter of pile plus pile properties (such as concrete compressive strength, reinforcing pattern and grade, pile capacity) - this may have been a manufacturer design and supply. Testing found piles extending 19' below the pile cap.

*Information not found

Fairfax-Jersey Creek Unit

CLOSURE STRUCTURES								
Station (ft.)	Function	Type	Gap Height (ft.)	Width (ft.)	Foundation Type	Closure Materials	Analysis	Comments
2+45	Railroad	Sandbag	2.0	26	Spread	Sandbags	N/A	Union Pacific Railroad Tracks; Kaw Valley Drainage District
5+87	Vehicle	Stoplog	5.8	20	Spread	Timber	N/A	Kaw Valley Drainage District
6+97	Railroad	Stoplog	6.2	17.5	Spread	Timber	N/A	Kaw Valley Drainage District
13+93	Railroad	Stoplog	7.5	17.5	Spread	Timber	N/A	Kaw Valley Drainage District
296+89	Vehicle	Stoplog	Gap closed - gap filled in with concrete (field verified)					
297+98	Walkway	Stoplog	Gap closed - gap filled in with concrete (field verified)					
312+75	Railroad	Stoplog	11.1	17.5	Spread	Aluminum	Stoplog gap performs adequately - refer to the Structural Chapter of this Appendix	Based on concerns and recommendations from the Fairfax Drainage District, this gap was analyzed during Phase 1 work

*Information not found

Fairfax-Jersey Creek Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Jersey Creek Pump Plant / approx. 29+00	755.0	Storm Sewer System Flow: The flow contributed by an area north of the railroad tracks, in the northern and northwestern portions of the Fairfax Drainage District.	11' x 12' RCB for the main pumps and a 36" SP for each of the 2 auxiliary pumps	N/A	A. The Jersey Creek Pump Plant was originally known as the Fairfax Drainage District Sewer Pump Plant. B. Maximum ponding occurs under gravity flow conditions due to the insufficient sewer capacity, which is 0.324 in (avg. ponding across tributary area). Ponding at the 16.9 ft stage is 0.214 inches over the entire area. C. There is sufficient pumping capacity for all stages. Even if current runoff values based on percent impervious area are not found to have bee used in the latest pump design, the design is adequate. The sewer capacity is controlling. D. The same design flows used for the original design were assumed to be used for the current design even though sanitary sewage is no longe received by this pump. E. The new percent impervious was approximated by visual inspection of 1996 aerial photographs. The greater percent impervious will, in turn, cause a greater runoff flow rate. F. The precise new pump plant capacity at the design river stage is unknown, but it is known to be greater the original capacity.
F-9 / 61+90	758.7	Seepage Flow: The flow is from the portion of the seepage collection system between sta. 83+62 and 29+35 coming through a 42" CMP upstream and 42" CMP downstream.	54" steel	N/A	A. Stage-seepage curves can be found on Plate 15 of the Supplement on Interior Drainage. B. Pump Plant Condition 1 is equal to Pump Plant Condition 2 for pump plants that have seepage as the only contributing flow. C. Seepage conditions should not have changed since the design of the pump plant.
F-8 / 84+53	759.4	Seepage: The flow is from a portion of the seepage collection system between sta. 96+31 and 83+62 coming through a gated manhole and a 15" seepage lateral and a 42" CMP upstream.	36" SP	N/A	A. There is only 910 cubic ft of storage, which is not sufficient to satisfy electrical limitations. Therefore a 20" recirculating bypass is installed to provide for recycling on Pump #2. Stage-seepage curves can be found on Plate 15 of the Supplement on Interior Drainage. B. Seepage is the only contributing flow. C. Seepage conditions should not have changed since the design of the pump plant.
F-7 / 110+26	759.8	(1) Seepage: The flow is from a portion of the seepage collection system between sta. 111+63 and 96+31 coming through a 48" relief well header pipe into a manhole. It then goes through a 66" pipe through a diversion gate manhole to the pump plant. (2) Storm Sewer System Flow: The flow is from a gravity storm sewer draining a portion of the Fairfax Airport area coming through a 66" pipe draining to the diversion gate manhole and then into the pump plant.	Two 30"	N/A	A. At low river stages, the storm flow is carried to the river in a 66" sewer. At 17.8 feet (736.6 elevation at outlet), the river sluice gate is closed. The landward sluice gate in the diversion gate manhole is opened and all flow goes to the plant. A sluice gate on the 48" relief well header pipe coming into a downstream manhole is opened at 22 feet, allowing the relief and seepage flow to go to the plant. B. Instead of outletting to a ditch which carries the flow to the river, the pipes were extended and now outlet at the riverbank. C. The new percent impervious was approximated by visual inspection of 1996 aerial photographs. The greater percent impervious will, in turn, cause a greater runoff flow rate. D. During low river stages, water was stored in a depression located near the hangers of the Trans World Airline Overhaul Base below 739.2 and the maximum gravity capacity of the sewer was about 160 cfs. Average depth of ponding was 0.66 inches. At 17.8', with the pumping plant in operation, the average depth of ponding was 0.65 inches. The water during the low stage condition is no longer stored near and around the airport due to the fact that the airport is no longer in operation. The GM Fairfax plant has now been placed in this area. Therefore, the original storage area is now impervious land. The size of the drainage area remains the same; however, the percent impervious has changed. In turn, this will increase the runoff flows and depth of water in ponded areas.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

Fairfax-Jersey Creek Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
F-11 / 146+90	760.9	(1) Seepage Flow: The flow is form a portion of the seepage collection system between sta. 156+32 and 111+63 coming through a 48" CMP upstream and 42" CMP downstream. (2) Storm Sewer System Flow: The flow is from the northeast section of the Fairfax Industrial District (GM Plant area) in a double 10' x 8' RCB	Two 10' x 8' RCB	N/A	A. Seepage flows that used to go to Pump Plant F-6 were diverted to Pump Plant F-11. Plans for Pump Plant F-11 are dated 1985 and 1986 by the designers. B. Stage refers to the new Hannibal gage datum, which is 9.39 feet lower than the old gage (706.4 verses 715.79). C. Seepage is the only contributing flow. D. The pump plant was designed for certain flows at total dynamic head conditions. The pump capacities appear adequate and the conditions of the contributing area should not have changed since the plant design.
F-5 / 165+80	761.5	Seepage: The flow is from a portion of the seepage collection system between sta. 168+56 and 156+32 coming through a 4' x 5' gated opening. This opening is fed by a 30" CMP upstream and a 48" CMP downstream.	30" for each pump	N/A	A. There is only 1970 cubic ft of storage, which is not sufficient to satisfy electrical limitations. Therefore a 24" recirculating bypass is installed to provide for recycling on Pump #2. Stage-seepage curves can be found on Plate 15 of the 1952 "Supplement on Interior Drainage". B. Seepage is the only contributing flow. C. The seepage conditions should not have changed since the design of the pump plant.
F-4 / 175+03	761.6	Seepage: The flow is from a portion of the seepage collection system between sta. 177+30 and 168+56 coming from a 21" CMP upstream and a 42" CMP downstream.	30" steel	N/A	Sluice gates on the 21" and 42" relief well header pipes coming into the diversion manhole are opened at 18.5 feet, allowing the relief and seepage flow to go to the plant. This pump plant only drains seepage now; the storm flow goes to Pump Plant F-11. Therefore, it will only be in operation during high river stages and has adequate capacity.
F-3 / 184+30	761.8	Seepage: The flow is from a portion of the seepage collection system between sta. 223+00 and 177+30 coming through a 42" CMP upstream and 42" CMP downstream.	54" steel	N/A	A. Stage-seepage curves can be found on Plate 15 of the 1952 "Supplement on Interior Drainage". B. The seepage conditions should not have changed since the design of the pump plant.
F-10 / 222+95	762.6	(1) Seepage: The flow is from a system of five new seepage wells added in 1993 between sta. 220+96.81 and 226+99.02 conveying water through a 24" CMP upstream and an 18" CMP downstream. (2) Storm Sewer System Flow & Industrial Flow: The flow is from the industrial area south of the pump plant in a 9'0" x 7'4" RCB	9'0" x 7'4" RCB	N/A	A. The wells added in 1993 are in addition to the seepage collection system that drains to Pump Plant F-2 (to the west of Pump Plant F-10). B. Stage refers to the new Hannibal gage datum, which is 9.39 feet lower than the old gage (706.4 verses 715.79). C. It appears that the pump plant was designed for certain capacities at given stages. The need for these capacities broken down by flow source does not exist within the sources obtained. The conditions of the contributing area have not changed significantly since the construction of the plant and the D. The Fairfax Drainage District manager noted that a CMP connected to the plant failed in 1993 and was replaced by a similar capacity concrete box, but he is not aware of any pump capacity problems.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

Fairfax-Jersey Creek Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
F-2 / 251+60	763.3	Seepage: The flow is from a portion of the seepage collection system between sta. 265+05 and 226+99 coming through a 36" CMP upstream and 42" CMP downstream.	42" SP	N/A	A. Stage-seepage curves can be found on Plate 15 of the 1952 "Supplement on Interior Drainage". B. The seepage conditions should not have changed since the design of the pump plant.
F-1 / 267+70	761.9	(1) Seepage: The flow is from a portion of the seepage collection system between sta. 287+98 and 267+44 fed by a 42" pipe.	60" SP	N/A	A. There is only 1810 cubic feet of storage, which is not sufficient to satisfy electrical limitations. Therefore a 36" butterfly valve is installed to provide for recycling. B. The seepage conditions should not have changed since the design of the pump plant.
	761.9	(2) Storm Sewer System Flow: Flow that drains to the Foothills Drainage Ditch. The area is south of the railroad tracks and in the western portion of the Fairfax Drainage District. It is outlined on the map of the levee system.	60" SP	N/A	A. The maximum allowable water surface elevation in the Main Foothills Drainage Ditch is 750; the minimum allowable elevation is 744 (due to seepage conditions). Therefore, pumping will start at elevation 744. B. The storage or impounding of the Ditch for runoff is expected between stages 22.9 and 25.5, which allows the pump station to obtain capacit throughout the full range of the activation elevations. 760 cfs is the capacity of the ditch system at maximum peak runoff of 2,010 cfs (at stage 14.0 feet). Excess runoff is temporarily ponded in the hillside area and the railroad ditches. C. After stage 25.5, the capacity of the pump will allow Q_{out} to be greater then Q_{in}. D. This pump plant was only run three times in 1999, according to the General Manager of the Fairfax Drainage District. E. More residential development has occurred in the southern part of the drainage area since the design of the pump plant, increasing percent impervious area. This, in turn, increases the runoff from the plant service area.
	761.9	(3) Seepage: The flow is from a portion of the seepage collection system between sta. 267+44 and 265+05 which is fed by a 30" pipe and 18" pipe, along with a small amount of surface drainage from the railroad drains.	60" SP	N/A	A. There is only 412 cubic feet of storage, which is not sufficient to satisfy electrical limitations. Therefore a 16" bypass is installed to provide fo recycling. B. The contributing area conditions should not have changed since the design of the pump plant.
KCK, Municipal Water and Light Plant (Board of Public Utilities) / 283+36	***	Storm Sewer System Flow: Flow from the eastern portion of the Water and Light Plant area.	42" CIP	N/A	A. There used to just be a gravity flow pipe for an abandoned basin at the pump plant location. The basin no longer exists; that same pipe is used, now having about 40' of 42" RCP on the end of the CIP, in conjunction with the pump plant. B. The project team worked with the Board of Public Utilities to obtain more design information on this plant. The team has been told that the pump plant was put in about 1968, it only has one pump, the plant is about 250' south of the discharge, and that it does pick up some water fro their eastern neighbor (used to be Mobil oil). C. BPU calls this Pump No. 3. No design information was located, but BPU is not aware of any pump capacity problems.
KCK, Municipal Water and Light Plant (Board of Public Utilities) / 291+49	764.2	(1) Storm Sewer System Flow and (2) Industrial Flow: The flow is contributed from the Water Light Plant area which normally goes to the outlets at 289+70, 291+53, 291+89, & 292+73 which is the east side of the power plant.	4' x 6' RCB	Adjust new pile spacing and bridge to protect RCB	A. The only structure without capacity for gravity flow is the 24" @ 289+70, yet ponding would be less than 0.1 in. B. BPU calls this structure the No. 2 Weir. C. The plant no longer receives the sanitary flow that originally contributed to the plant; however, the flow was not considered in design becaus of its small flow rate. D. This plant has not gone through any changes since its original design according to BPU. The conditions surrounding the runoff to the plant are relatively the same also. The estimated % impervious from visual inspection of 1996 aerial photographs is shown, and does not reflect a significant change.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

Fairfax-Jersey Creek Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
1	State Street Sewer: This is a closed system draining through a gravity sewer.	-(4+43)	210	4' W x 3' H	RCB	None	N/A	A. The critical section is between MH8 and MH9 shown in the 1952 "Supplement on Interior Drainage"; it would not flow full below MH8. B. No significant changes have taken place with regard to drainage area or percent impervious for this structure since the time of its design. The estimated percent impervious from visual inspection of the 1996 aerial photographs is shown, and does not reflect a significant change. C. This conduit is maintained by Kaw Valley Drainage District.
1A	Track Drains: This is railroad track drainage to a gravity sewer.	-(2+51)	240	24"	CMP	Sluice Gate (LW)	N/A	A. The entire area is below the design flood elevation, seepage amounts are negligible, and ponding is not detrimental. B. No significant changes have taken place with regard to drainage area or percent impervious for this structure since the time of its design. The estimated percent impervious from visual inspection of the 1996 aerial photographs is shown, and does not reflect a significant change. C. This conduit is maintained by Kaw Valley Drainage District.
3	Third Street and Minnesota Avenue Sewer: This is a closed drainage system leading to a gravity sewer.	1+66	300	33"	RCP	Sluice Gate (LW) and Flap Gate (RW)	N/A	A. The sewer is pressurized by the use of bolt-down lids on some of the manholes. This allows for greater capacity within the sewer system to be utilized. B. No significant changes have taken place with regard to drainage area or percent impervious for this structure since the time of its design. The estimated percent impervious from visual inspection of the 1996 aerial photographs is shown, and does not reflect a significant change. C. This conduit is maintained by Kaw Valley Drainage District.
4A	Market Center Building Sewer: This is a gravity outfall for the area around the Market Center Building.	10+60	***	10"	***	***	N/A	A. The Market Center Building has its own 10" outlet storm drainage pipe at Sta. 10+60 which goes through the floodwall. It is thought that the small discharge pipe outlets water immediately around the building to the river and any excess water will pond in the lower areas south of the building. Little information is known about the design of the gravity discharge pipe. B. The conditions of the area appear to be unchanged from the time of pipe design. C. This conduit is maintained by Kaw Valley Drainage District.
5	Jersey Creek Sewer: This is a conduit for conveyance of storm drainage in various parts of the basin, most of which is pumped from Jersey Creek Pump Plant.	28+71	70	18.5' W x 17.5' H	RCB	Sluice Gate (LW)	Refer to the Geotechnical Chapter of this Appendix	A. This is the Jersey Creek Sewer which takes flow mainly from the Jersey Creek Pump Plant area. B. No significant changes have taken place with regard to drainage area or percent impervious for this structure since the time of its design. C. While no alterations are directly proposed to the Jersey Creek Sewer, failure of tieback connections and extensive rusting of the retaining wall structure near the sewer conduit were reported by the drainage district. Investigation concluded that the reach of flood protection should be strengthened by the use of driven sheet pile system without the reliance upon tieback anchors.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

Fairfax-Jersey Creek Unit

STORM SEWERS

Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
7	Outfall pipe for Pump Plant F-9	61+90	50	54"	SP	Flap Gate (RW)	N/A	A. The series of pipe sections follows the shape of the levee, going up, across, and then back down to the discharge elevation. B. No changes have taken place with regard to the seepage flow to this pump plant.
9	Outfall pipe for Pump Plant F-8	84+53	60	36"	SP	Flap Gate (RW)	N/A	A. The series of pipe sections follows the shape of the levee, going up, across, and then back down to the discharge elevation. B. No changes have taken place with regard to the seepage flow to this pump plant.
10	F-7 Storm Pipe: This pipe is used for conveying storm drainage to Pump Plant F-7.	109+34	90	66"	RCP	Sluice Gate (LW)	N/A	A. This pipe is located next to Pump Plant F-7 and is used for gravity flow conditions to the river. The flow is diverted to F-7 in high flow situations. B. As noted in the pump plant information, some water storage area has been taken away and impervious area has increased because of the GM Fairfax plant.
11	Pump Plant F-7 Sump Pipe: This is a sump pump pipe coming from Pump Plant F-7.	110+26	120	6"	SP	Gate Valve (LW)	N/A	A. This pipe is not on the 1997 levee plans, but is a sump pump line according to the original Design Memorandum and the 1979 Operational Drawings. The length of pipe is given as greater than the original length to the outlet. The outlet used to dump into a ditch which carries the flow to the river, but now outlets directly to the river. B. The conditions for which it was designed have remained relatively constant.
11A	Outfall pipes for Pump Plant F-7	110+26	120	2 - 30"	SP	2 Flap Gates (RW) and 2 Gate Valves (LW) for each pipe	N/A	A. There are two 30" pipes which connect to the 66" outfall pipe. The length of pipe is given as greater than the original length to the outlet. The outlet originally dumped into a ditch which carried the flow to the river, but now discharges directly to the river. The series of pipe sections follows the shape of the levee. B. As noted in the pump plant information, some water storage area has been taken away and impervious area has increased because of the GM Fairfax plant.
12A	Outfall conduit for Pump Plant F-11	146+82	683	2 - 8'W x 10'H	RCB	6 Sluice Gates (LW) and 10 Flap Gates (LW)	N/A	A. There are five 48" discharge pipes (one from each pump) plus a 16" sump pump which all empty into a discharge chamber. The double 8' x 10' boxes then discharge to the river from the chamber. B. As explained in the pump plant information, the plant was designed for certain flows at total dynamic head conditions. Therefore, not all detailed information was available. However, the conditions of the contributing area should not have changed since the plant design.
14	Outfall pipes for Pump Plant F-5	165+80	130	2 - 30"	SP	1 Flap Gate (RW) for each pipe	N/A	A. There are two 30" pipes which discharge from Pump Plant F-5. B. No changes have taken place with regard to the seepage flow coming to these pipes.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

Fairfax-Jersey Creek Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
14A	Pump Plant F-5 Sump Pipe: This is a sump pump pipe that connects to one of the 30" pipes under the levee for Pump Plant F-5.	165+80	130	6"	SP	1 Sluice Gate (LW)	N/A	A.This pipe is not on the 1997 levee plans, but is a sump pump line according to the original Design Memorandum and the 1979 Operational Drawings. The pipe ties into one of the 30" discharge lines at a point just riverward of the levee. B. The conditions for which it was designed have remained constant.
17	Outfall pipe for Pump Plant F-4	175+03	70	30"	SP	Flap Gate (RW)	N/A	A. The series of pipe sections follows the shape of the levee, going up, across, and then back down to the discharge elevation. B. As noted in the pump plant information, the current conditions call for this plant to handle seepage flow only. It was designed for stormwater runoff and seepage, so the design is more than adequate.
18	Outfall pipe for Pump Plant F-3	184+30	65	54"	SP	Flap Gate (RW)	N/A	A. There area three 30" pipes from the plant which connect immediately to the 54" outlet. B. No significant changes have taken place with respect to seepage flows to the pipe.
19	Outfall box for Pump Plant F-10	222+95	60	7'4"W x 9'0"H	RCB	Sluice Gate (LW)	N/A	A. There are four discharge pipes (one from each pump) plus a sump pump which all empty into a discharge chamber. The 7'4" x 9'0" box then discharges to the river from the chamber. B. As noted in the pump plant information, it appears that the pump plant was designed for certain capacities at given stages. The conditions of the contributing area have not changed significantly since the construction of the plant. C. The Fairfax Drainage District manager noted that a CMP connected to the plant failed in 1993 and was replaced by a similar capacity concrete box, but he is not aware of any pump capacity problems.
20	Outfall pipe for Pump Plant F-2	251+60	50	42"	SP	Flap Gate (RW)	N/A	A. There are three 24" pipes from the plant which connect immediately to the 42" outlet pipe. B. No significant changes have taken place with regard to seepage flows to this pipe.
21	Outfall pipes for Pump Plant F-1	267+70	110	3 - 60"	SP	3 Flap Gates (RW), 2 Sluice Gates (LW), and 1 Butterfly Valve (LW) for the 3 pipes	N/A	A. There are three separate 60" outfalls for this pump plant. B. As noted in the pump plant information, more residential development has occurred in the southern part of the storm drainage area since the design of the pipes. This means that more flow will be coming to the middle 60" pipe outlet, which is used for the surface runoff.
23	Outfall for KCK Municipal Water and Light Pump Plant	283+36	130	42"	CIP	Sluice Gate (LW)	N/A	A. About 40' on the end of the pipe is 42" RCB. B. As noted in the pump plant information, little information was available on the design of the pump plant associated with this pipe. However, BPU is not aware of any pump capacity problems.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

Fairfax-Jersey Creek Unit

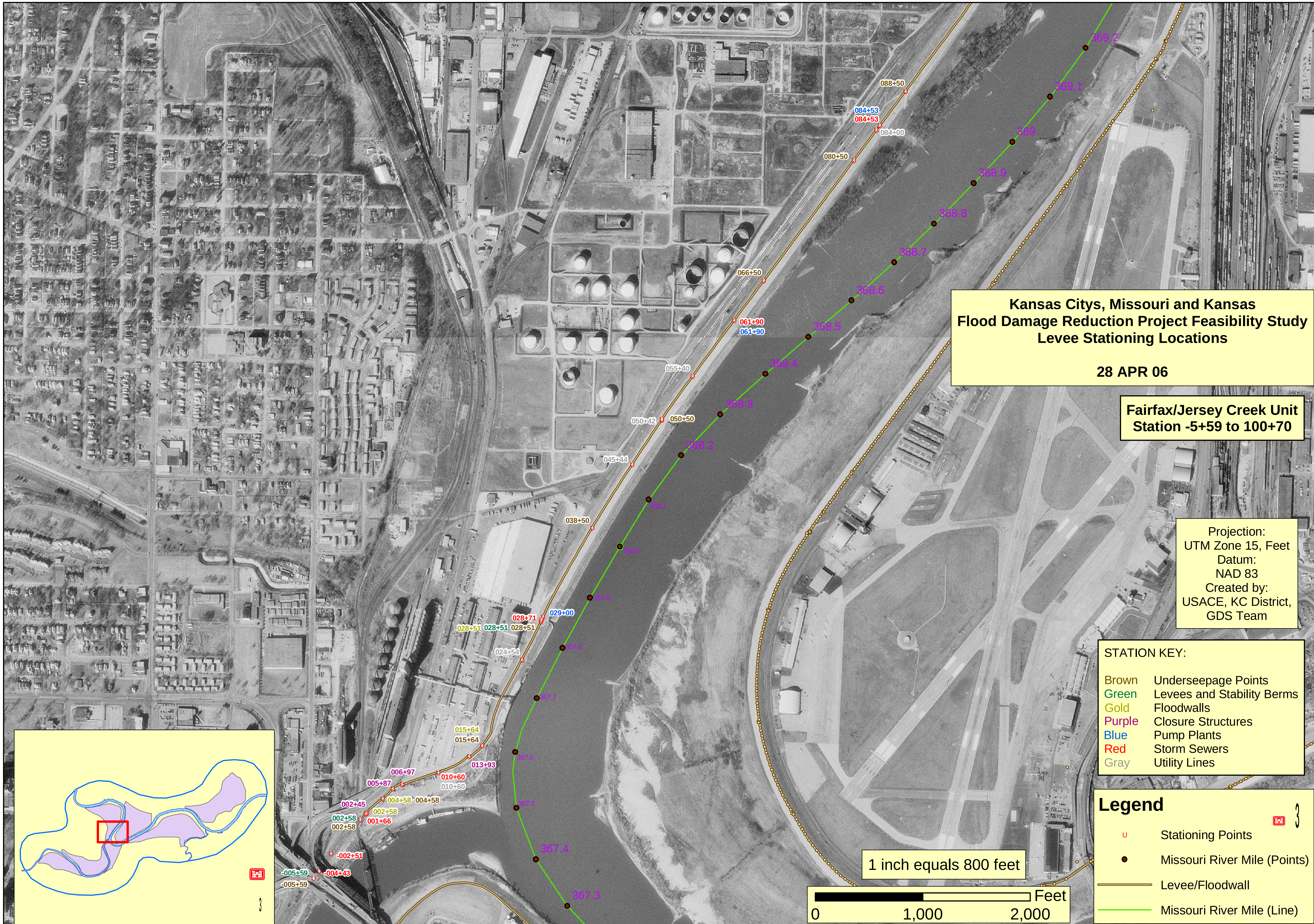
STORM SEWERS								
		Location		STRUCTURE INFORMATION				
Structure ID	Description	Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward	Analysis	Comments
30	KCK Municipal Water and Light Plant area drainage	289+70	45	24"	CIP	Flap Gate (RW) and Gate Valve (LW)	Adjust new pile spacing and bridge to protect CIP; Refer to the Civil Chapter of this Appendix	A. This is diverted to the pump plant at sta. 291+49 in times of flood. B. No significant changes have taken place with regard to the flows reaching this pipe since its design. The estimated percent impervious from visual inspection of the 1996 aerial photographs is shown, and does not reflect a significant change.
31	Outfall for KCK Municipal Water and Light Pump Plant	291+49	35	4'W x 6'H	RCB	Flap Gate (RW)	Adjust new pile spacing and bridge to protect RCB; Refer to the Civil Chapter of this Appendix	A. This plant receives water from several pipes in high stage situations. B. The plant no longer receives the sanitary flow that originally contributed to the pump plant; however, the flow was not considered in design because of its small flow rate. C. No significant changes have taken place with regard to the flows reaching this pipe since its design. The estimated percent impervious from visual inspection of the 1996 aerial photographs does not reflect a significant change.
32	KCK Municipal Water and Light Plant area drainage	291+86	40	4'W x 6'H	RCB	Flap Gate (RW) and Sluice Gate (LW)	Adjust new pile spacing and bridge to protect RCB; Refer to the Civil Chapter of this Appendix	A. This is diverted to the pump plant at sta. 291+49 in times of flood. B. No significant changes have taken place with regard to the flows reaching this pipe since its design. The estimated percent impervious from visual inspection of the 1996 aerial photographs does not reflect a significant change.
33	Drains area along the railroad tracks and 31.5 acres of upland area to the south	312+45	***	48"	CIP	Flap Gate (RW) and Sluice Gate (LW)	N/A	A. There is floodwall at this location. B. No significant changes have taken place with regard to the flows reaching this pipe since its design. The estimated percent impervious from visual inspection of the 1996 aerial photographs does not reflect a significant change.

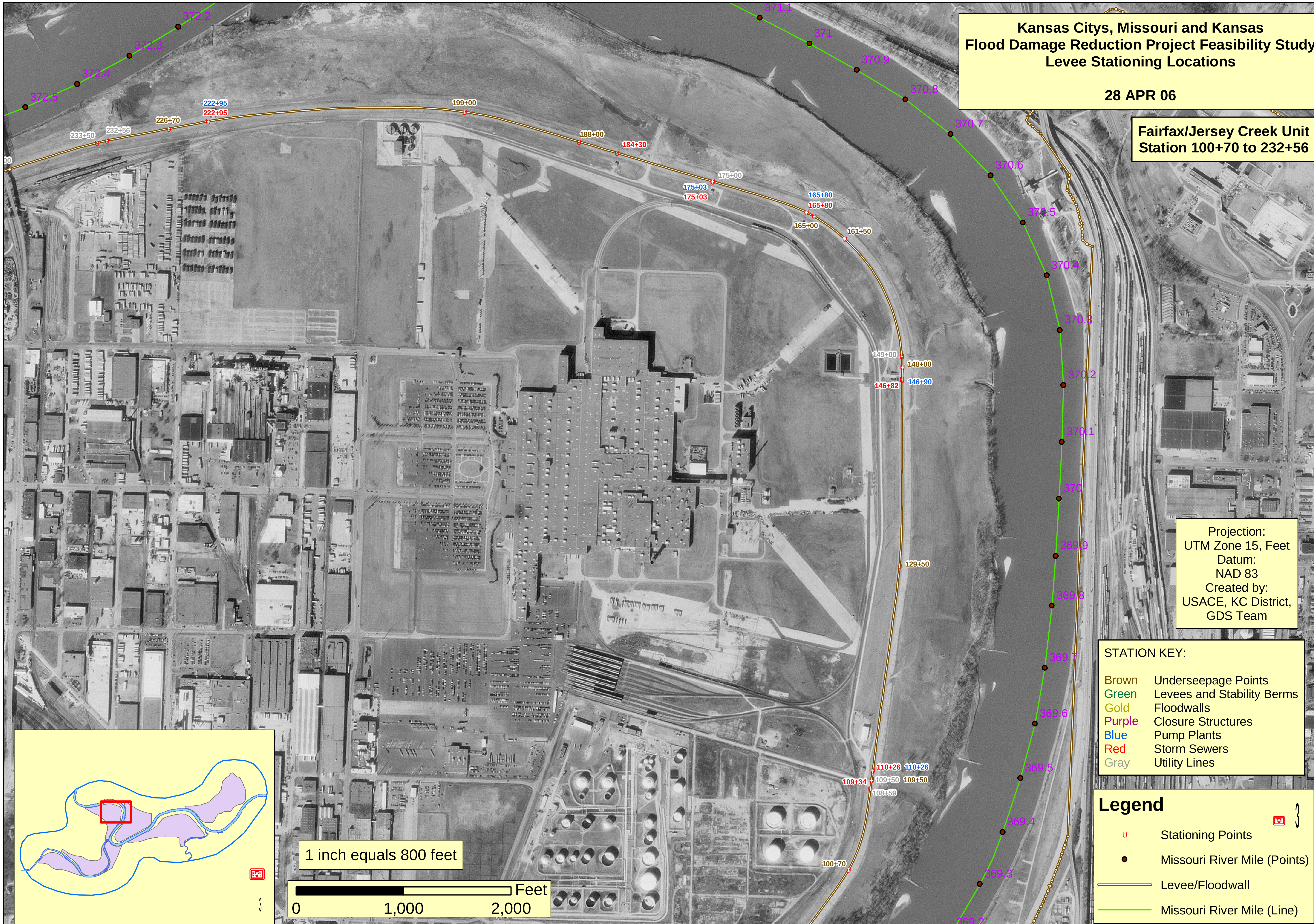
Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

Fairfax-Jersey Creek Unit

UTILITY LINES							
Station (ft.)	Function	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Analysis	Comments
10+60	Sanitary sewer	CIP	10"	*		N/A	Abandoned River Rail Elevator Sewer
24+54	Sanitary sewer	CIP	16"	*	Gate Valve, Sluice Gate, and Flap gate	N/A	Serves Cold Storage area riverward of floodwall
45+44	Industrial water	SP	20"	90'	Flap gate	N/A	Phillips Petroleum
50+42	Unloading dock pipe	SP	8"	240'	*	N/A	Williams Loading Dock
55+40	Petroleum	SP	1.3', 0.23', 0.13'	N/A	N/A	N/A	Phillips Petroleum - plugged
84+00	*	SP	20"	125	Flap gate	N/A	Phillips Petroleum - plugged
108+59	Gas line	SP	6"	210'	N/A	N/A	Williams - plugged
109+50	Gas line	SP	4-12"	150'	N/A	N/A	Williams Bros. pipe line
149+00	Storm sewer/wells	SP	54"	90'	Flap gate	N/A	PP/ F-6, abandoned
175+00	Storm sewer	SP	30"	260'	Flap gate and gate valve	N/A	Plugged
232+56	Petroleum	SP	8"	168'	N/A	N/A	Williams Bros. pipe line
233+50	Petroleum	SP	3-8"	174'	N/A	N/A	3 - Williams Bros. pipe line
242+00	Petroleum	SP	2-12"	230'	N/A	N/A	2 - Williams Bros. pipe line
285+87	Discharge	SP	54"	210'	Butterfly valve	N/A	Quindaro Power Plant/Line D
286+00	Discharge	SP	108"	210'	Butterfly valve	N/A	Quindaro Power Plant/Line C
286+14	Discharge	SP	108"	210'	Butterfly valve	N/A	Quindaro Power Plant/Line B
286+26	Discharge	SP	8"	210'	N/A	N/A	
286+34	Water intake	SP	108"	210'	Butterfly valve	N/A	Quindaro Power Plant/Line A
286+55	Electric	RCB	1'4"Wx3'H	120'	N/A	N/A	12 - 4" Electrical fiber ducts
292+69	Storm sewer	CIP	30"	*	Flap gate and gate valve	Adjust new pile spacing and bridge to protect utility line; Refer to the Civil Chapter of this Appendix	
293+60	Water intake	CIP	48"	*	*	Adjust new pile spacing and bridge to protect utility line; Refer to the Civil Chapter of this Appendix	Quindaro Power Plant/No. 1 & 2
293+70	Water intake	CIP	48"	*	*	Adjust new pile spacing and bridge to protect utility line; Refer to the Civil Chapter of this Appendix	Quindaro Power Plant/No. 1 & 2
293+84	Water intake	CIP	24"	*	*	Adjust new pile spacing and bridge to protect utility line; Refer to the Civil Chapter of this Appendix	Quindaro Power Plant/No. 1 & 2
293+89	Water intake	CIP	48"	*	*	Adjust new pile spacing and bridge to protect utility line; Refer to the Civil Chapter of this Appendix	Quindaro Power Plant/No. 1 & 2
295+59	Sanitary sewer	CIP	6"	*	Flap gate and gate valve	Adjust new pile spacing and bridge to protect utility line; Refer to the Civil Chapter of this Appendix	
297+92	Water line	SP	30"	*	N/A	Adjust new pile spacing and bridge to protect utility line; Refer to the Civil Chapter of this Appendix	Plugged and abandoned
298+04	Water line	SP	30"	*	N/A	Adjust new pile spacing and bridge to protect utility line; Refer to the Civil Chapter of this Appendix	Plugged and abandoned
307+89	Overflow	SP in CMP	36" IN 48"	30'	Flap gate and sluice gate	N/A	
312+28	Water line	SP	36"	10'	N/A	N/A	
313+17	Sanitary sewer	CIP	24"	10'	Sluice gate	N/A	

*Information not found


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Fairfax/Jersey Creek Unit
Station -5+59 to 100+70
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Stationing Points
Missouri River Mile (Points)
Levee/Floodwall
Missouri River Mile (Line)
1 inch equals 800 feet
Feet
0
1,000
2,000
369.2
369.1
369
368.9
368.8
368.7
368.6
368.5
368.4
368.3
368.2
367.4
367.3
088+50
084+53
084+53
084+00
080+50
066+50
061+90
061+90
055+40
050+42
050+50
045+44
038+50
029+00
028+71
028+51
028+51
028+51
024+54
015+64
015+64
013+93
010+60
010+60
006+97
005+87
004+58
004+58
002+45
002+58
002+58
002+58
001+66
-002+51
-004+43
-005+59
-005+59



Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Fairfax/Jersey Creek Unit
Station 100+70 to 232+56
372.2
372.3
372.4
372.5
371.1
371
370.9
370.8
370.7
370.6
370.5
370.4
370.3
370.2
370.1
370
369.9
369.8
369.7
369.6
369.5
369.4
369.3
369.2
233+50
232+56
226+70
222+95
222+95
199+00
188+00
184+30
175+00
175+03
175+03
165+80
165+80
165+00
161+50
149+00
148+00
146+82
146+90
129+50
110+26
110+26
109+34
109+50
109+50
108+59
100+70
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Stationing Points
Missouri River Mile (Points)
Levee/Floodwall
Missouri River Mile (Line)
1 inch equals 800 feet
Feet
0
1,000
2,000

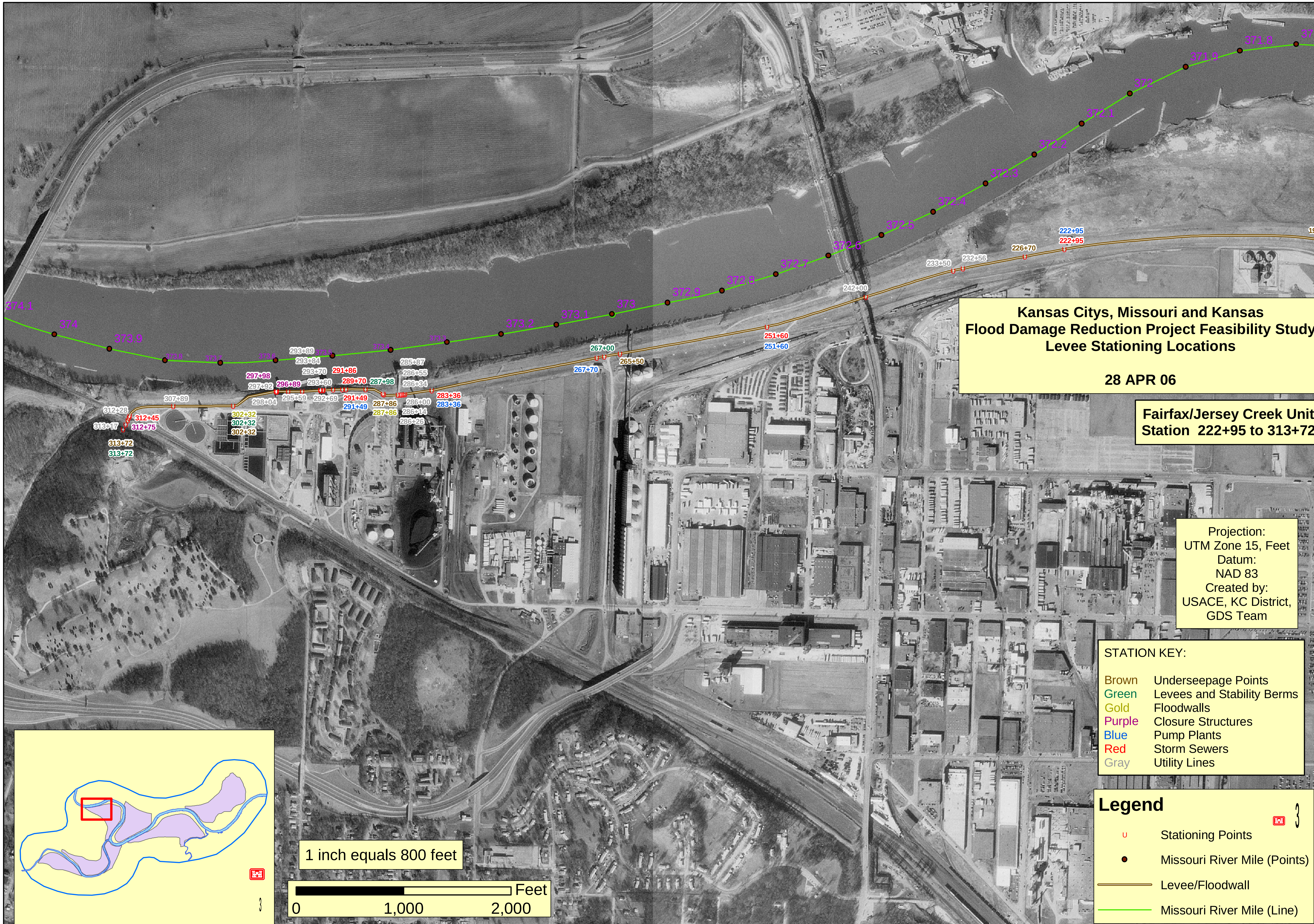
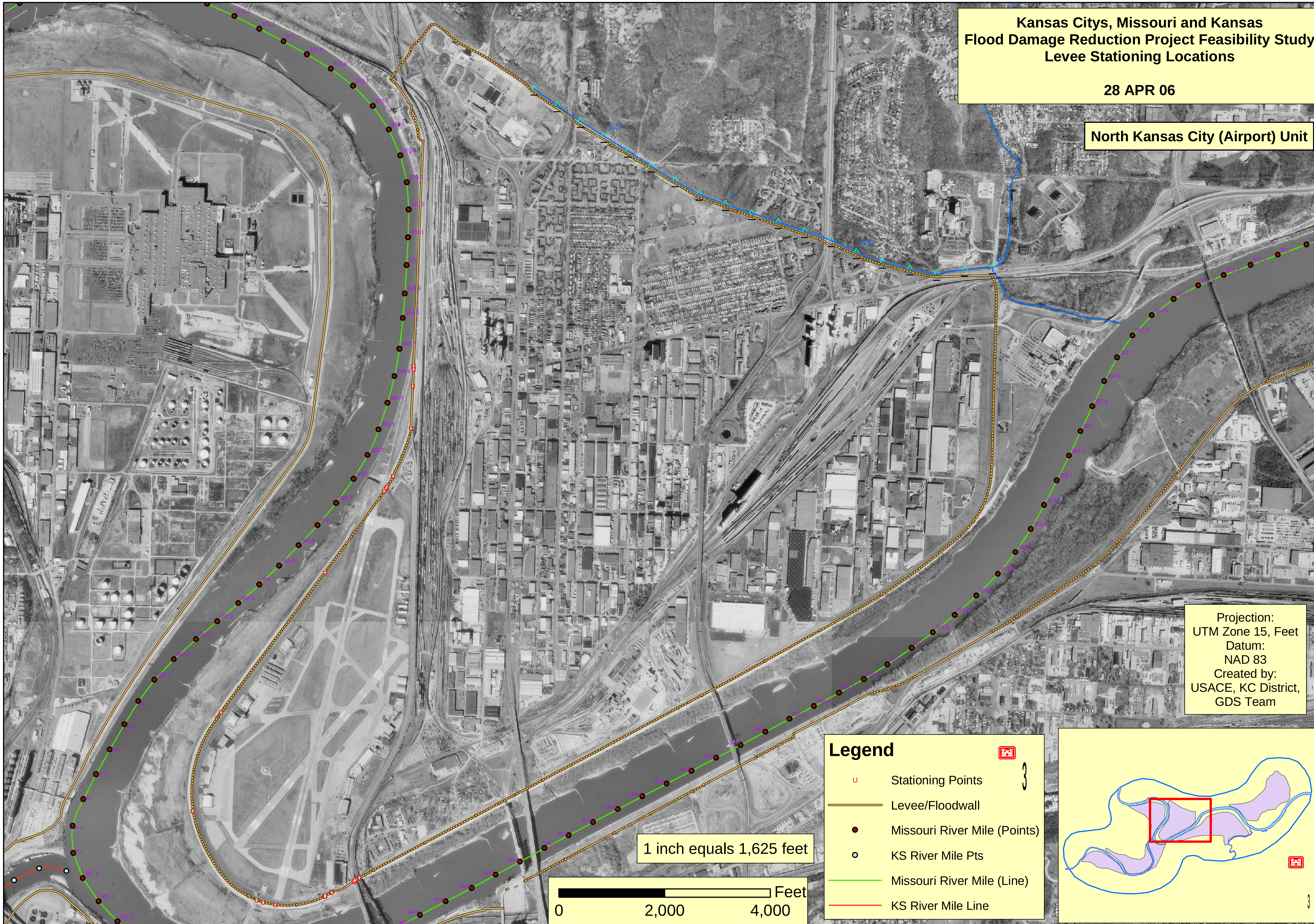

Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
Fairfax/Jersey Creek Unit
Station 222+95 to 313+72
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Stationing Points
Missouri River Mile (Points)
Levee/Floodwall
Missouri River Mile (Line)
1 inch equals 800 feet
Feet
0
1,000
2,000

EXHIBIT A-1.8
North Kansas City (Airport) Unit – Levee/Floodwall Features Inventory


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
North Kansas City (Airport) Unit
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
KS River Mile Pts
Missouri River Mile (Line)
KS River Mile Line
1 inch equals 1,625 feet
0
2,000
4,000
Feet

North Kansas City - Airport Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
70+40	71+00	None	7	N/A	
71+00	82+15	Collector pipe	20	N/A	
82+92	147+15	Relief wells (19)	20	N/A	Pumped to plant at 94+00; Average spacing of wells is 340'
147+15	208+43	Relief wells (29)	19	N/A	Pumped to plant at 188+82; Average spacing of wells is 210'

* Information not found

North Kansas City - Airport Unit

Relief Well Details

Well No.	*Station*
1	82+92.2
2	86+45
3	89+60
4	92+89.1
5	96+65
6	100+65
7	103+55
8	105+69.7
9	108+45.3
10	111+95
11	115+09.8
12	117+94.7
13	121+16.6
14	124+20.6
15	127+74.8
16	132+01.3
17	136+11.1
18	140+12.0
19	144+95.2
20	149+30.8
21	153+86.9
22	158+69.6
23	163+79.8
24	168+34.4

Well No.	*Station*
25	171+29.9
26	173+90.7
27	176+29.8
28	178+24.5
29	179+84.8
30	180+98.7
31	181+95.1
32	182+75.3
33	183+50.3
34	184+26.5
35	185+10.1
36	185+90.1
37	186+70
38	187+45
39	188+18.7
40	189+30.6
41	190+69.4
42	192+44.5
43	194+14.3
44	195+70.3
45	198+00
46	201+29.7
47	205+06.2
48	208+42.7

"All of the pressure relief wells in the North Kansas City Unit, Airport Section, are c the gravel pack type, fully penetrating, using Armco Iron Commercial wells screen manufactured by Edward E. Johnson, Inc., and wrought iron casing. All well screen and casing is 12 inches I.D. The minimum diameter of the gravel pack is 32 inches. The well is centered in the gravel pack which was tremied into place. Three gradations of gravel pack were used depending upon the gradation of the foundation materials obtained from the pilot holes. A pilot hole was drilled first at the proposed location of each well. After analysis of the logs of each pilot hole, the well was designed, establishing the elevation of each section of screen, casing, type of gravel pack and all other pertinent factors. Most of the wells were drilled by the reverse rotary method but a few of the initial wells constructed were drilled by the temporary casing method. In the majority of the wells, 18 feet of 36-inch I.D. temporary casing was placed usually by excavating from the inside of the pipe. The reverse rotary method was used to complete the well to the design depth. After each well was completed, it was surged and pump tested." (NKCA-7, Pages 5 and 6)

North Kansas City - Airport Unit

LEVEES					
Reach		Stability Berm		Analysis	Comments
Station	Station	Spring Point (ft.)	Width (ft.)		
70+40	74+18	N/A	N/A	N/A	A short retaining wall connects the levee to the floodwall, which extends from station 203+48 to 208+82
74+18	201+94	N/A	N/A	N/A	

North Kansas City - Airport Unit

FLOODWALLS							
Reach		Wall Type	Foundation Type	Piles		Analysis	Comments
Station	Station			Type	Length (ft.)		
FLOODWALL							
203+48	208+82	Cantilever wall	Concrete	Piles	21' minimum	N/A	Floodwall on levee for first 34' and last 12'; floodwall is in the vicinity of the Broadway bridge
RETAINING WALL							
201+94	203+48	*	*	*	*	N/A	This is a transition section from floodwall to levee

* Information not found

North Kansas City - Airport Unit

CLOSURE STRUCTURES								
Station (ft.)	Function	Type	Gap Height (ft.)	Width (ft.)	Foundation Type	Closure Materials	Analysis	Comments
None								

North Kansas City - Airport Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
North Airport Pump Plant / 94+19	759.0	(1) Storm sewer runoff: The flow is contributed by approximately the north 1/3 of the airport property (2) Seepage flow: The flow is from the portion of the seepage between sta. 76+00 and sta. 147+15 coming in from a relief well system.	36" CIP	N/A	A. There is a 30" CMP for the relief well system coming in from upstream (with respect to Missouri River) and a 48" CMP coming in from downstream. B. This pump plant was originally used for seepage only. A storm sewer system was eventually connected to the pump plant, which is reflected in the table. C. Representatives with Kansas City, Missouri said that the storm sewer area includes a portion of the Broadway Extension and a tank farm (for airport and jet fuel storage). Generally, the drainage area is above Taxiway D (runs east-west). D. Estimates were made of Design River Stage conditions based on best available information. The service area was delineated from a 1996 aerial map. The percent impervious was anticipated in the 1947 "Supplement on Interior Drainage" as 25%; this was found to be high because the anticipated buildings were not constructed. E. In obtaining design information, the project team learned that the ongoing Airport Drainage Improvements Plan includes construction of a new North Airport Pump Plant on the west side of the Airport. This would accompany an improved connecting sewer system (increase capacities to the plant). The new plant would handle most of the stormwater runoff now going to the existing North Airport Pump Plant, while the existing plant would handle relief well flows and minor stormwater. With that in mind, the conditions of the service area have not changed significantly since the construction of the existing plant.
South Airport Relief Well Pump Plant / 188+82	761.0	(2) The portion of the seepage between sta. 194+95 and sta. 210+35 coming in from a relief well system	Four 14" DIP	N/A	A. The new (current) South Pumping Plant for relief well flow was completed in 1994. Design of the plant was done by HNTB Corporation. B. A 36" RCP enters the plant from the west (from Relief Well #39 on plans) and an 18" RCP enters the plant from the east (from Relief Well #40 on plans). C. There is a 3" sump pump line (100 - 250 gpm) which is connected to one of the main pump outlet lines just outside of the valve chamber. D. As noted, this plant was designed a relatively short time ago, and conditions have not changed since that time.
South Airport Stormwater Pump Plant / 202+03	756.1	Storm sewer system flow: The flow goes through a 9' x9' RCB influent chamber which collects water from the southeast and southwest storm sewer systems.	Double 6' x 7' RCB	N/A	A. The Operation and Maintenance Manual for the pump plant is from 1995. The current pump plant replaces the old pump station located about 1/4 mile west which was inadequate for the design storm flow. B. The stages referred to for this pump plant are for the current Hannibal gage zero elevation of 706.4 feet. C. Excess storm flow is temporarily stored in the sewer system and designated detention areas between taxiways. The capacity for gravity flow through the system exceeds that of the pumping capacity up to a river stage of 24.0 feet. D. The pump plant is designed (240 cfs) taking into consideration some improvements to the storm sewer system leading to the pump plant. Those improvements are ongoing, so the capacity of the pumps is greater than that which can be conveyed through the system currently. E. As noted, this pump plant was designed only a relatively short time ago with the anticipation of continued improvements to the sewer systems. Other than those ongoing improvements (included in design capacity), the conditions of the service area have not significantly changed.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

North Kansas City - Airport Unit

STORM SEWERS								
		Location		STRUCTURE INFORMATION				
Structure ID	Description	Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward	Analysis	Comments
2	Outfall pipe for North Airport Pump Station	94+19	110'	36"	CIP	Upper Flap Gate (RW), Lower Flap Gate (RW), and Sluice Gate (in levee)	N/A	A. There was a portion of the discharge pipe replaced after the 1993 flood between the pump plant and discharge box. However, the replacement pipe is the still a 36" CIP. B. The percent impervious was estimated from 1996 aerial mapping. C. The conditions of the service area have not changed significantly since the time of design.
3	Outfall pipe for South Airport Relief Well Pump Plant	188+82	80'	four 14"	DIP	4 Gate Valves (in levee), 4 Check Valves (LW), 4 Shutoff Valves (LW), and 4 Flap Valves (RW)	N/A	A. The series of pipe sections follows the shape of the levee, going up, across, and then back down to the discharge elevation. B. As noted, this plant was designed a relatively short time ago, and conditions have not changed since that time.
3A	Outfall pipe for South Airport Stormwater Pump Plant	202+03	45'	double 6' W x 7' H	RCB	2 Sluice Gates (LW) and a Flap Gate (RW)	N/A	As noted in the pump plant information, the pump plant was designed a relatively short time ago with the anticipation of continued improvements to the sewer systems. Other than those ongoing improvements (included in design capacity), the conditions of the service area have not significantly changed.

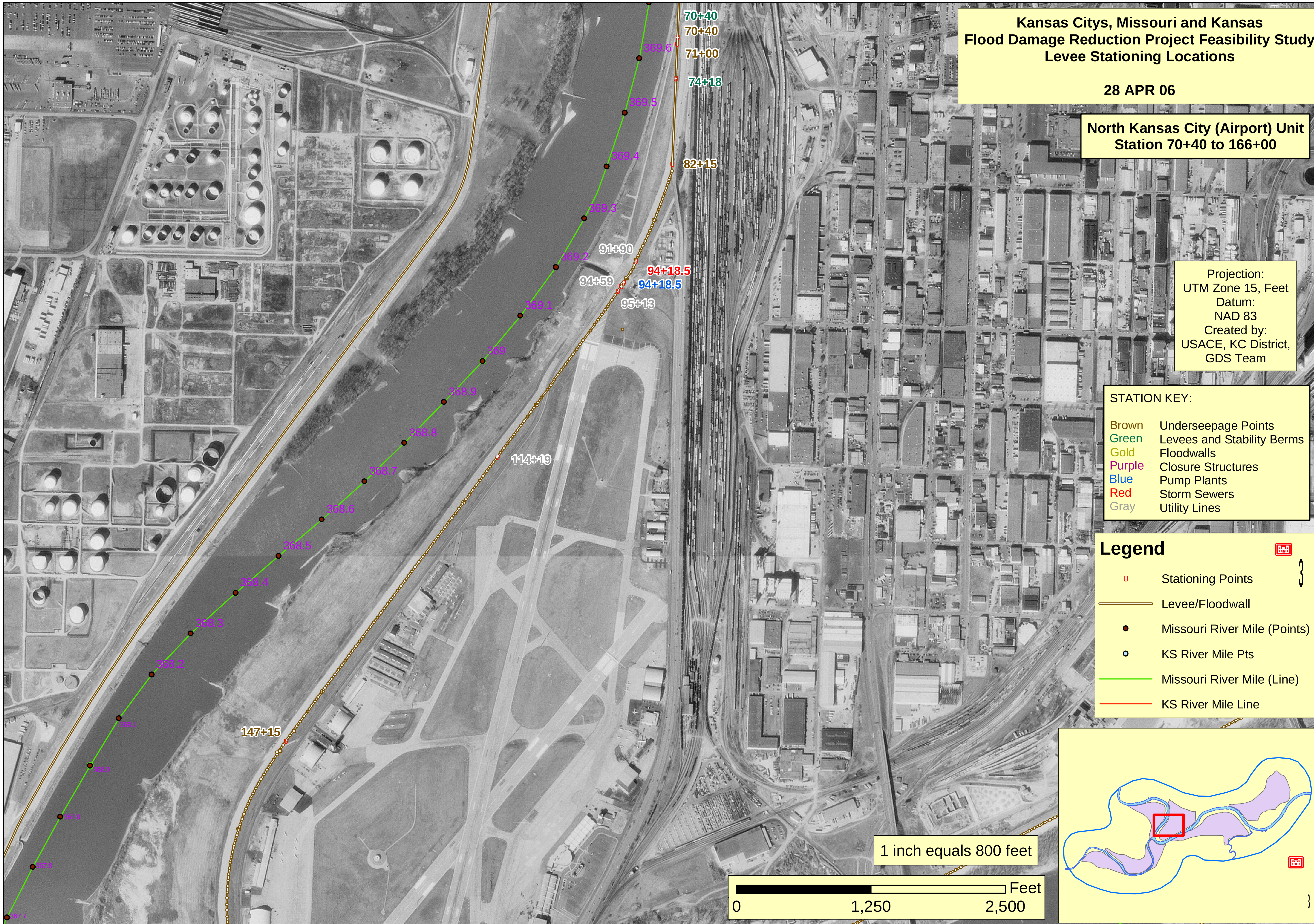
Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

North Kansas City - Airport Unit

UTILITY LINES

Station (ft.)	Function	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Analysis	Comments
91+90	Petroleum				*	N/A	
94+59	Electrical				N/A	N/A	
95+13	Electrical				N/A	N/A	
114+19	Electrical				N/A	N/A	Runway light cable
190+02	Sanitary sewer				Air relief valve	N/A	

* Information not found


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
North Kansas City (Airport) Unit
Station 70+40 to 166+00
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
KS River Mile Pts
Missouri River Mile (Line)
KS River Mile Line
1 inch equals 800 feet
0 1,250 2,500 Feet
70+40
70+40
71+00
74+18
82+15
91+90
94+59
94+18.5
94+18.5
95+13
114+19
147+15
369.6
369.5
369.4
369.3
369.2
369.1
369
368.9
368.8
368.7
368.6
368.5
368.4
368.3
368.2

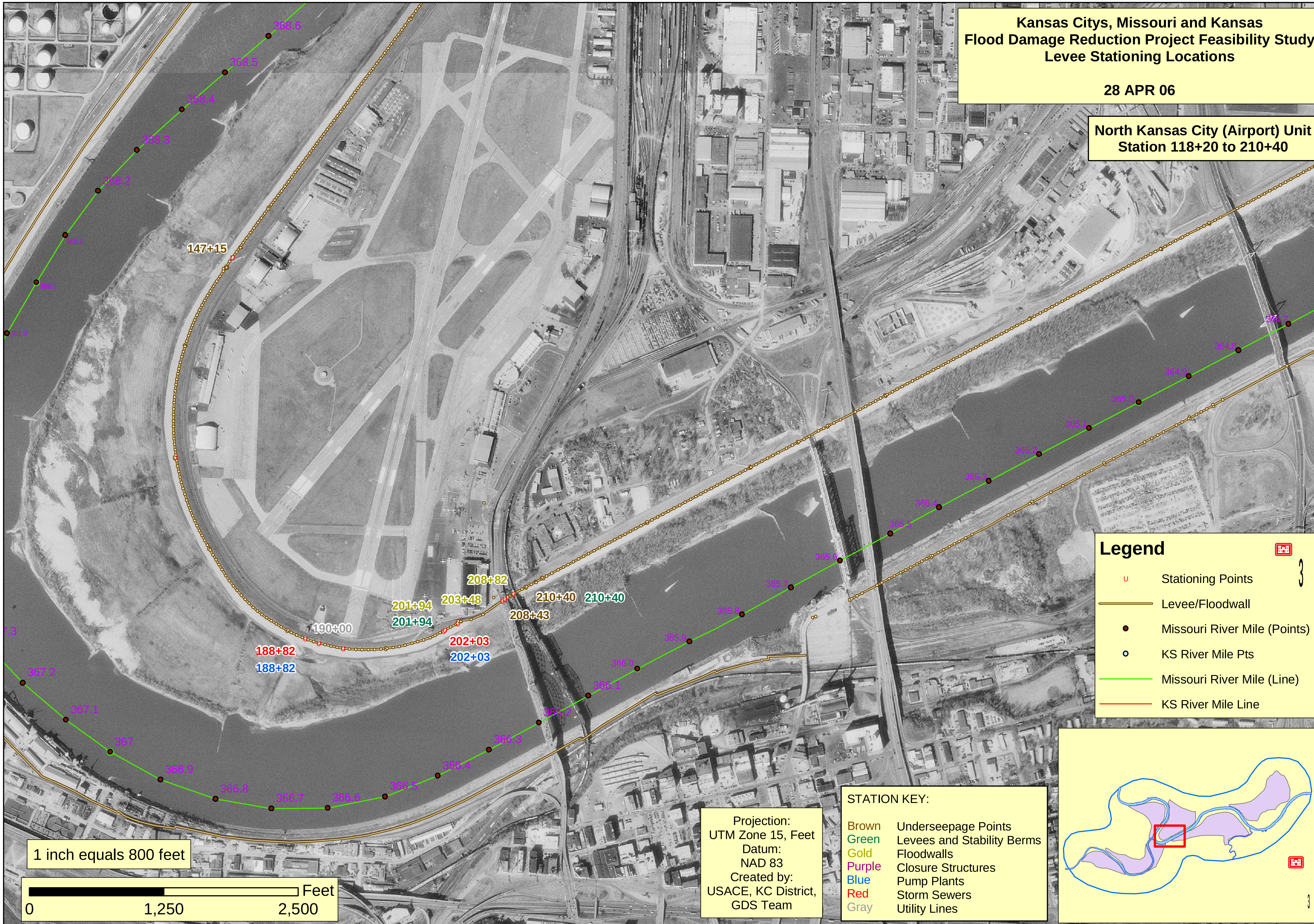
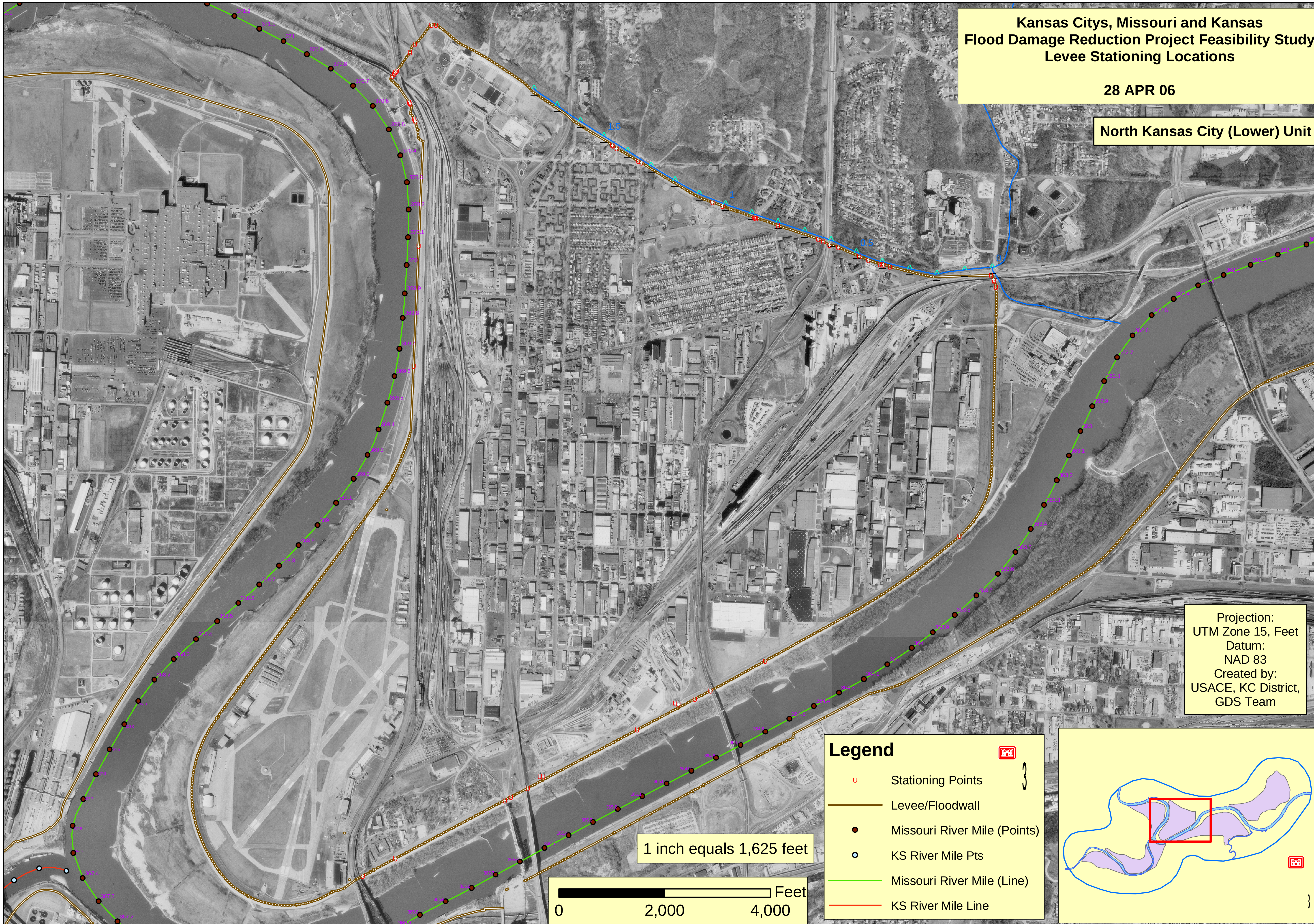

Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
North Kansas City (Airport) Unit
Station 118+20 to 210+40
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
KS River Mile Pts
Missouri River Mile (Line)
KS River Mile Line
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
1 inch equals 800 feet
Feet
0
1,250
2,500
147+15
208+82
201+94
203+48
210+40
210+40
201+94
208+43
190+00
188+82
188+82
202+03
202+03
368.6
368.5
368.4
368.3
368.2
367.2
367.1
367
366.9
366.8
366.7
366.6
366.5
366.4
366.3
366.2
366.1
366.0
365.9
365.8
365.7
365.6
365.5
365.4
365.3
365.2
365.1
365.0
364.9
364.8
364.7

EXHIBIT A-1.9
North Kansas City (Lower) Unit – Levee/Floodwall Features Inventory



Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
North Kansas City (Lower) Unit
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
KS River Mile Pts
Missouri River Mile (Line)
KS River Mile Line
1 inch equals 1,625 feet
0
2,000
4,000
Feet

North Kansas City - Lower Unit

UNDERSEEPAGE CONTROL					
Reach		Type of Control	Design Head (ft.)	Analysis	Comments
Station	Station				
0+00	7+60	None	10 to 20	N/A	Highly variable ground surface according to NKCA-6, Plate 12
7+60	11+89	Collector pipe	20	N/A	2 access manholes and 2 discharge manholes; discharged to the ground surface.
11+89	70+40	None	7	N/A	
Stations 70+40 to 210+40 are detailed in the NKC Airport spreadsheets					
210+40	245+00	Landside underseepage berm from Station 242+80 to 257+00	18	Refer to the Geotechnical Chapters of this Appendix	Harlem Area of Kansas City North; Originally designed to have 13 relief wells but they were eliminated in favor of using the natural blanket for seepage protection. This area was to be under close observation during high river stages.
245+00	281+00	Landside underseepage berm from 242+80 to 257+00	17	Refer to the Geotechnical Chapters of this Appendix	10.9 cfs of uncontrolled seepage currently goes to the National Starch pumping plant, with the remainder to be ponded near 253+00; 5 to 10 ft of sand overlies the blanket between 241+40 and 312+00; a new pump plant is part of the recommended pressure relief well system improvements
281+00	390+00	Long landside underseepage berm from 271+00 to 390+00	17 to 21	N/A	48 cfs of uncontrolled seepage can be handled by Rock Creek pumping plant with remainder to be ponded to max elevation of 734; 5 to 10 ft of sand overlie the blanket between 241+40 and 312+00
390+00	469+17	None	17	N/A	

North Kansas City - Lower Unit

LEVEES

Reach		Stability Berm		Analysis	Comments
Station	Station	Spring Point (ft.)	Width (ft.)		
0+00	12+62	N/A	N/A	N/A	Existing conditions analysis uses strength values of Tan (phi) and C of 0.55 and 0.0, respectively
12+62	70+40	N/A	N/A	N/A	Existing conditions analysis uses strength values of Tan (phi) and C of 0.55 and 0.0, respectively
Stations 70+40 to 210+40 are detailed in the NKC Airport spreadsheets					
210+40	240+00	N/A	N/A	N/A	
241+40	390+33	*	*	N/A	Minimum FS assumes that water is trapped in the random fill zone and exerts pressure on riverside slope.
390+33	469+11	*	*	N/A	Existing conditions analysis uses strength values of Tan (phi) and C of 0.55 and 0.0, respectively; Floodwalls at 411+30 to 412+55 and 415+60 to 417+42

* Information not found

North Kansas City - Lower Unit

FLOODWALLS									
Reach		Wall Type	Foundation Type	Piles		Cutoff		Analysis	Comments
Station	Station			Type	Length (ft.)	Type	Length (ft.)		
411+30	412+55	Inverted cantilever T-wall	Spread	N/A	N/A	N/A	N/A	N/A	Along Hillside Ditch
415+60	417+42	Inverted cantilever T-wall	Spread	N/A	N/A	N/A	N/A	N/A	Along Hillside Ditch

* Information not found

North Kansas City - Lower Unit

CLOSURE STRUCTURES								
Station (ft.)	Function	Type	Gap Height (ft.)	Width (ft.)	Foundation Type	Closure Materials	Analysis	Comments
13+17	Railroad	Stoplog	7.3'	73'	Spread	Aluminum	N/A	Burlington Northern Railroad tracks
421+90	Vehicle	Sandbag	3.0'	52'	Spread	Sandbags	N/A	Antioch Road (Missouri State Highway 1)
463+33	Vehicle	Stoplog	3.0'	30'	Spread	Aluminum	N/A	Holmes Street
468+16	Vehicle	Stoplog	3.0'	30'	Spread	Aluminum	N/A	Cherry Street

* Information not found

North Kansas City - Lower Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
26th Avenue Pump Plant / 47+66	760.8	(1) Storm sewer system flow: The flow comes from the northwestern part of the Drainage District.	72" RCP	N/A	A. This was a combined sewer system with a sanitary flow estimated at 1.6 cfs. However, a separate pump was designated for the sanitary flow and was therefore not considered in the contributing flows. The sanitary flow no longer is pumped through this pump plant outlet to the river, but was not initially considered anyway. B. Ponding due to the lack of sewer capacity will concentrate in low undrained areas and be disposed of by the natural processes of infiltration and evaporation. The very flat nature of the area will force the runoff to be spread thinly over large areas and not accumulate to considerable depth at any one point. As a result, there should be no damage. It is noted, though, that many more buildings have been constructed in the drainage area, greatly increasing the percent impervious. The new percent impervious was approximated by visual inspection of 1996 aerial photographs. Ponding may increase slightly, but the cause is lack of sewer capacity.
		(2) Seepage flow: The flow is from the portion of the seepage between sta. 0+00 and sta. 76+00, which by nature of typography reaches the 26th Ave. sewer system.			C. Analysis was done using the Condition 1 stage of 10.6 feet, then it was decided to start pumping at the slightly higher 11.7 feet stage. The difference did not warrant a new analysis. D. If the system capacity was ever increased, the runoff reaching the pump plant could cause the pump capacity to be inadequate.
Atlantic-Erie Pump Plant / 248+47	755.4	(1) Seepage flow: The flow is from the portion of the seepage between sta. 241+40 and sta. 280+00.	Three 66" L / 48" R	N/A	A. This plant was essentially built next to the Burlington Avenue Pump Plant to replace the older pump plant. The city of North Kansas City built the Atlantic-Erie in the early 1970s and leases it to the levee district. The gates of the Burlington Avenue Pump Plant are used to back water up to the Atlantic Erie Pump Plant. B. The outlet pipes discharge at the top of the levee. C. The project team contacted the City of North Kansas City to obtain design information on the plant. The Atlantic-Erie Pump Plant has 3 pumps with a rating of 88,000 gpm each. The City has never seen all three pumps working; generally only one is needed. D. There is undrained seepage between sta. 210+40 and sta. 240+00. E. As the Atlantic-Erie Pump Plant receives water backed-up from the Burlington Avenue Pump Plant, the general design conditions were the same when the plant was built. The percent impervious has increased since that time in the service area and the new value is reflected in the table. The percent impervious was approximated by visual inspection of 1996 aerial photographs. F. If the system capacity was ever increased, the runoff reaching the pump plant would increase. However, it seems that the pump capacity is adequate to handle a substantial increase.
		(2) Storm sewer system flow: The flow is from storm sewers in the eastern and southern part of the Drainage District, and a small amount of flow from the National Starch Company area.			

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

North Kansas City - Lower Unit

PUMP PLANTS					
Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Burlington Avenue Pump Plant / 248+84	755.4	(1) Storm sewer system flow: The flow is from the eastern and southern part of the North Kansas City Drainage District.	84" RCP	N/A	A. The 1945 Supplement on Interior Drainage proposed the plant that now exists, but the design stages and flows discussed was for the old plant located 65 feet riverward of the centerline of levee at approximately station 249+22. Therefore, the exact gate closure elevation for the current plant is not known. B. This was a combined sewer system with all of the flow going to the same pumps. Sanitary flow no longer contributes to this pump plant and was, therefore, removed from the listing. This would slightly improve conditions in that respect. The slight improvement is outweighed by an increase in impervious area. C. The entire drainage area was largely developed in the original design condition, but it is even more so now. The percent impervious and the runoff have increased slightly, but it is still the sewer capacity that controls with respect to pumping needs. D. The flat nature of the topography causes the ponded water due to insufficient sewer capacity to be spread out thinly, resulting in a depth that should not be sufficient to block traffic or to produce damage to the area. E. If the system capacity was ever increased, the runoff reaching the pump plant would increase. However, the pump plant is now only used for emergencies.
Linn-Jasper Pump Plant / 277+48	754.7	Storm sewer system flow: The flow is surface water runoff collected in the Howell Street closed sewer system in the central portion of the North Kansas City Drainage District.	42" L / 30" R	N/A	A. This plant was essentially built next as a replacement for the function of the Howell Street Pump Plant. The city of North Kansas City built the Linn-Jasper in the early 1970s and leases it to the levee district. The gates of the Howell Street Pump Plant are used to back water up to the Linn-Jasper Pump Plant. B. The outlet pipes discharge at the top of the levee. C. As the Linn-Jasper Pump Plant receives water backed-up from the Howell Street Pump Plant, the general design conditions were the same when the plant was built. The area tributary to the pump plant has not undergone any significant changes since the design. The estimated percent impervious was from visual inspection of 1996 aerial photographs. D. If the system capacity was ever increased, the runoff reaching the pump plant would increase.
Howell Street Pump Plant / 277+86	754.7	Storm sewer system flow: The water is surface water runoff collected in the Howell Street closed sewer system in the central portion of the North Kansas City Drainage District.	72" RCP	N/A	A. This system had industrial waste and sanitary flow reaching the pump plant at an estimated 2.3 cfs. However, there were separate pumps for the sanitary flow, so it was not considered in the analysis. The sanitary flows no longer go to the pump plant, but were not considered in the first place. B. The sewers are expected to be overcharged practically every year. However, as with the Burlington Avenue system, the overcharge of sewers in a flat area of this kind does not result in any appreciable damage. C. There is no seepage to consider for this area. D. The conditions of the service area for this pump plant have not gone through any significant changes since the original design of the plant. The estimated percent impervious was from visual inspection of 1996 aerial photographs. E. If the system capacity was ever increased, the runoff reaching the pump plant would increase. However, the pump plant is now only used for emergencies.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

North Kansas City - Lower Unit

PUMP PLANTS

Name / Station (ft) or Location	Design Flood Elevation (ft)	Contributing Flows	River Discharge Conduit(s)	Analysis	Comments
Rock Creek Pump Plant / 388+96	751.8	(1) Seepage flow: The flow has contributions from about sta. 240+00 to about sta. 390+00.	2 - 6' x 6' RCB, but one is blocked with a bulkhead	N/A	A. Sanitary flow from the 19th Street Pump Plant no longer goes to the Rock Creek Pump Plant. This slight advantage is outweighed by the increased storm runoff. B. The flow to the Rock Creek Pump Plant is carried by a ditch system. The main ditch is called the Armour ditch, which drained a large portion of the area north of Armour Road. The other part of the ditch system is the Railroad Avenue ditch which drained a mixture of industrial area and open fields. The entire area is now heavily developed, with increased impervious area and runoff.
		(2) Storm runoff: The flow reaches the plant by overland flow and ditch conveyance.			C. Between stations 241+40 and 390+33, a landside blanket is used for seepage control. With the use of the blanket, all surface runoff and seepage water between stations 281+00 and 390+33 drains to the Rock Creek Pumping Plant. D. If the ditch compacity were somehow increased, the runoff reaching the plant would increase. The pump capcity for the "Design Flood Stage" condition already appears inadequate.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pump plant location.

North Kansas City - Lower Unit

STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
1	Outlet pipe for 26th Avenue Pump Plant	47+66	150	72"	RCP	Upper Flap Gate (LW), Lower Flap Gate (RW) and Sluice Gate (LW)	N/A	A. The conduit used to be a 54" pipe, but was modified in 1962 to a 72" RCP. B. As noted in the pump plant information, the drainage area has been developed to a greater extent than the original design condition. However, the storm sewer system upstream of the plant still controls.
4	Outlet pipes for Atlantic-Erie Pump Plant	248+47	95	Three 66" L / 48" R	SP	N/A	N/A	A. There are no control structures because the outlets are above the design flood level. B. As the Atlantic-Erie Pump Plant receives water backed-up from the Burlington Avenue Pump Plant, the general design conditions were the same when the plant was built. The percent impervious has increased since that time in the service area and the new value is reflected in the table. The percent impervious was approximated by visual inspection of 1996 aerial photographs. C. If the upstream system capacity was ever increased, the runoff pumped through the outfall pipe would increase. However, it seems that the pipe capacity is adequate to handle a substantial increase.
5	Outlet pipe for Burlington Avenue Pump Plant	248+84	80	84"	RCP	Flap Gate (RW) and Sluice Gate (LW)	N/A	A. The pump plant is not used much anymore because of the Atlantic-Erie Pump Plant. The Atlantic-Erie plant essentially replaced the function of the Burlington Avenue plant. B. As noted in the pump plant information, the drainage area is even more developed than it was in the original design condition. However, the upstream sewer system capacity controls the flow reaching the plant.

Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

North Kansas City - Lower Unit

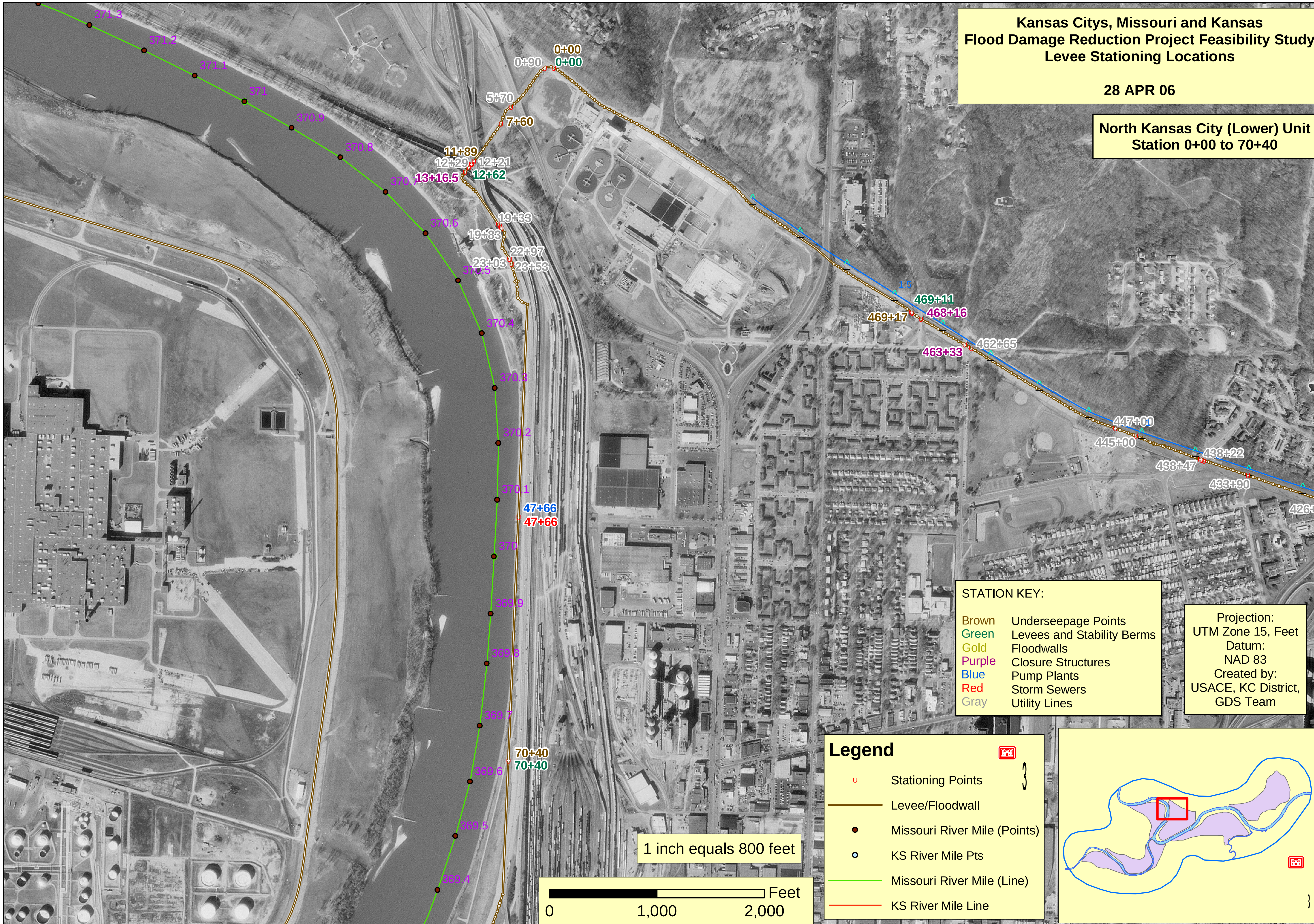
STORM SEWERS								
Structure ID	Description	Location		STRUCTURE INFORMATION			Analysis	Comments
		Levee Station (ft)	Offset to Outlet (ft)	Conduit Size	Conduit Composition	Control Structure Type LW = landward RW = riverward		
7	Outlet pipes for Linn-Jasper Pump Plant	277+48	70	Two 42" L / 30" R	SP	2 Flap Gates (RW)	N/A	A. As the Linn-Jasper Pump Plant receives water backed-up from the Howell Street Pump Plant, the genera design conditions were the same as when the plant was built. The area tributary to the pump plant has not undergone any significant changes since the design. The estimated percent impervious was from visual inspection of 1996 aerial photographs. B. If the upstream system capacity was ever increased, the runoff pumped through the outfall pipe would increase. However, it seems that the pipe capacity is adequate to handle a substantial increase.
8	Outlet pipe for Howell Street Pump Plant	277+86	100	72"	RCP	Sluice Gate (LW) and Flap Gate (RW)	N/A	A. The pump plant is not used much anymore because of the Linn-Jasper Pump Plant. The Linn-Jasper plant essentially replaced the function of the Howell Street plant. B. The conditions of the service area for the pump plant have not gone through any significant changes since the original design of the plant. The estimated percent impervious is from visual inspection of 1996 aerial photographs.
10	Outlet boxes for Rock Creek Pump Plant	388+96	100	Double 6' X 6'	RCB	Sluice Gate (LW) and Flap Gate (RW)	N/A	A. One of the boxes is plugged with a bulkhead. B. Sanitary flow from the 19th Street Pump Plant no longer goes to the Rock Creek Pump Plant. C. As noted in the pump plant information, the entire contributing area is now heavily developed. The estimated percent impervious is from visual inspection of 1996 aerial photographs.

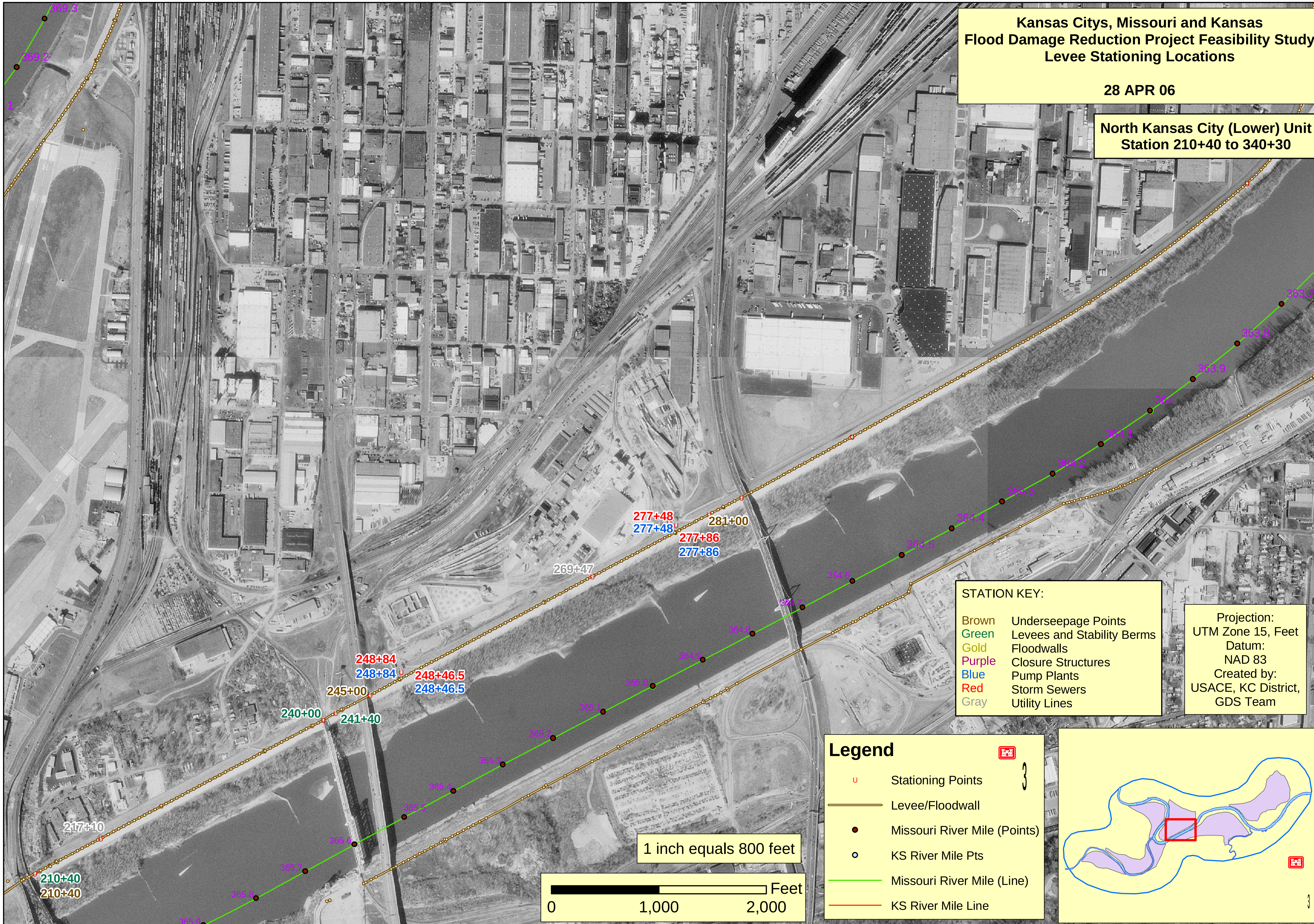
Note: Unless shown otherwise, stages given refer to the Kansas City gage on the Hannibal Bridge at Missouri River mile 366.1 using the original datum of 715.79. This original datum was in use from February, 1948 to October, 1989, when the current datum of 706.4 went into effect. Elevations in the table correspond to the river at the pipe location.

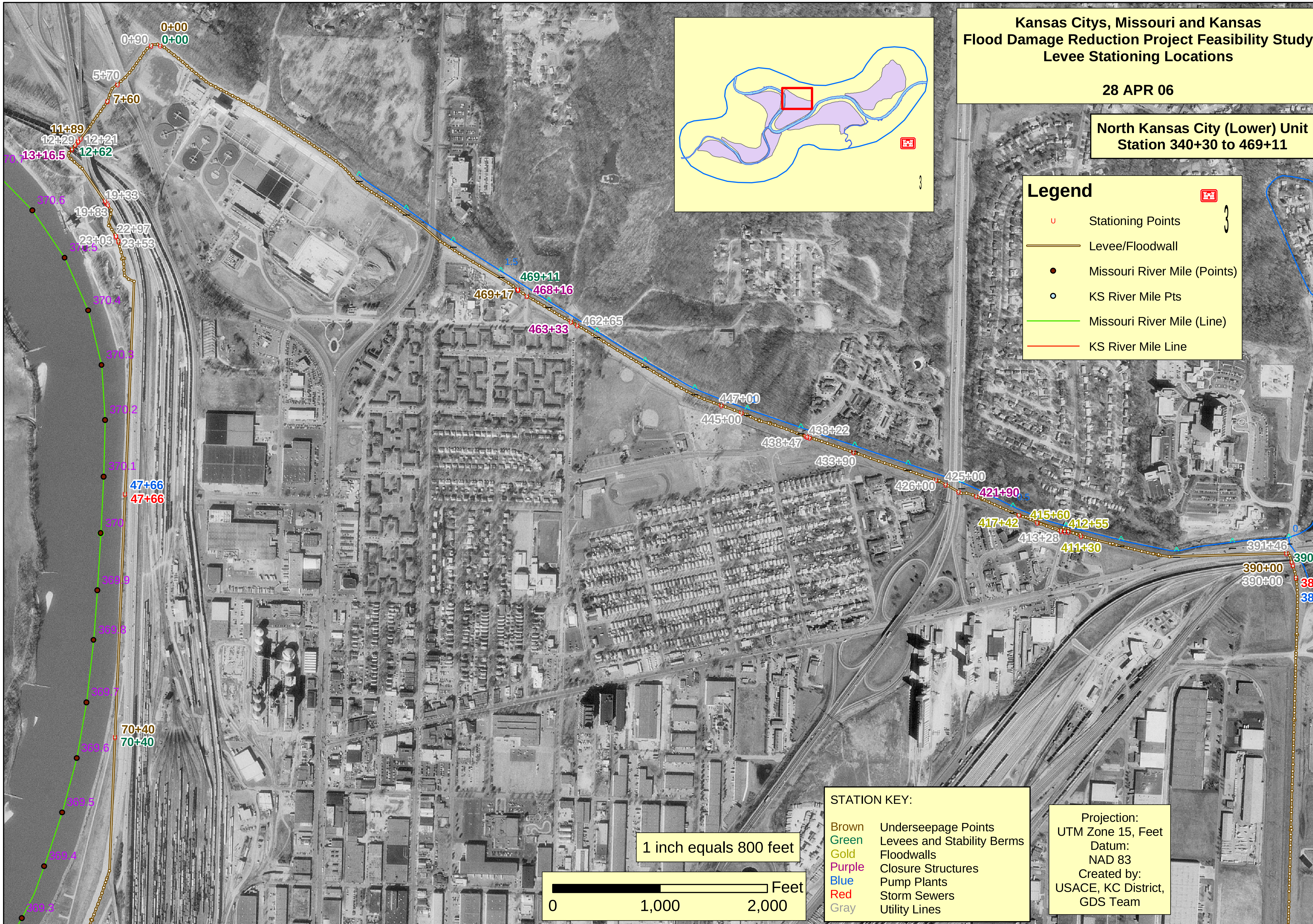
North Kansas City - Lower Unit

UTILITY LINES							
Station (ft.)	Function	Conduit Composition	Conduit Size	Conduit Length Below Flood Protection (ft.)	Control Structure Type	Analysis	Comments
0+90	Water line	*	36"	110'	N/A	N/A	
5+70	Gas main	SP	6"	*	N/A	N/A	
12+21	Natural gas	Iron pipe	3"	*	N/A	N/A	
12+29	Sanitary sewer	Iron pipe	20"	*	N/A	N/A	
19+33	Water intake	RCP	78"	*	6 Sluice gates	N/A	
19+83	Water line	CIP	8"	*	Valve	N/A	
22+97	Electrical conduit	N/A	2-5"	*	N/A	N/A	
22+97	Water intake	SP	2-60"	*	*	N/A	2 pipes
22+97	Water line	CIP	6"	*	N/A	N/A	
23+03	Water outlet	RCP	6"	*	*	N/A	
23+53	Effluent	RCP	54"	*	*	N/A	
217+10	Sanitary sewer	CIP	8"	140'	*	Refer to the Civil Chapter of this Appendix	
269+47	Industrial water	CIP	24"	150'	*	Refer to the Civil Chapter of this Appendix	
390+00	Water force main	*	24" to 30"	140'	N/A	N/A	
391+46	Gas main	Iron pipe	30"	*	N/A	N/A	
413+28	Water main	*	12"	60'	N/A	N/A	
425+00	Fiber optic cable	*	*	110'	N/A	N/A	
426+00	Fiber optic cable	*	*	N/A	N/A	N/A	
433+90	Storm sewer	SP	10"	130'	*	N/A	Abandoned
438+22	Gas main	SP	6"	190'	N/A	N/A	
438+47	Water main	CIP	8"	190'	N/A	N/A	
445+00	Water main	*	16"	*	*	N/A	
447+00	Water main	*	12"	*	*	N/A	
462+65	Sanitary sewer	Iron pipe	20"	200'	N/A	N/A	
447+00	Water line	SP	16"	120"	N/A	N/A	

* Information not found


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
North Kansas City (Lower) Unit
Station 0+00 to 70+40
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
KS River Mile Pts
Missouri River Mile (Line)
KS River Mile Line
1 inch equals 800 feet
Feet
0
1,000
2,000
0+00
0+90
0+00
5+70
7+60
11+89
12+29
12+21
12+62
13+16.5
19+33
19+83
22+97
23+03
23+53
47+66
47+66
70+40
70+40
469+11
469+17
468+16
462+65
463+33
447+00
445+00
438+22
438+47
433+90
426+00
371.3
371.2
371.1
371
370.9
370.8
370.7
370.6
370.5
370.4
370.3
370.2
370.1
370
369.9
369.8
369.7
369.6
369.5
369.4


Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
North Kansas City (Lower) Unit
Station 210+40 to 340+30
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
KS River Mile Pts
Missouri River Mile (Line)
KS River Mile Line
1 inch equals 800 feet
Feet
0
1,000
2,000
277+48
277+48
281+00
277+86
277+86
269+47
248+84
248+84
248+46.5
248+46.5
245+00
240+00
241+40
217+10
210+40
210+40



Kansas Citys, Missouri and Kansas
Flood Damage Reduction Project Feasibility Study
Levee Stationing Locations
28 APR 06
North Kansas City (Lower) Unit
Station 340+30 to 469+11
Legend
Stationing Points
Levee/Floodwall
Missouri River Mile (Points)
KS River Mile Pts
Missouri River Mile (Line)
KS River Mile Line
STATION KEY:
Brown Underseepage Points
Green Levees and Stability Berms
Gold Floodwalls
Purple Closure Structures
Blue Pump Plants
Red Storm Sewers
Gray Utility Lines
1 inch equals 800 feet
0 1,000 2,000 Feet
Projection:
UTM Zone 15, Feet
Datum:
NAD 83
Created by:
USACE, KC District,
GDS Team