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-2

HYDROLOGY AND HYDRAULICS

CHAPTER A-2
HYDROLOGY AND HYDRAULICS

A-2.1 INTRODUCTION

A hydraulic analysis was performed on the Missouri and Kansas Rivers by the U.S. Army Corps of Engineers (USACE), Kansas City District (KCD). The hydraulic computations are based on the USACE HEC-RAS step-backwater computer software program (HEC-RAS 3.1.1). Calibration was performed to produce water surface profiles for the Missouri and Kansas Rivers near Kansas City, Missouri. The study area consists of approximately 40 river miles on the Missouri River, from RM 340 to RM 380, and 15 river miles on the Kansas River, from RM 0 to RM 15. The HEC-RAS model was developed using the latest available floodplain mapping for the Missouri and Kansas Rivers and the latest hydrographic survey data. The existing conditions model was calibrated to the 1993 flood event using surveyed high-water marks.

The seven levee units of interest for this study include: Argentine, Armourdale, Birmingham, Central Industrial District, East Bottoms, Fairfax-Jersey Creek, and North Kansas City. This section of the Engineering Appendix documents development of water surface profiles through the existing seven-levee system in the Kansas City area and evaluates alternatives for improving the integrity of the existing flood control system. The HEC-RAS model developed in this study was used to model existing conditions, future conditions without project, and future conditions with project alternatives.

In addition to the hydraulic analysis performed on the Missouri and Kansas Rivers, results from other studies are presented that characterize the existing conditions. These additional studies include: an analysis of levee tiebacks; development of interior floodwater/exterior water surface elevation relationships; an evaluation of drainage control structures and associated areas of interior stormwater flooding; and an analysis of the hydraulic impacts from bridges.

A-2.2 STREAM AND VALLEY CHARACTERISTICS

A-2.2.1 Missouri River

The Missouri River natural valley floodplain is approximately 2 to 2½ miles wide, while the main channel averages about 1,000 feet wide throughout the project reach. Bank-full discharge is approximately 140,000 cubic feet per second (cfs) for the reach of the Missouri River upstream of the mouth of the Kansas River. For the reach of the Missouri River downstream of the mouth of the Kansas River, the bank-full discharge is approximately 180,000 cfs. These discharges correspond to a flood event between the 50% chance of exceedance (2-year) and the 20% chance of exceedance (5-year) event. The average bed slope through the project reach is approximately 1 foot per mile. The drainage area of the Missouri River just upstream of the confluence with the Kansas River is 425,100 square miles.

There is one stream gage located on the Missouri River within the project reach. The Kansas City Gage is on the downstream side of the right pier of the Chicago, Burlington, and Quincy Railroad Bridge, 1.4 miles downstream from the mouth of the Kansas River at RM 366.1. This railroad bridge is also known as the Hannibal Bridge.

The datum of the gage is 706.4 feet above mean sea level (msl) (NGVD 1929). The flood stage for the Kansas City Gage is 32 feet, which corresponds to an elevation of 738.4 feet. The period of record for this gage extends from 1897 to present. Exhibit A-2.1 shows the latest rating curve, USGS curve #13, at the Kansas City Gage.

A-2.2.2 Kansas River

The Kansas River natural valley flood plain is approximately 1¼ miles wide, while the main channel averages about 600 feet wide throughout the project reach. Bank-full discharge is approximately 60,000 cfs. This corresponds to a flood event between the 50% chance of exceedance (2-year) and the 20% chance of exceedance (5-year) event. The average bed slope through the project reach is approximately 1.6 feet per mile. The drainage area of the Kansas River basin is 60,060 square miles.

A-2.3 FLOOD HISTORY

A listing of the ten largest floods on the Missouri River for the Kansas City area between 1897 and 1997 was taken from the Upper Mississippi River System Flow Frequency Study (KCD 2001). The table below shows these floods, which are based on either flow estimates derived from stage records at the Kansas City Gage or discharges published by the USGS.

TABLE A-2.1
10 Largest Floods on the Missouri River
in the Vicinity of the Kansas Citys Study Area
1897-1997

Rank	Water Year	Discharge Estimate at Kansas City Gage at Hannibal Bridge (cfs)
1	1951	573,000
2	1903	548,000
3	1993	541,000
4	1952	400,000
5	1908	386,000
6	1943	366,000
7	1915	357,000
8	1974	313,000
9	1944	311,000
10	1909	304,000

A-2.4 HYDROLOGY

The overall hydrology and the consequent flow frequencies on the Missouri and Kansas Rivers in the Kansas City metropolitan area have been estimated in three major studies. These are: the Original Levee Design Discharges (circa 1943); the *Missouri River Agriculture Levee Restudy Program* (circa 1962); and the *Upper Mississippi River*

System Flow Frequency Study, 2001. A discussion of each of those study results is provided below.

A-2.4.1 Original Levee Design Discharges

The original design discharges for the seven levees varied between 170,000 cfs and 540,000 cfs as shown in Table A-2.2. The design discharges depended on assumptions made about the centering of the storm events. The following excerpt was taken from House Document No. 342 (Congress 1943): "With an excessive storm centered principally over the Kansas River basin, the design-flood discharge at the Kansas Citys would be 170,000 cfs from the Kansas River and 330,000 cfs from the upper Missouri River, or a total of 500,000 cfs. Conversely, with an excessive storm centered principally over the Missouri River basin, the design flood discharges would be 80,000 cfs from the Kansas River and 460,000 cfs from the upper Missouri River, or a total of 540,000 cfs."

TABLE A-2.2
Kansas City Metropolitan Area Levees
Design and Coincident Discharges - Missouri and Kansas Rivers

Levee Unit	Missouri River Discharge (cfs)		Kansas River Discharge (cfs)
	u/s of Kansas River	d/s of Kansas River	
Birmingham	460,000	***540,000**	80,000
East Bottoms	460,000	***540,000**	80,000
North Kansas City - Lower	460,000	***540,000**	80,000
CID - Missouri	460,000	***540,000**	80,000
North Kansas City - Upper	***460,000**	540,000	80,000
Fairfax-Jersey Creek	***460,000**	540,000	80,000
Armourdale	330,000	500,000	***170,000**
CID - Kansas	330,000	500,000	***170,000**
Argentine	330,000	500,000	***170,000**

***actual levee design discharge**

After the devastating flood event of 1951, the Kansas River Levee Units were improved to pass higher discharges. Table A-2.3 shows these design discharges with coincident Missouri River discharges. All of the levee units were designed with 2-3 feet of freeboard. However, the Missouri River levees were not improved as a result of the 1951 flood event, even though the 1951 flood discharge exceeded the design discharge of the units downstream of the Kansas River.

TABLE A-2.3
Discharges Used to Design Kansas River
Kansas City Metropolitan Area Levees

Levee Unit	Kansas River Design Discharge (cfs)	Missouri River Coincident Discharge (cfs)	
		u/s of Kansas River	d/s of Kansas River
Armourdale	***390,000**	220,000	610,000
CID - Kansas	***390,000**	220,000	610,000
Argentine	***390,000**	220,000	610,000

***actual levee design discharge**

A-2.4.2 Missouri River Agricultural Levee Restudy Program (1962)

Hydrology for the Missouri River in the Kansas City District was developed and published in a Hydrology Report dated March, 1962. The data presented in that report has been used by the Kansas City District to estimate flood flows for subsequent flood control studies, Federal Emergency Management Agency (FEMA) Flood Insurance Studies, and similar purposes since that time**.** Table A-2.4 summarizes these flows at the Kansas City Gage.

TABLE A-2.4
Flow Frequency from
March, 1962 Hydrology Report

Frequency in Percent Chance of Exceedance	Return Interval (years)	Missouri River Discharge at Kansas City Gage (cfs)
0.2	500	540,000
1	100	425,000
2	50	380,000
10	10	270,000

A-2.4.3 Upper Mississippi River System Flow Frequency Study (2001) and Kansas River Hydrology Study (2002)

Recently, new discharge-frequency relationships on the Missouri and Kansas Rivers were produced through two separate independent studies. The Upper Mississippi River System Flow Frequency Study (UMRFFS) (KCD 2001) is a large, complex evaluation of the regulated and unregulated flows on the Mississippi, lower Illinois, and Missouri River Basins. This study produced a detailed analysis of the effects of reservoir regulation on the main stem of the Missouri River and in the Kansas and Osage River basins. The other study, Kansas River Hydrology (KRH) (KCD 2002), utilized the regulated and unregulated flow data developed in the Kansas River basin by the UMRFFS study. The principal purpose of the KRH study was to provide up-to-date

flood frequency estimates on the main stem of the Kansas River for use in an ongoing study in Topeka, and this study of the Kansas Citys levees. Table A-2.5 summarizes the regulated flow frequency estimates published in the two referenced documents, as applicable to the Kansas Citys study.

TABLE A-2.5
Flow Frequency Data as Developed in
Upper Mississippi River System Flow Frequency Study and
Kansas River Hydrology Report

Frequency in Percent Chance of Exceedance	Missouri River Downstream of Blue River (cfs)	Missouri River Downstream of Kansas River (cfs)	Missouri River Upstream of Kansas River (cfs)	Kansas River at Mouth (cfs)
0.2	537,000	530,000	358,000	341,000
0.5	459,000	454,000	316,000	283,000
1	405,000	401,000	287,000	241,000
2	354,000	351,000	257,000	202,000
5	292,000	289,000	220,000	150,000
10	247,000	245,000	192,000	121,000
20	203,000	201,000	162,000	90,700
50	143,000	142,000	120,000	51,200
80	104,000	103,000	89,500	26,400
90	89,100	88,300	77,200	18,700
95	78,800	78,100	68,500	14,000
99	63,400	62,900	55,100	8,200

Discharges developed from these two studies have been used to establish the existing conditions flow frequency data used in this study. Since flood events above the 0.2% chance of exceedance (500-year) event need to be considered in this study, the discharge-frequency curves were extended up to the 0.067% chance of exceedance (1,500-year) flood event. This was accomplished by graphing the discharge-frequency curves and performing a straight-line extrapolation. Table A-2.6 summarizes all of the discharges developed for use in this study. Exhibits A-2.2 through A-2.5 at the end of the chapter show the discharge-frequency curves.

TABLE A-2.6
Summary of Flood Discharges Used in this Study

Frequency in Percent Chance of Exceedance	Missouri River Downstream of Blue River (cfs)	Missouri River Downstream of Kansas River (cfs)	Missouri River Upstream of Kansas River (cfs)	Kansas River at Mouth (cfs)
0.067	637,000	625,000	414,000	417,000
0.08	621,000	610,000	403,000	403,000
0.1	600,000	590,000	390,000	388,000
0.133	573,000	565,000	377,000	367,000
0.2	537,000	530,000	358,000	341,000
0.5	459,000	454,000	316,000	283,000
1	405,000	401,000	287,000	241,000
10	247,000	245,000	192,000	121,200

Note: Expressing discharge probability in percent chance exceedance (occurrence) is currently used in lieu of a flood return interval expressed in years. Percent chance exceedance expresses the probability of the discharge occurring each year. A return interval is the period of time over which, on average, one flood event will equal or exceed that discharge. For example, a 1% chance exceedance flood event has a one-in-one-hundred chance of being equaled or exceeded in any given year. If a 1% chance exceedance flood event were to occur this year, the probability of occurring next year and the year after is still the same, 1%. On average, only one flood event would equal or exceed the 1% chance event during a 100-year time period, thus the term a 100-year flood event. For this document, discharge will be expressed as a percent chance of exceedance followed by the equivalent return interval. All profiles presented herein represent the "most probable" or "nominal" estimates of water surface elevations. It is possible that actual water surface elevations may be higher or lower than those shown.

A-2.4.4 Traditional Analysis vs. Risk Based Analysis

To account for uncertainties in discharge-frequency estimates, stage-discharge functions, and engineering parameters (geotechnical and structural), the traditional analysis allowed for freeboard (a factor-of-safety) to be added to the top-of-levee design. In other words, if 540,000 cfs were the design discharge, the levee would be designed to pass this flow with a certain degree of freeboard, typically 3 feet on Federal levees. Therefore, when describing the project performance (or level of protection) one would assign it an average return period in years of the largest flood that can be accommodated by the project, with a high degree of assurance. This assurance came from the freeboard. Therefore, if the design discharge of 540,000 cfs had a frequency of 0.2% chance of exceedance, the levee could be characterized as a "500-year levee."

Recently, the Corps of Engineers has adopted a new methodology called Risk Based Analysis (RBA) for formulating flood damage reduction projects. This method considers all of the same engineering parameters as the traditional method, but accounts for the uncertainties in these parameters during the analysis in lieu of using freeboard. Project performance is measured in terms of how a given plan will function when

exposed to a full range of floods that could occur. Under this new method, the project performance will be expressed as the chance in any year of a flow exceeding the largest flood that can be accommodated by the plan under study, with a conditional non-exceedance probability of 90%. The concept of freeboard in plan formulation is no longer used.

For the Kansas Citys study, plan alternatives will be assigned a level of protection based on the RBA methodology rather than the traditional analysis. For example, what would have traditionally been described as a 100-year levee with 3 feet of freeboard will now be described as a levee having a "90% chance of passing the 1% chance of exceedance flood event."

A-2.4.5 Hydrologic Uncertainty

The use of the new RBA methodology requires a characterization of the hydrologic uncertainty of the flow estimates used. This uncertainty will be recognized in the Monte Carlo algorithms built into the Flood Damage Analysis (FDA) computer program as developed by the Hydrologic Engineering Center (HEC). The uncertainty bands used in this program are based on the effective record lengths used to develop the flow frequency estimates. For this study, the effective record length is governed by the gage histories of the main stem Kansas River gages. These gage records are not only applicable directly to the Kansas River, but were also necessary to estimate regulated peak flows on the Missouri River for the period prior to the construction of the Kansas River basin reservoir system. Useable information from these gages goes back to 1920, therefore in both the UMRFFS study and the Kansas River study, the effective record length is considered to be 70 years.

A-2.5 HYDRAULICS

The basis for the hydraulic analysis was the development of an existing conditions HEC-RAS model. HEC-RAS, version 3.1.1, as developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, was used in the analysis. This model was calibrated to the flood event of 1993 from measured high-water marks and corresponding instantaneous discharge estimates. Once the model was calibrated, a series of steady flow water surface profiles was created based on flood discharges previously discussed.

A-2.5.1 HEC-RAS Model Development

The first step in the model development was to enter all applicable geometric data, including a schematic of the river system, cross-section data, bridge data, and other geometric data. A single model was developed for both the Missouri River and the Kansas River.

A-2.5.2 River System Schematic and Cross-Section Data

The Missouri River centerline was established by the Kansas City District and is based on the navigation sailing line and the 1960 adjusted river mileage. All of the mapping and cross section production work was part of the Mississippi Basin Modeling System (MBMS) project. The Missouri River mapping of the floodplain from bluff-to-bluff was accomplished under contracts with Horizons, Inc. The mapping is based on aerial photography from 1995 and 1998. Digital format for this mapping data is in the

form of a digital terrain model, or DTM. Data files are in Universal Transverse Mercator (UTM) Zone 15, North American Datum (NAD) 83, National Geodetic Vertical Datum (NGVD) 29, with units in feet. Mapping in the Kansas City area is from the 1995 data.

Hydrographic survey of the Missouri River channel was accomplished via channel soundings performed by the Kansas City District in 1998/99. A contractor, Bohannan Huston, merged the channel soundings and the DTM data into one continuous surface in DTM format to represent the Missouri River and its floodplain from bluff-to-bluff. Using the DTMs of the merged data, the contractor then produced geo-referenced, bluff-to-bluff cross sections based on cross section layouts received from the Kansas City District. On average, there are about three cross-sections per river mile with a higher density in the vicinity of the bridges.

The River System Schematic was imported into the HEC-RAS model using ArcView Geographic Information System (GIS) software. The River System Schematic consists of 3 river segments, Missouri-Upper, Missouri-Lower, and Kansas, with one reach in each segment. The Missouri-Upper extends from the confluence with the Kansas River (RM 367.5) upstream to RM 379.53. The Missouri-Lower begins at RM 339.67 and extends upstream to the confluence with the Kansas River at RM 367.5. The downstream end of the model was extended far enough (RM 339.67) to account for uncertainties in starting water surface elevations. That is, any instability would be eliminated before the water surface profile reached the downstream end of the project reach. The upstream end was extended far enough (RM 379.53) to assess project impacts upstream from the seven-levee area.

The Kansas River centerline and cross-section data utilized some of the same mapping efforts as the Missouri River. However, it was necessary to obtain additional mapping to extend the Kansas River up to RM 15. The mapping was obtained from the Unified Government of Wyandotte County in contour map (2-D) format. Cross-section overbank data was obtained by cutting sections and manually reading off contour elevations. The channel data are taken from a hydrographic survey conducted by the Kansas City District in 1998 and degradation range surveys conducted in 1998. The channel data are the same as were used in the Reconnaissance Report (KCD 1999). See Exhibit A-2.6 for a plan view HEC-RAS schematic of the Missouri and Kansas Rivers.

A-2.5.3 Bridge Data

Most of the bridge data (i.e. low chord elevations, top-of-road elevations, pier widths, pier shapes, etc.) were gathered during the Reconnaissance Phase. This same information was transferred to the new hydraulic model. The standard step energy method was used to calculate bridge losses in the HEC-RAS model. As stated in the Reconnaissance Report, the bridge data was obtained from engineering drawings from the Kansas City District and supplemented by information obtained from both the Kansas and Missouri Departments of Transportation. A total of 33 bridges are located within the project study area, 12 on the Missouri River and 21 on the Kansas River. A summary of the bridges and the sources of the bridge information are listed in Exhibit A-2.103, located in the Supplemental Exhibits section.

For the Missouri River, impacts of the bridges are mostly limited to pier effects. However, during low frequency flood events, water surface elevations submerge the low chord of the Hannibal Bridge and the ASB Bridge. The low chord elevations obtained

from drawings were 758.6 feet msl for the Hannibal Bridge and 758.0 feet msl for the ASB Bridge.

Although 21 bridges were located on the Kansas River within the project area, only 19 bridges were modeled in HEC-RAS. Four of the bridges were combined into two composite structures. The two bridges at 7th Street were modeled as one bridge since they are located less than 50 feet apart. The bridge widths were added together and entered into HEC-RAS. Since the bridge geometry of the old 7th Street Bridge is more constrictive to flows at low frequency flood events, it was used as the geometry in HEC-RAS. Similarly, the I-670 Bridges (northbound and southbound lanes) were modeled as one structure. As they are within 50 feet of one another, and they have similar geometry and pier locations, this is an acceptable assumption. For higher frequency flood events, impacts from bridges are limited to pier effects. For lower frequency flood events, pier effects along with friction losses impact the water surface profile calculations. Some of the bridges at the downstream end have low chord elevations at or below the top of the adjacent levees. Table A-2.7 summarizes the low chord elevations of 10 critical bridges on the Kansas River.

TABLE A-2.7
Kansas River Bridges
Critical Low Chord Elevations

HEC-RAS River Mile	Kansas River Bridge	Critical Low Chord Elevation (ft) msl	Location of Critical Low Point
0.26	Missouri Pacific #1	759.0	Channel Centerline
0.50	James Street	761.8	Right Bank Pier
0.81	KC Southern	759.9	Channel Centerline
1.11	Central Ave.	760.6	Channel Centerline
1.40	I-670	763.6	2nd Pier from left
1.62	Missouri Pacific #72	758.9	Channel Centerline
1.64	*Union Pacific #3	754.6/*762.6	Channel Centerline
2.10	CRI&P	763.1	Channel Centerline
2.17	Kansas Ave. (East)	760.8	Channel Centerline
2.53	*KC Terminal	755.9/*765.7	Channel Centerline

*temporary raise – see below

Two bridges were temporarily raised on the Kansas River during the Great Flood of 1993. The Kansas City Terminal Bridge (~RM 2.53) was raised approximately 10 feet. All three spans were designed to rise, but only the outer two were raised. The middle span was stuck in the down position with a low chord elevation of approximately 755.9 feet above mean sea level (msl). The other bridge that was temporarily raised was the Union Pacific Railroad Bridge #3. It was estimated that the raise was about 8 feet, from a low chord elevation of 754.6 to 762.6 ft msl. For modeling purposes, it was assumed that the same raises could be implemented today as they were in 1993.

A-2.5.4 Other Geometric Data

Ineffective flow areas were entered into the HEC-RAS model to account for areas of quiescent water that do not contribute to the discharge calculations.

Contraction and expansion coefficients were entered into the model according to the guidance distributed by HEC (HEC-RAS 2001). These parameters account for losses associated with flows expanding and contracting across the flood plain. For areas with gradual transitions between cross sections, contraction and expansion coefficients were set at 0.1 and 0.3, respectively. In the vicinity of bridges on the Missouri River with abrupt changes in flow top widths, contraction and expansion coefficients were increased to 0.3 and 0.5, respectively. For all Kansas River bridges, the coefficients were not increased since there is limited expansion and contraction of flows between the levees.

Initial Manning's n-values were entered based on land cover from field investigation and aerial photography. These roughness coefficients were modified during the calibration, which will be discussed further in this chapter.

The existing top-of-levee elevations were surveyed for all seven levee units to more accurately define the levee profiles. The data were collected by the Kansas City District Survey Section in the spring of 2001. Survey shots were taken every 50 to100 feet along the levee centerline. Survey shots on floodwalls were also taken. Exhibit A-2.104, located in the Supplemental Exhibits section, summarizes the top-of-levee elevations for each unit as applicable to the HEC-RAS model.

A-2.5.5 1993 Flow Data

The next step in the HEC-RAS model development was to enter the flow data specific to the 1993 flood event. A known peak discharge of 541,000 cfs was used at the Kansas City Gage located on the Hannibal Bridge just downstream of the confluence of the Kansas River. This discharge was entered into the model at RM 367.04 and is constant throughout the Missouri-Lower Reach.

One-hour discharge measurements on the Kansas River at the Desoto Gage were obtained from the USGS around the time that the Missouri River had the peak flow condition. Hourly data on the Missouri River suggests that the peaking time on the Missouri River at the Kansas City Gage occurred around 7:00 a.m. on July 27, 1993. Assuming a mean channel velocity on the Kansas River of 7 feet per second, and since the Desoto Gauge is located 31 miles above the mouth, a lag time of 6 hours was computed between the Kansas City Gage and the Desoto Gage. Therefore, the discharge on the Kansas River at Desoto, as the Missouri River was peaking, was found by taking the gage reading at Desoto 6 hours earlier (1:00 a.m.). This discharge (165,000 cfs) was used on the Kansas River for the entire Kansas Reach. The UMRSFFS study records indicated that the flows at the mouth of the Kansas River are nearly equal to flows at the Desoto Gage. This is because only 300 square miles of drainage area enters the Kansas River downstream of Desoto and the storage along 31 miles of channel offsets the additional flow. By taking the difference between 541,000 cfs below the confluence and 165,000 cfs on the Kansas River, the upper Missouri discharge is estimated at 376,000 cfs. This discharge was entered into the model at RM 379.53 and is constant throughout the Missouri-Upper Reach.

Along with entering the discharges from the 1993 flood event, it was also necessary to enter high-water mark data. The Missouri River high-water mark data were

taken from the U.S. Army Corps of Engineers 1993 Post-Flood Report (USACE 1994). The Kansas River high-water mark data were taken from the Reconnaissance Report (KCD 1999).

The highwater marks were used to set the starting water surface elevation within the HEC-RAS model. Interpolation of the two high-water marks immediately upstream and downstream of RM 339.67 resulted in a starting water surface of 723.14 feet msl.

A-2.5.6 Calibration

Once all of the geometric and flow data were entered into the model, an iterative process of calibration began. The model was calibrated to the 1993 flood event. Manning's n-values and ineffective flow areas were changed in an attempt to match the resulting water surface elevations with the observed high-water mark elevations. Table A-2.8 compares the observed high-water mark data to the computed water surface elevation for the 1993 flood event on the Missouri River. These data are also presented graphically on Exhibit A-2.7. Table A-2.9 compares the observed high-water mark data to the computed water surface elevation for the 1993 flood event on the Kansas River. These data are also presented graphically on Exhibit A-2.8.

TABLE A-2.8
Comparison of 1993 High-Water Mark Elevations and Computed Water Surface Elevations (Missouri River)

HEC-RAS River Station (mi)	Missouri River Discharge (cfs)	Observed 1993 High-Water Mark Elevation (ft)msl	Computed Water Surface Elevation (ft) msl	Difference: Observed vs. Computed Water Surface Elevation (ft)
339.67	541,000	723.1	723.1	0.0
345.67	541,000	730.2	730.0	0.2
352.66	541,000	736.2	736.1	0.1
357.94	541,000	741.7	742.6	-0.9
360.29	541,000	746.1	746.0	0.1
366.121*	541,000	**755.3	754.9	0.4
370.54	376,000	761.2	760.5	0.7
373.46	376,000	762.8	762.9	-0.1
379.53	376,000	766.0	766.1	-0.1

*interpolated cross-section
**USGS measured stage at Kansas City Gage

TABLE A-2.9
Comparison of 1993 Highwater Mark Elevations and Computed Water Surface Elevations (Kansas River)

HEC-RAS River Station (mi)	Kansas River Discharge (cfs)	Observed 1993 Highwater Mark Elevation (ft) msl	Computed Water Surface Elevation (ft) msl	Difference: Observed vs. Computed Water Surface Elevation (ft)
1.27	165,000	759.2	759.3	-0.1
1.413	165,000	759.5	759.4	0.1
2.097	165,000	760.2	760.0	-0.2
3.05	165,000	761.3	761.3	0.0
3.96	165,000	762.0	762.2	-0.2
4.97	165,000	763.0	763.4	-0.4
5.967	165,000	763.7	763.8	-0.1
6.88	165,000	764.3	764.1	0.2
8.42	165,000	765.3	765.1	0.2
9.04	165,000	765.8	765.5	0.3
9.505	165,000	766.1	766.0	0.1
9.88	165,000	766.2	766.2	0.0
10.15	165,000	766.7	766.3	-0.4
11.73	165,000	768.1	767.8	-0.3
12.4	165,000	768.1	768.2	0.1
13.58	165,000	769	768.8	-0.2
14.25	165,000	768.9	769.1	0.2

For the Missouri River, only two of the nine locations did not come within 0.5 foot of their respective observed high-water marks. On the Kansas River, all 11 high-water mark locations were matched within 0.4 foot. The resulting range of roughness coefficients is presented in Table A-2.10.

TABLE A-2.10
Kansas Citys Study
Roughness Coefficient Range
(Manning's "n" values)

River Reach	River Mile	Channel Roughness Coefficient Range	Overbank Roughness Coefficient Range
Missouri River-Upper	379.53 to 367.04	0.03	0.05 – 0.06
Missouri River-Lower	367.04 to 339.67	0.02 – 0.03	0.04 – 0.07
Kansas River	0.0 to 14.62	0.0345 – 0.045	0.045 – 0.130

A-2.6 EXISTING CONDITIONS

A-2.6.1 Missouri River Water Surface Profiles

Once the model was calibrated, existing conditions water surface profiles were generated for the 10% (10-year), 1% (100-year), 0.5% (200-year), 0.2% (500-year), 0.133% (750-year), 0.1% (1,000-year), 0.08% (1,250-year), and 0.067% (1,500-year) chance of exceedance flood events. The starting water surface elevations for each of the profiles were calculated using the normal depth option within HEC-RAS.

For each of these flood events, an assumption was made about overbank flows. As levees begin to overtop, it was assumed in HEC-RAS that the overbank areas would be considered ineffective flow areas. That is, the profiles will reflect a confined cross-sectional area from levee to levee and will not compute the overbank areas as flowing. This was assumed to avoid trying to predict where a levee would fail. With seven separate levee units, there are many different combinations of failure scenarios that could physically occur. Potentially, each could produce a different overbank flow path. HEC-RAS is a one-dimensional steady state model. It is beyond the limitations for HEC-RAS to predict the overbank flow scenarios or to model multi-dimensional flow.

The methodology used in the Reconnaissance Report (KCD 1999) for developing peak discharge values assumed a Kansas River discharge for each flood event by simply subtracting the Upper Missouri Reach discharge from the corresponding discharge for the Lower Missouri Reach. This approach did not consider coincidence of peak flood flows between the Kansas River and Missouri River. For the Kansas Citys existing conditions model, a study was performed to address the relationship between peak flood flows from the Kansas River and the Missouri River. Results of this study were documented in a Memorandum for Record (MFR), dated July 2, 2002. A copy of the MFR is provided as an attachment (Exhibit A-2.116), located at the back of this document. For the Missouri River, two peak-discharge scenarios were considered. The first scenario assumes that the Missouri River reach downstream of the Kansas River confluence (hereinafter called the "Lower Missouri River reach") is the controlling reach. The second scenario assumes that the Missouri River reach upstream of the Kansas River confluence (hereinafter called the "Upper Missouri River reach") is the controlling reach. For each controlling-flow scenario, historical gage readings were used to develop a corresponding non-controlling Missouri River flow, representative of the most likely flow expected for a particular study reach. For the Kansas River, discharge values (hereinafter called "complementary discharge values") were obtained by simply subtracting each non-controlling Missouri River discharge value from each corresponding controlling discharge value.

The resulting peak discharge values are summarized in Tables A-2.11 and A-2.12, for Lower Missouri control and Upper Missouri control scenarios, respectively.

TABLE A-2.11
Kansas Citys Study Missouri River Discharges (Lower Missouri River Control)

Frequency in Percent Chance of Occurrence	Return Interval (year)	Missouri River d/s of Blue River - Mile 339.67 to Mile 357.30 (cfs)	Missouri River d/s of Kansas River - Mile 357.30 to Mile 367.04 (cfs)	Missouri River u/s of Kansas River - Mile 367.04 to Mile 379.53 (cfs)	**Kansas River at Mouth - Mile 0.0 to Mile 10.0 (cfs)*
0.067	1500	637,000	625,000	414,000	***211,000***
0.08	1250	621,000	610,000	403,000	***207,000***
0.1	1000	600,000	590,000	390,000	***200,000***
0.133	750	573,000	565,000	374,000	***191,000***
0.2	500	537,000	530,000	348,000	***182,000***
0.5	200	459,000	454,000	295,000	***159,000***
1	100	405,000	401,000	261,000	***140,000***
10	10	247,000	245,000	168,000	***77,000***

**Complementary discharge values*

TABLE A-2.12
Kansas Citys Study Missouri River Discharges (Upper Missouri River Control)

Frequency in Percent Chance of Occurrence	Return Interval (year)	Missouri River d/s of Blue River - Mile 339.67 to Mile 357.30 (cfs)	Missouri River d/s of Kansas River - Mile 357.30 to Mile 367.04 (cfs)	Missouri River u/s of Kansas River - Mile 367.04 to Mile 379.53 (cfs)	**Kansas River at Mouth - Mile 0.0 to Mile 10.0 (cfs)*
0.067	1500	597,000	587,000	414,000	***173,000***
0.08	1250	581,000	573,000	403,000	***170,000***
0.1	1000	562,000	555,000	390,000	***165,000***
0.133	750	543,000	536,000	377,000	***159,000***
0.2	500	515,000	508,000	358,000	***150,000***
0.5	200	448,000	442,000	316,000	***126,000***
1	100	398,000	394,000	287,000	***107,000***
10	10	242,000	240,000	192,000	***48,000***

**Complementary discharge values*

Two separate HEC-RAS models were constructed that utilized peak discharge values based on each controlling discharge scenario. Results of the two models were compared on a station-by-station basis, with the highest water surface elevation being retained for tabulation and for generating water surface profiles.

The HEC-RAS results for the Missouri River are presented in Exhibit A-2.105, located in the Supplemental Exhibits section. It should be realized that this exhibit does not show the results from one model condition, but rather is a tabulation of RAS results for two conditions. The listed summary information at each cross section is for the controlling condition that produces the highest water surface elevation. For the lower frequency flood events, discretion should be used when applying these profiles because of the assumptions about overbank flows previously discussed. These lower frequency events are highly speculative and would not necessarily match what would physically happen. These events were produced to formulate frequency-stage curves for economic analyses in the HEC-FDA computer program.

For illustration purposes, water surface profiles have been grouped to show results for the 10% (10-year), 1% (100-year), 0.5% (200-year), 0.2% (500-year) chance of exceedance flood events (referred herein as "higher probability events"), and the 0.133% (750-year), 0.1% (1,000-year), 0.08% (1,250-year), and 0.067% (1,500-year) chance of exceedance flood events (referred herein as "lower probability events"). Exhibit A-2.9 shows the Missouri River profiles for the higher frequency events. Exhibit A-2.10 shows the Missouri River profiles for the lower frequency events.

Levee-Unit-specific water surface profiles showing the 0.2% (500-year) chance of exceedance flood event in relation to the top-of-levee were created for the Birmingham (Exhibit A-2.11), East Bottoms, (Exhibit A-2.12), Central Industrial District (CID) (Missouri) (Exhibit A-2.13), North Kansas City-Airport (Exhibit A-2.14), and Fairfax-Jersey Creek (Exhibit A-2.15) Levee Units. Water surface profiles for the 0.2% (500-year) chance of exceedance flood event are presented solely to facilitate the comparison of the hydraulic performance of the various levee units. The actual rating of these levees is a function of the uncertainties associated with the local hydraulics and flow estimates, and the geotechnical and structural reliability of the levee.

The HEC-RAS model indicates that none of the Missouri River Levee Units in this study physically overtop for the 0.2% (500-year), 0.133% (750-year), or even the 0.1% (1,000-year) chance of exceedance flood event.

A-2.6.2 Kansas River Water Surface Profiles

In the Reconnaissance Report (1999), water surface profiles were generated for the Kansas River for the same events analyzed for the Missouri River, without considering coincidence of peak flood flows between the Kansas River and Missouri River. Discharge for the Kansas River was subtracted from the discharge for the Lower Missouri River reach to create a discharge value for the Upper Missouri River reach.

For the Kansas Citys existing conditions model, results from the coincidental flow study (Exhibit A-2.116) were incorporated to account for coincident peak flows for the Kansas River and Missouri River. Based on the results of this study, two peak-discharge scenarios were considered for the Kansas River. The first scenario assumes that discharge is controlled by the Lower Missouri River reach, while the second scenario assumes Kansas River control. For each controlling-flow scenario, historical gage readings were used to develop a corresponding non-controlling river flow, representative of the most likely flow expected for a particular study reach. For the Upper Missouri River reach, complementary discharge values were obtained by simply subtracting each non-controlling discharge value from a corresponding controlling discharge value.

The resulting peak discharge values are summarized in Table A-2.13 and A-2.14 for Kansas River control and Lower Missouri control scenarios, respectively.

TABLE A-2.13
Kansas Citys Study Kansas River Discharges (Kansas River Control)

Frequency in Percent Chance of Exceedance	Return Interval (year)	Missouri River d/s of Blue River - Mile 339.67 to Mile 357.30 (cfs)	Missouri River d/s of Kansas River - Mile 357.30 to Mile 367.04 (cfs)	**Missouri River u/s of Kansas River - Mile 367.04 to Mile 379.53 (cfs)*	*Kansas River at Mouth - Mile 0.0 to Mile 10.0 (cfs)*
0.067	1500	617,000	606,000	***189,000***	417,000
0.08	1250	596,000	586,000	***183,000***	403,000
0.1	1000	573,000	565,000	***177,000***	388,000
0.133	750	545,000	538,000	***171,000***	367,000
0.2	500	513,000	507,000	***166,000***	341,000
0.5	200	449,000	444,000	***161,000***	283,000
1	100	404,000	400,000	***159,000***	241,000
10	10	247,000	245,000	***124,000***	121,000

**Complementary discharge values*

TABLE A-2.14
Kansas Citys Study Kansas River Discharges (Lower Missouri River Control)

Frequency in Percent Chance of Exceedance	Return Interval (year)	Missouri River d/s of Blue River - Mile 339.67 to Mile 357.30 (cfs)	Missouri River d/s of Kansas River - Mile 357.30 to Mile 367.04 (cfs)	**Missouri River u/s of Kansas River - Mile 367.04 to Mile 379.53 (cfs)*	*Kansas River at Mouth - Mile 0.0 to Mile 10.0 (cfs)*
0.067	1500	637,000	625,000	***218,000***	407,000
0.08	1250	621,000	610,000	***219,000***	391,000
0.1	1000	600,000	590,000	***221,000***	369,000
0.133	750	573,000	565,000	***222,000***	343,000
0.2	500	537,000	530,000	***222,000***	308,000
0.5	200	459,000	454,000	***217,000***	237,000
1	100	405,000	401,000	***209,000***	192,000
10	10	247,000	245,000	***160,000***	85,000

**Complementary discharge values*

Two separate HEC-RAS models were constructed that utilized peak discharge values based on the controlling discharge scenario. Results of the two models were compared on a station-by-station basis, with the highest water surface elevation being retained for tabulation and developing water surface profiles.

The HEC-RAS results for the Kansas River are presented in Exhibit A-2.106, located in the Supplemental Exhibits section. It should be realized that this exhibit does not show the results from one model condition, but rather is a tabulation of RAS results for two conditions. The listed summary information at each cross section is for the controlling condition that produces the highest water surface elevation. The same assumptions that were made on the Missouri River about overbank flows were also made on the Kansas River, and as such, discretion should be used when applying the lower frequency profiles.

Exhibit A-2.16 shows the resulting Kansas River profiles for the higher frequency events. Exhibit A-2.17 shows the resulting Kansas River profiles for the lower frequency events.

Water surface profiles, showing the 0.2% (500-year) chance of exceedance flood event in relation to the top-of-levee, were created for the CID (Kansas) (Exhibit A-2.18), Armourdale (Exhibit A-2.19), and Argentine (Exhibit A-2.20) Levee Units.

The point of overtopping is considerably less on the Kansas River Levee Units. None of the levee units overtop for the 0.5% (200-year) chance of exceedance flood event. In analyzing the 0.2% (500-year) chance of exceedance flood event, it is evident that many of the bridges on the downstream end of the Kansas River have negative impacts to the water surface profile. Many of the bridges on the downstream end have low chords that become submerged for these lower frequency events.

A-2.6.3 Hydraulic Uncertainty

Uncertainties in computed water surface profiles are a result of imperfect knowledge and lack of appropriate data. Uncertainties in stage result from a number of physical factors such as bed forms, debris and other obstructions, channel scour or deposition, sediment transport, and waves. In hydraulic modeling, other factors such as hydraulic roughness variation with season, inexact geometry and loss coefficients, and error in setting high-water marks result in errors in computed water surface elevations. Estimating these uncertainties in stage is based on sensitivity analyses, analytical studies of gage readings, and interpretation of the success of model adjustments following traditional procedures presented in USACE Engineering Manual (EM) No. 1110-2-1619 (EM 1996).

Stage uncertainty is expressed in the Risk Based Analysis as a standard deviation (in feet). To obtain a total standard deviation the formula below was applied.

$$\text{Total Standard Deviation} = \text{SQRT}\left((S_{natural})^2 + (S_{model})^2\right)$$

where SQRT = square root mathematical function
$S_{natural}$ = standard deviation based on historical data and gage readings
S_{model} = standard deviation based on mapping detail and reliability of estimating Manning's n values

$S_{natural}$, is calculated by comparing observed data with the latest rating curve at the gage in the project reach. To avoid potential problems due to shifts in the rating curve over time, only observed data going back to 1990 were used. Exhibit A-2.21 shows this observed data compared to the current rating curve at Kansas City. Only data for bank full discharges and greater were analyzed. The formula on the next page is used to calculate $S_{natural}$.

$$S_{natural} = SQRT((\Sigma(X-M)^2)/(N-1))$$

where SQRT = square root mathematical function
X = stage corresponding to measured Q
M = best fit curve estimate of stage corresponding to Q
N = number of stage-discharge observations in the range being analyzed

The standard deviation based on historical data and gage readings, $S_{natural}$, was computed as 1.3 feet. This same standard deviation was applied to the computed water surface elevations. Exhibit A-2.22 compares the Kansas City Gage rating curve with the computed water surface elevations at this location.

Since the model was calibrated to the 1993 flood event, the computed water surface elevations at the upper end of the curve closely match the rating curve. However, the higher frequency events tend to drift further from the rating curve. Consideration was given to creating a model to reflect the more frequent flood events, such as the 10% (10-year) and the 2% (50-year) chance of exceedance flood event. It was decided that, since this study will be focusing on flood events that are larger than the 1% (100-year) chance of exceedance event, a calibrated model for the higher frequency events was unnecessary.

The second component in quantifying standard deviation is S_{model}. S_{model} is obtained by estimating the confidence in the cross-section data from topographic mapping efforts and in estimating the reliability of the Manning's n-value. Table 5-2 in EM 1110-2-1619 quantifies an S_{model}, based on these two factors. A standard deviation of 0.7 foot was chosen since the cross-sections were based on current aerial mapping and the Manning's n-values were assumed to be "fairly" reliable.

Once $S_{natural}$ and S_{model} are known, a total standard deviation can be computed. Following traditional procedures presented in EM 1110-2-1619, a total standard deviation of 1.5 feet was computed for the entire discharge set.

A-2.7 LEVEE TIEBACK ANALYSIS

A-2.7.1 Introduction

As discussed in the introduction, existing conditions water surface profiles were generated for Missouri and Kansas River study areas. When combined with associated top-of-levee elevations, these profiles provide information that can be used for evaluating levees that border the main stem of each study reach. At some locations, landward extensions of the main stem levee protect interior areas from backwater and/or tributary headwater flooding. These extensions are called levee tiebacks. Additional hydraulic analysis is required to characterize existing conditions relative to a levee tieback.

For this study, purposes for analyzing levee tiebacks include determining their impacts on interior floodwater and exterior water surface elevation relationships, and identifying the longitudinal extent of backwater-control on water surface elevations along a levee tieback.

For the Missouri River, three levee tiebacks were analyzed for existing conditions hydraulics. No levee tiebacks were identified for the Kansas River.

Summarized in Table A-2.15 are each levee tieback analyzed as part of the Kansas City study.

TABLE A-2.15
Kansas Citys Study Area Levee Tiebacks

Missouri River Levee Unit	Levee Tieback Headwater Source Area	Missouri River HEC-RAS River Station
Birmingham	Shoal Creek	353.45
East Bottoms	Blue River	357.60
North Kansas City	North Kansas City Hillside Drainage Ditch	362.80

A-2.7.2 Birmingham Levee Unit

For the Birmingham Levee Unit, a levee tieback protects the interior area from Missouri River backwater and Shoal Creek headwater source areas. To evaluate the levee tieback, a Shoal Creek flood profile for the 0.2% (500-year) chance of exceedance flood event was obtained from a FEMA Flood Insurance Study (FEMA 1990) and combined with 0.2% (500-year) chance of exceedance flood event Missouri River water surface elevations from the existing conditions HEC-RAS model (Exhibit A-2.23). Because the Shoal Creek channel does not parallel the levee tieback, adjustments to the original Shoal Creek water surface profile were required to create a profile that shows water surface elevations along the levee tieback. Also shown in Exhibit A-2.23 are corresponding top-of-levee elevations collected by the Kansas City District Survey Section. A field reconnaissance was conducted in September 2002 for the purpose of verifying levee conditions.

Exhibit A-2.23 shows that backwater from the Missouri River controls the water surface elevations to a location approximately 1.95 miles above the start of the levee tieback. This location coincides with the start of levee improvements, consisting of a levee raise and flood walls. This improved section of levee continues until its termination at high ground**.** Exhibit A-2.23 also shows that neither Missouri River backwater nor Shoal Creek headwater physically overtop the levee tieback for the 0.2% (500-year) chance of exceedance flood event.

Along the levee tieback, the 0.2% (500-year) chance of exceedance water surface profile comes within 1.8 feet of the top-of-levee. As shown in Exhibit A-2.11, the 0.2% (500-year) chance of exceedance water surface profile comes within 3.0 feet of the Birmingham Unit main stem top-of-levee.

Based on results of this analysis, physical overtopping of the Birmingham Levee Unit will most likely occur along the levee tieback prior to any overtopping of the main stem levee, and the source of overtopping will be Missouri River backwater. The levee tieback will govern Birmingham Levee Unit interior floodwater and exterior water surface elevation relationships. Along the levee tieback, Missouri River backwater for the 0.2% (500-year) chance of exceedance flood event controls the water surface elevations for approximately 1.95 miles. The levee tieback above this location is controlled by Shoal Creek headwater, and therefore, will not be evaluated under the Kansas Citys study.

A-2.7.3 East Bottoms Levee Unit

For the East Bottoms Levee Unit, a levee tieback protects the interior area from Missouri River backwater and Blue River headwater sources. To evaluate the levee tieback, an existing HEC-RAS model created for the Blue River (HNTB 2002) and results from the existing conditions HEC-RAS model for the Missouri River were used.

A field reconnaissance was conducted in September 2002 for the purpose of verifying levee conditions. It was noted in the field that, approximately 1.74 miles above its starting point, the East Bottoms levee tieback terminates at the junction of a levee raise that continues along the Blue River.

Using the Blue River model, water surface profiles were created for the 1% (100-year) and 0.2% (500-year) chance of exceedance flood events. The Blue River model was also used to create profiles for the same events, but with a known starting water surface elevation based on a 50-year flood event as obtained from the existing conditions model. The 50-year Missouri River water surface elevation (736.3 feet msl at RM 357.63) was obtained from the existing conditions models and used to represent Missouri River and Blue River coincidental flow conditions. This method for assigning a representative coincidental flow condition is based on KCD past experiences, which considers the total size of each contributing source area. The resulting water surface profiles are shown in Exhibit A-2.24. Also shown in Exhibit A-2.24 are corresponding top-of-levee elevations collected by the Kansas City District Survey Section.

Exhibit A-2.24 shows that Missouri River backwater for the 0.2% (500-year) chance of exceedance flood event controls the water surface elevations for approximately 1.25 miles along the levee tieback. At a distance of approximately 1.66 miles above the start of the levee tieback, the levee tieback is physically overtopped by the 0.2% (500-year) chance of exceedance flood event, where water surface elevations are controlled by Blue River headwater.

Based on results of this analysis, Missouri River backwater will result in overtopping of the East Bottoms main stem levee prior to any overtopping along the levee tieback. The main stem levee governs interior floodwater and exterior water surface elevation relationships. Although the water surface profile for the 0.2% (500-year) chance of exceedance flood event shows physical overtopping along the levee tieback, the location of overtopping is controlled by Blue River headwater. Further evaluation of the East Bottom levee tieback may be conducted separate from the Kansas Citys study.

A-2.7.4 North Kansas City Levee Unit

For the North Kansas City Levee Unit, a levee tieback protects the interior area from Missouri River backwater, Rock Creek backwater, and headwater from hillside drainage. Hillside drainage is conveyed along a ditch (referred in this study as the North Kansas City [NKC] Hillside Drainage Ditch) that parallels the northern extent of the North Kansas City Levee Unit.

The NKC Hillside Drainage Ditch drains west-to-east and is bounded by bluffs to the north and the levee tieback to the south. The NKC Hillside Drainage Ditch empties into Rock Creek, a tributary of the Missouri River, within the confines of a culvert beneath Highway 210. To evaluate the levee tieback, hydrologic and hydraulic analyses were used to create water surface profiles for the 2% (50-year), 1% (100-year), and 0.2% (500-year) chance of exceedance flood event. Backwater contribution from Rock Creek was not considered in the analysis.

For the hydrologic analysis, peak discharge values were calculated from Hydrologic Modeling System (HEC-HMS) model, version 2.2.0, developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers (HEC-HMS 2000). A site reconnaissance was performed in September 2002 to verify site conditions, determine Manning's "n" values, and conduct land surveying to obtain channel invert profiles, bridge geometries, and top-of-levee elevations. Contributing source area delineations, land surface slopes, and surface area calculations were made from a USGS topographical map. Precipitation data for the 2% (50-year), 1% (100-year), and 0.2% (500-year) chance of exceedance/24-hour duration storm events were obtained from TP-40 (Herschfield 1961) for developing hypothetical frequency storm events. Lag times were calculated using SCS Unit Hydrograph Transform Method. Channel routing was performed using Muskingum-Cunge 8-Point Section Method. Results of the hydrologic analysis are provided in Table A-2.16.

TABLE A-2.16
North Kansas City Hillside Drainage Ditch Peak Discharge Values

Source Areas	Drainage Area (sq. mi.)	Peak Discharge (cfs)		
		2% (50-year) event	1% (100-year) event	.2% (500-year) event
Upstream of Oak Street	0.31	573	710	1,010
Upstream of Upstream Cherry Street	0.88	984	1,260	1,720
Upstream of Holmes Street	1.1	1,170	1,500	2,080
Upstream of Vernon Street	2.0	2,090	2,730	3,830
Upstream of Hwy 210	2.3	2,090	2,760	3,870

Hydraulic analysis was performed using the HEC-RAS model, version 3.1.1. Existing conditions water surface profiles were generated for the 2% (50-year), 1% (100-year), and 0.2% (500-year) chance of exceedance flood event. The starting water surface elevations for each of the profiles were calculated using the normal depth option within HEC-RAS. As was assumed for the Missouri and Kansas River existing conditions models, it was assumed in the NKC Hillside Drainage Ditch HEC-RAS that the overbank areas would be considered ineffective flow areas. Water surface profiles for the NKC Hillside Ditch are shown in Exhibit A-2.25, together with corresponding top-of-levee elevations collected by the Kansas City District Survey Section.

As shown on Exhibit A-2.25, headwater from the NKC Hillside Drainage Ditch physically overtops the levee tieback for the 1% (100-year) and 0.2% (500-year) chance of exceedance flood event. The Missouri River backwater water surface elevation for 0.2% (500-year) chance of exceedance flood event is approximately 750.2 feet msl, which is approximately the same elevation of the NKC Hillside Drainage Ditch 2% (50-year) chance of exceedance flood event water surface at its downstream limit.

The results of this analysis indicate that the entire North Kansas City levee tieback is controlled by headwater from the NKC Hillside Drainage Ditch, and that backwater from the Missouri River will not result in overtopping of the levee tieback prior to any overtopping along the main stem levee. Therefore, results of this analysis will be not be used for developing interior floodwater and exterior water surface elevation relationships. Although profiles for the 1% (100-year) and 0.2% (500-year) chance of exceedance flood event show overtopping along the levee tieback, the overtopping is not attributed to Missouri River backwater. Future evaluation of the NKC Hillside Drainage Ditch may be conducted separate from the Kansas Citys study.

A-2.8 INTERIOR FLOODWATER/EXTERIOR WATER SURFACE ELEVATION RELATIONSHIPS

A-2.8.1 Introduction

For each levee unit, an analysis was performed for estimating a land-side (interior) floodwater elevation at a given river-side (exterior) water surface elevation. Interior flooding attributed to levee failure or levee overtopping was considered for developing interior/exterior water surface relationships. Results of this analysis will be used as input to the HEC-FDA model.

A-2.8.2 Approach

Sources of data used in the analysis consisted of exterior water surface elevations from the existing conditions hydraulic model, and elevations and probabilities from geotechnical and structural (if any) failure analyses. Failure analyses were performed by KCD for the Kansas City study. General discussions of the methods and results for all levee geotechnical and structural failure analyses can be found in the relevant Geotechnical and Structural chapters of this appendix. For each levee unit, exterior water surface and levee failure elevation data were translated to a single point along the top-of-levee (index point). For ease of analysis, the index point was fixed to the same location where input data for the geotechnical failure analysis were obtained.

The approach used for estimating interior floodwater elevations was dependent upon the cause of interior flooding (levee failure or levee overtopping) and the elevation of the lowest point along the top-of-levee. To identify the location and translate the elevation of initial levee overtopping to the index point, the existing conditions 0.2% chance of exceedance (500-year) flood event water surface profile was adjusted (equally raised or lowered) to intersect the top-of-levee at the initial point of overtopping. For levee failures below both the lowest top-of-levee and the elevation of initial levee overtopping, it was assumed that the interior floodwater would equilibrate to the elevation of the levee failure. When levee failure is above the lowest top-of-levee-elevation, but below the initial levee overtopping elevation, it was assumed that the interior floodwater elevation would equate to the lowest top-of-levee elevation. Once the levee is overtopped, it is assumed that the interior floodwater elevation would initially equate to lowest top-of-levee elevation. Once the exterior surface water exceeds the lowest top-of-levee elevation, it is assumed that the interior water surface elevation would then equal the exterior water surface elevation at that location. Incremental values (up to 3 feet) in exterior water surface elevation above the elevation of initial levee overtopping were used to identify situations where the initial overtopping flood profile was within 3 feet of overtopping the lowest top-of-levee elevation.

Figures are provided for each levee unit (Exhibit A-2.26 through A-2.33) that show top-of-levee; 0.2% (500-year) chance of exceedance water surface profile; water surface profile corresponding to initial levee overtopping; location of initial levee overtopping; index point (same location as geotechnical analysis point); and the structural analysis point (if any).

Probabilities were assigned to each interior/exterior relationship. The approach used for assigning probability was dependent upon the exterior water surface elevation at initial levee overtopping. Prior to any levee overtopping, probabilities were based on the results of geotechnical and structural (if any) failure analyses. Once the levee is overtopped, the probability becomes 100 percent.

Once all interior and exterior elevations and probabilities values were tabulated, a final evaluation of the results was made to categorize the results and, if necessary, exclude some data. Interior/exterior water surface elevation relationships were first categorized to show the results of combined levee geotechnical failure/overtopping, combined levee structural failure (if any)/overtopping, and combined levee failure/overtopping. Because the probability assigned to levee overtopping is 100 percent, any levee failure analysis at an elevation greater than that of initial levee overtopping was excluded. For the combined levee failure/overtopping category, geotechnical and structural (if any) failure probability values were compared to assure that probabilities increased with increasing exterior elevation, and if not, resulted in some data being excluded from the final listing of results. In some instances, the combined levee failure/overtopping category was a repeat of a combined levee failure-specific/overtopping category. In such instances, the applicable combined levee failure-specific/overtopping category was not shown.

A-2.8.3 Results

Results of categorizing interior floodwater and exterior water surface relationships and associated probabilities were tabulated and provided for input into the

HEC-FDA analysis of the Kansas Citys Levees. Figures showing the interior/exterior water surface relationship for combined levee failure/overtopping are provided for each levee unit (Exhibit A-2.34 through A-2.41).

A-2.9 INTERIOR STORMWATER FLOODING EVALUATION

A-2.9.1 Introduction

The following section is an evaluation of storm sewers, creeks, and ditches that pass through the existing levee system at selected drainage control structures. The present policy permits the Federal government to participate in improvements to any crossing of the levee system or upgrades to any pumping station, if those improvements can be independently justified by a hydraulic/economic analysis of the performance of the structure. Federal participation is limited to improvements at the line-of-protection (LOP).

Results of the evaluation were used to identify drainage control structures associated with a potential for economic damage resulting from stormwater inundation near the LOP. Stormwater flooding attributed to inadequate drainage control outside of the LOP was not addressed in this evaluation. Study methods and results are presented in the following sections.

A-2.9.2 Drainage Control Structure Preliminary Screening

Components of a drainage control structure typically include a system comprised of inflow and outflow pipes; storage pond; pump(s); and seepage collector system. Within the Kansas Citys Levee Study area, more than one hundred drainage control structures transfer stormwater runoff through the LOP.

A qualitative screening process was used for identifying structures to include in the evaluation. This process began with preparing schematics of each levee unit to show the location of each structure and major sources of contributing flow (e.g. overland, storm sewer, and/or seepage flow) (Exhibit A-2.42 through A-2.48). This information provided a tool for future discussions with each sponsor on a number of considerations for screening structures. This process resulted in an agreement with each sponsor on which drainage control structures to carry forward in the evaluation. Drainage control structures selected for the evaluation are provided in Exhibit A-2.107**,** located in the Supplemental Exhibits section.

Since its original selection, it has been noted that several efforts are on-going to evaluate the Turkey Creek drainage system. The Turkey Creek drainage system refers to the system of enclosed storm sewers draining from east to west along a former tributary to Turkey Creek. The Turkey Creek drainage system feeds a pump station located at the upper end of the CID-Kansas Unit. Since the Turkey Creek drainage system sewer outfall is served by a pressure sewer system, interior stormwater flooding is minimized along the line of protection. Given the current situation, an evaluation of interior stormwater flooding at the Turkey Creek drainage system sewer outfall was not included in this document. If the ongoing studies by the City of Kansas City using the procedures laid out in EM 1110-2-1413, and associated guidance, can demonstrate that improvements at the LOP are economically justified, then improvements in the area of this system outfall might be incorporated into the final plan.

A-2.9.3 Hydrologic and Hydraulic Analysis

Hydrologic and hydraulic analyses used the United States Environmental Protection Agency Storm Water Management Model (SWMM), Version 4.3. SWMM4.3 was chosen based on its ability to analyze interior areas having storm sewers, or combined sewers and natural drainages. The RUNOFF Module in SWMM was used for generating overland flows for a 50% (2-year), 20% (5-year), 10% (10-year), 4% (25-year), and 2% (50-year) chance of exceedance/24-hour duration design storm. Precipitation depths were obtained from TP-40 and applied to an SCS Type-II distribution. Infiltration was computed by the Horton equation. Infiltration rates were based on information obtained from soil surveys. All remaining RUNOFF Module input parameters (e.g. subcatchment area, surface slopes, Manning's "n" values, and others) were based on information obtained from USGS 7.5-Minute Quadrangles, aerial photos, or field reconnaissance.

The EXTRAN Module was used for accurate simulation of surcharging and pressure flow. All structures were evaluated under outfall gate-open and outfall gate-closed conditions. With the exception of three systems (Mattoon Creek basin storm sewer, Splitlog Outfall, and Southeastern Drainage), which only operate under gravity-flow, all other systems operate under both gravity-flow and pumping-flow. For storm sewers, only those conduits 36-inches-in-diameter or greater were considered. Field reconnaissance was performed in August 2002 at a limited number of investigation areas to verify conditions of storm sewer connectivity and pump plant operations. Sources of information used in the evaluation relied on readily available information, and as such, the level-of-detail was not the same for all evaluations. Exhibit A-2.108, located in the Supplemental Exhibits section, lists various data sources specific to each drainage control structure.

For all pumps, it was assumed that pumping began at an elevation equal to the mid-point of the inlet pipe. A majority of the pumping capacities were obtained from the Reconnaissance Report (1999). Information on pumps not included in the Reconnaissance Report was obtained from various sources. The Reconnaissance Report provides pumping capacities under design river-stage and design flood-stage conditions. Design river-stage is the stage for which the capacity of the pump was designed. Generally, this corresponds to a low river stage with a high intensity rainfall event. Design flood-stage is the stage for which the levees are designed. Generally, this corresponds to a high stage and a low intensity rainfall event.

While the efficiencies of seepage control systems were not evaluated, seepage flow rates, if available, were removed from the pumping capacity(ies) under design flood-stage conditions. This approach allowed for some consideration of the impact from seepage flow on the drainage control system. None of the drainage control structures had a storage pond designed specifically for that structure with regards to the collection of stormwater and/or seepage flow.

Figures were created to display interior stormwater flooding volumes (in acre-feet) attributed to a 50% (2-year), 20% (5-year), 10% (10-year), 4% (25-year), and 2% (50-year) chance of exceedance event under flood-stage, river-stage, and gate open conditions (Exhibit A-2.49 through A-2.65). These flooding volumes were determined by only combining those node-specific flooding volumes that were assumed to ultimately transfer to the area-of-inundation closest to the LOP. Because all flooding volumes under

gate-open and gate-closed conditions were less than one acre-foot, no figure was created for the Jersey Creek Outfall and the Mattoon Creek basin storm sewer.

Exhibit A-2.109, located in the Supplemental Exhibits section, lists the interior stormwater flooding volumes, specific to each drainage control structure under gate-open conditions and gate-closed/design river-stage conditions for a 50% (2-year), 20% (5-year), 10% (10-year), 4% (25-year), and 2% (50-year) chance of exceedance event. Results for design river-stage conditions were presented to account for conditions of low river stage with a high intensity rainfall event.

A-2.9.4 Flood Inundation Mapping

From Exhibit A-2.109, flooding volumes attributed to a 2% (50-year) chance of exceedance event under gate-closed/design river-stage conditions were used to prepare maps that approximate the extent of interior stormwater flooding closest to the LOP (Exhibit A-2.66 through A-2.77). Figures were only created for those drainage control structures with corresponding interior flooding volumes of at least one acre-foot. Base maps used for display were obtained from readily available sources and do not show the same level of detail for each study area. The boundary lines for interior flood inundation maps were based on interior stage/volume curves developed using Conic Method and interpolating between elevation contour lines. Each map only shows the area of impoundment closest to the LOP.

Results of flood inundation mapping provide a tool for screening critical drainage control structures. Inundation boundary lines are approximate and do not consider site-specific surface and subsurface features that could impact the storage and transfer of floodwaters such as floor drains, depression storage areas, private sump pumps, and others.

A-2.9.5 Critical Drainage Control Structure Screening

Results of the flood inundation mapping were used to screen drainage control structures associated with interior stormwater flooding where economic damages are anticipated (critical drainage control structures). These critical structures were identified through a qualitative screening that considered existing types of structures and facilities lying within the area of flood inundation closest to the LOP. Prior to screening, structures were rank-ordered according to flooding volume. Results of the ranking, flood inundation area characterization, and critical structure screening are provided in Exhibit A-2.110, located in the Supplemental Exhibits section.

Flood inundation maps were not prepared for Osage Avenue Pumping Plant, 12th Street Sewer System, or Santa Fe Pump Plant drainage control structures. At each of these sites, volumes of interior stormwater, attributed to a 2% (50-year) chance of exceedance event under gate-closed/design river-stage conditions, will drain towards a definable area of impoundment. For these sites, interior stormwater will move as shallow surface flow along streets, with isolated areas of depression storage.

Critical drainage control structures listed in Exhibit A-2.110 will be retained for detailed analysis to occur concurrently with adjacent major feature improvements. This approach to future analysis has been chosen as the current focus of the Kansas Citys study is on river flooding and not interior storm drainage. As part of this analysis, a coincident frequency analysis (as outlined in USACE Engineering Technical Letter

(ETL) No. 1110-2-367 (ETL 1995)) will be conducted at each critical drainage control structure. Additional hydraulic analysis will be performed to evaluate potential improvements to each structure (e.g. increased pumping capacities, larger inflow/outflow pipes, and others). Detailed economic analysis of the impacts of flooding in the immediate area of each critical drainage control structure identified in Exhibit A-2.110 may be conducted if improvements to those drainage control structures are independently justified economically. Those improvements could be incorporated into the overall recommended plan.

A-2.10 BRIDGE HYDRAULIC IMPACT ANALYSIS

As discussed earlier, several hydraulic structures are located along the Missouri and Kansas River study reaches, and consist mostly of bridges designed for vehicular or railroad traffic. A majority of the structures are located along the Kansas River. Water surface profiles of the Kansas River (Exhibit A-2.16 and Exhibit A-2.17) show that bridges impact the exiting conditions hydraulics. Additional analysis is required to determine which structures have the greatest impact and the extent to which those structures influence the Kansas River water surface profiles. Information from this study could be used in the plan formulation process.

Results of the existing conditions modeling were used in evaluating single-bridge hydraulic impacts. For each bridge, upstream and downstream water surface elevations were obtained for the 1% (100-year), 0.5% (200-year), 0.2% (500-year), 0.133% (750-year), 0.1% (1,000-year), 0.08% (1,250-year), and 0.067% (1,500-year) chance of exceedance flood events. The changes in water surface elevations were used for ranking single-bridge hydraulic impacts. Results of this ranking are displayed in Exhibit A-2.111, located in the Supplemental Exhibits section. For both the 0.2% (500-year) and 0.133% (750-year) chance of exceedance flood event, the top four ranking bridges were KC Terminal Bridge (RM 2.531), Missouri Pacific Bridge No. 72 (RM 1.619); Kansas Avenue East Bridge (RM 2.172); and CRI& P Bridge (RM 2.104). These bridges were selected for evaluating their cumulative impacts on the Kansas River existing conditions water surface elevations.

Beginning with a scenario that only included the KC Terminal Bridge, and ending with one that includes all four bridges, four separate bridge-removal scenarios were considered for evaluating the impacts of bridge hydraulics on the 0.2% (500-year) chance of exceedance flood event water surface profile. For each bridge-removal scenario, bridges were removed from the existing conditions model to create a 0.2% (500-year) chance of exceedance event water surface profile. Water surface profiles for each bridge-removal scenarios are shown in Exhibit A-2.78.

To identify the maximum potential reduction in water surface elevation, 0.2% (500-year) chance of exceedance event water surface profiles were also developed based on an assumption that all bridges were removed (unconstrained conditions) as compared to existing conditions (Exhibit A-2.78). From the downstream extent of bridge removal (Missouri Pacific No. 72 at RM 1.619) to upstream study limit (RM 10.0), existing conditions water surface elevations for the 0.2% (500-year) chance of exceedance event are between 2.0-ft. (RM 2.54) and 1.1-ft. (RM 10.0) above those produced under unconstrained conditions.

Table A-2.17 lists cumulative impacts of bridge removal in reducing water surface elevations for the 0.2% (500-year) chance of exceedance flood event. The results in Table A-2.17 indicate that the benefit of bridge removal is less than originally expected. Thus bridge removal, due to the large costs of removal and smaller than projected benefits, will not be further investigated as an alternative in this study.

TABLE A-2.17
Results of Bridge Hydraulic Impact Analysis

Bridge Removal Scenario	Reductions from Existing Conditions 0.2 % (500-year) Flood Event Water Surface Elevation		
	Maximum (ft)	Minimum (ft)	Average (ft)
KC Terminal Bridge (RM 2.531)	0.29	0.17	0.26
KC Terminal Bridge + Missouri Pacific Bridge No. 72 (RM 1.619)	0.74	0.32	0.45
KC Terminal Bridge + Missouri Pacific Bridge No. 72 + Kansas Avenue East Bridge (RM 2.172)	1.1	0.37	0.62
KC Terminal Bridge + Missouri Pacific Bridge No. 72 + Kansas Avenue East Bridge + CRI&P Bridge (RM 2.104)	1.3	0.37	0.74

A-2.11 FUTURE CONDITIONS WITHOUT PROJECT (BASELINE)

The future conditions without project represents the probable stage-discharge relationship at a selected future date based on the best available current data, the incorporation of any definite projects planned to be completed within the study reach, and any long term natural river processes that may affect future stages. For the purposes of this study, the future conditions have been defined as conditions reasonably expected to be present in 2030. A critical assumption in the future conditions analysis is that hydrologic conditions along the Missouri River and the Kansas River are relatively static and that flows used in the existing conditions study will be used in the future conditions analysis. The assumption was also implemented in the development of the recently released *Upper Mississippi River System Flow Frequency Study* (UMRFFS), 2003, which was based on the study of 100 years of gage records along the Missouri River. The UMRFFS superseded the previous Missouri River hydrology published in 1962 in the report titled *Missouri River Agricultural Levee Restudy Program*. It is therefore reasonable to assume that the newly published flows in the UMRFFS will still be applicable at the future conditions date.

A-2.11.1 Future Changes to Missouri River Model

Both man-made projects and natural processes will affect the future conditions as seen on the Missouri River. The primary man-made feature included in the future conditions HEC-RAS model is the construction of Missouri River Levee System (MRLS) L385. Construction of L385 was completed in 2005 and the levee extends from River Mile 371.4 to 376.5 on the left bank of the Missouri River. L385 is situated at the extreme upstream end of the studied reach and is not considered a part of this study. The planning of this levee carefully evaluated the hydrologic and hydraulic effects of the new levee on existing flood protection projects, including the Kansas Citys local protection. The other man-made feature considered in the feasibility study is the proposed Downtown Airport runway extension that, if constructed, will require fill in the floodway at river mile 369.2. The proposed fill lies between cross-sections in the HEC-RAS model used for the Kansas City's study and therefore is not reflected in the future conditions model. The responsibility for addressing fill impacts to the flood control works lies with the runway extension proponent. Coordination and assuring compliance is through the non-Federal flood control work's sponsors. The Corps of Engineers, through the Inspection of Completed Works Program, provides technical review of proposed work analysis and design. Proposed projects are approved if there are no adverse impacts to the flood control works. Even though the runway proponent is addressing impacts to the levee system existing condition, omission of this feature from the future conditions HEC-RAS model will not be detrimental to the accurate representation of the future conditions flood profiles. Subsequent evaluations of the Downtown Airport runway extension are underway and may slightly alter the findings to date.

The Missouri River has been subject to many natural processes that have affected river stages for both low and high frequency flood events. These long-term changes in the stage-discharge relationship of the river are referred to as stage trends. The USACE Northwest Division Missouri River Basin Reservoir Control Center in Omaha, Nebraska published *Missouri River Stage Trends, RCC Technical Report A-04* in April 2004. The stage trends at the Kansas City (Hannibal Bridge) Gage are shown on Exhibit A-2.79 for flows ranging from 20,000 cfs to 100,000 cfs. These trends clearly indicate a general decline in stages for flows greater than 80% annual chance of occurrence. The stage trends at the Kansas City Gage for low frequency flows are shown in Exhibit A-2.80. The 200,000 cfs data series reflects a slight rise in stages from 1950 to 2000. The higher flow data series generally reflect data collected in 1951 and 1952 flooding and from the flood of 1993. These floods are the only floods in recent history to produce flows greater than 200,000 cfs. The data indicate that stages recorded for similar flows in 1993 were higher than recorded in 1951 and 1952. However, these two data points in the highest flows do not provide enough data to quantify the trend. This matter of stage trends in the Kansas City reach may be further studied as part of the future Missouri River studies.

A likely cause for flood flow stage changes along the Missouri River is accretion behind dikes placed for navigation channel confinement. Exhibit A-2.81 and Exhibit A-2.82 display aerial photos of the Missouri River reach immediately downstream of the Hannibal Bridge in 1951 and 1998, respectively. Exhibit A-2.83 is an aerial photo from 1954 also showing the Missouri River, looking upstream at the reach between the Paseo Bridge, at the bottom of the photo, and the Hannibal Bridge at the top of the photo. Comparing the aerial photographs, it is evident that there has been significant accretion

along the left bank of the Missouri River in this reach. Flows deposit sediment in the quiescent area downstream of the navigation dike structures. This sediment builds over time and encroaches further into the channel. As time passes, vegetation has grown on this newly accreted land. The vegetation stabilizes this accreted land from future erosion and allows the cycle to continue further into the channel. This cycle produces the tall stands of timber present in the accreted land behind the dikes along the riverward side of the levees. The accreted land tree growth then leads to higher stages for a given flow as conveyance area is decreased and overbank roughness is significantly increased.

The Kansas City District is currently working on providing shallow water habitat (SWH) along the Missouri River in the forms of bank, dike, and revetment notches, creation of pilot channels and chutes, and major dike modification. The Kansas City District and the Omaha District combined to create over 1,200 acres of SWH for the endangered pallid sturgeon between April and June 2004. A portion of SWH created is located along the reach of the Missouri River in Kansas City. By constructing these river control modifications, accreted land is either removed or allowed to erode. The accreted lands removed by these modifications are replaced with shallow slack water areas that provide a rich environment for the pallid sturgeon as well as other wildlife. While providing an ecological benefit through diversifying the Missouri River ecosystem, the SWH program also helps deter and may even reverse the accretion/vegetation cycle contributing to the upward stage trends of high flows in the Missouri River. The design of these dike/bank modifications discourages any further accretion at that location and encourages bank loss at each site. The SWH work is expected to help offset potential stage increases in the Kansas City Reach. The degree of that offset is unknown at this time. Therefore, the future conditions HEC-RAS model incorporates MRLS L385 but does not include the effects of natural processes.

A-2.11.2 Future Changes to Kansas River Model

The Kansas River does not have any planned projects that will affect the water surface elevations in the future conditions. However, some of the natural processes occurring on the Missouri River are similar to processes occurring on the Kansas River. Exhibit A-2.84 and Exhibit A-2.85 show the Kansas River in aerial photography from 1955 and Exhibit A-2.86 from 1998 aerial photography. Significant tree growth on the foreshore seen in the 1998 photo can be found on both the left and right foreshores from the upper limits of the studied reach to approximately RM 3.5. Downstream of RM 3.5, very little vegetation exists on the foreshore. There has been some accretion along the studied reach, but not to the extent of the Missouri River, as navigation structures are not present in the Kansas River. The future conditions without project model assumes that since the upper reach is heavily vegetated in the existing conditions, the future conditions will not be worsened by further maturity of these growths. It is also assumed that the lower reach from RM 3.5 to the mouth has not seen significant vegetation from 1955 to the present and therefore will not see any further growth in the future. Therefore, the future conditions without project model along the Kansas River does not change from the existing conditions model.

A-2.11.3 Future Conditions Water Surface Profiles

Future conditions water surface profiles were generated for the 10% (10-year), 1% (100-year), 0.5% (200-year), 0.2% (500-year), 0.133% (750-year), 0.1% (1,000-year), 0.08% (1,250-year), and 0.067% (1,500-year) chance of exceedance flood events. The starting water surface elevations for each of the profiles were calculated using the normal depth option within HEC-RAS.

For each of these flood events, a similar assumption as used in the existing conditions model was made concerning overbank flows. As levees begin to overtop, the protected areas behind are considered ineffective flow areas. The profiles reflect flow in the area from levee to levee and do not consider the protected areas as conveying flow. It is not possible to predict where a levee would fail. With seven separate levee units, each with separate geotechnical reliability characteristics, there are many different combinations of failure scenarios that could potentially occur. Each scenario could produce a different overbank flow path. HEC-RAS is a one-dimensional steady state model. If it were possible to predict the sequence and location of levee failures, use of HEC-RAS in its unsteady flow mode might provide a more accurate picture of very high flow profiles. Since it is not possible to predict these failure sequences, unsteady flow simulations were not conducted.

Two separate HEC-RAS models were constructed that utilized peak discharge values based on each controlling discharge scenario, similar to existing conditions. Results of the two models were compared on a station-by-station basis, with the highest water surface elevation being retained for tabulation and for generating water surface profiles.

The HEC-RAS results for the Missouri River and Kansas River are presented in Exhibit A-2.112 and Exhibit A-2.113, located in the Supplemental Exhibits section. For the lower frequency flood events, discretion should be used when applying these profiles because of the assumptions about overbank flows previously discussed. These lower frequency events are highly speculative and would not necessarily match what would physically happen. These events were produced to formulate frequency-stage curves for economic analyses in the HEC-FDA computer program.

For illustration purposes, water surface profiles have been grouped to show results for the 10% (10-year), 1% (100-year), 0.5% (200-year), 0.2% (500-year) chance of exceedance flood events (referred herein as “higher probability events”), and the 0.133% (750-year), 0.1% (1,000-year), 0.08% (1250-year), and 0.067% (1500-year) chance of exceedance flood events (referred herein as “lower probability events”). Exhibit A-2.87 shows the Missouri River profiles for the higher frequency events. Exhibit A-2.88 shows the Missouri River profiles for the lower frequency events. Exhibit A-2.89 shows the Kansas River profiles for the higher frequency events. Exhibit A-2.90 shows the Kansas River profiles for the lower frequency events.

Levee unit-specific water surface profiles showing the 0.2% (500-year) chance of exceedance flood event in relation to the top-of-levee were created for the Birmingham (Exhibit A-2.91), East Bottoms, (Exhibit A-2.92), Central Industrial District (CID) (Missouri) (Exhibit A-2.93), North Kansas City-Airport (Exhibit A-2.94), Fairfax-Jersey Creek (Exhibit A-2.95), CID (Kansas) (Exhibit A-2.96), Armourdale (Exhibit A-2.97), and Argentine (Exhibit A-2.98) Levee Units. Water surface profiles for the 0.2% (500-year) chance of exceedance flood event are presented solely to facilitate the comparison

of the hydraulic performance of the various levee units. The actual rating of these levees is a function of the uncertainties associated with the local hydraulics and flow estimates, and the estimated geotechnical and structural reliability of the levee.

A-2.11.4 Hydraulic Uncertainty

As discussed in the existing conditions section, stage uncertainty is expressed in Risk Based Analysis as a standard deviation (in feet). Per USACE Engineering Manual (EM) No. 1110-2-1619 (EM 1996), a total standard deviation was obtained by applying the formula below:

$$\text{Total Standard Deviation} = \text{SQRT}\left((S_{natural})^2 + (S_{model})^2\right)$$

where SQRT = square root mathematical function
$S_{natural}$ = standard deviation based on historical data and gage readings
S_{model} = standard deviation based on mapping detail and reliability of estimating Manning's n values

The $S_{natural}$ will remain unchanged, as that portion of the uncertainty is due to the agreement between historical gage readings and modeled water surface elevations. $S_{natural}$ is a function of calibration accuracy and does not change from existing conditions to future conditions. However, due to additional assumptions in the development of the future conditions model, S_{model} will increase. The future conditions have been assumed to be similar to the existing conditions. This similarity includes channel section geometry as well as roughness values. Due to the uncertainty of future channel morphology and vegetation growth, the reliability of the cross-section data and Manning's n-value decreases. S_{model} is obtained by estimating the confidence in the cross-section data from topographic mapping efforts and in estimating the reliability of the Manning's n-value. Table 5-2 in EM 1110-2-1619 quantifies S_{model}, based on these two factors. A standard deviation of 1.3 feet was chosen since the cross-sections were based on current aerial mapping and the Manning's n-values were assumed to be less reliable than existing conditions.

Once $S_{natural}$ and S_{model} are known, a total standard deviation can be computed. Following traditional procedures presented in EM 1110-2-1619, a total standard deviation of 1.8 feet was estimated for the entire discharge set in the future conditions.

A-2.12 INTERIM FEASIBILITY – FUTURE CONDITIONS WITH PROJECT

The future conditions with project represents the probable stage-discharge relationship at a selected future date reflecting any proposed alternatives from the current feasibility study. The basis of this hydraulic model is the future conditions without project model modified to reflect any proposed alternatives. Potential projects included in the Interim Feasibility Report of this study include:

- Raise of the Argentine Unit.
- Installation of seepage controls at the confluence of the Missouri and Big Blue Rivers in the in the East Bottoms Unit.

- Rehabilitation/improvement of the existing Board of Public Utilities (BPU) floodwall at the upstream end of the Fairfax-Jersey Creek Unit.
- Rehabilitation/improvement of the Jersey Creek sheetpile wall in the Fairfax-Jersey Creek Unit.
- Installation of seepage controls in the Harlem area of the North Kansas City Unit.
- Installation of seepage controls near the National Starch Plant in the North Kansas City Unit.
- Removal of tree growth on the Kansas River.
- Channel Modifications and the removal of tree growth on the Kansas River.

A-2.12.1 Argentine Unit Levee Raise

Three alternatives have been identified for the Argentine levee raise alternative. The alternatives include raising the levee to the future conditions without project 0.2% (500-year) chance of exceedance flood event (referred to as the 500+0 alternative), raising the levee to 3 feet above the future conditions without project 0.2% (500-year) chance of exceedance flood event (referred to as the 500+3 alternative), and raising the levee to 5 feet above the future conditions without project 0.2% (500-year) chance of exceedance flood event (referred to as the 500+5 alternative). Freeboard does not explicitly enter into this set of alternatives. A typical spread of three raises is examined for purposes of allowing economic optimization. This spread was chosen based on practical experience and expected costs.

Both the existing conditions and the future conditions without project models were developed using a confined flow assumption. The future conditions with project also incorporates this basic confined flow assumption. This confined flow assumption dictates that any levee raise does not affect flood profiles along the Kansas River as no conveyance was allowed behind the levees regardless of levee elevation. Therefore, the future conditions with project profiles for the levee raise alternatives are identical to the future conditions without project profiles.

The economic analysis of the levee raises was completed using HEC-FDA. HEC-FDA requires that any induced damages to other flood control projects caused by an alternative action be calculated and assigned a cost of mitigation. To provide some data to HEC-FDA concerning induced damages, profiles were generated to provide estimates of any possible raises in water surface profiles adjacent to Armourdale and CID-Kansas due to an Argentine levee raise. The profiles generated in that study are for calculation of induced damages for HEC-FDA only and do not justify modifying the future conditions without project profiles. Procedures used and results of this study are included in a Memorandum for Record (MFR) included as Exhibit A-2.117 in the Supplemental Exhibits section.

A-2.12.2 Seepage Controls, Missouri and Blue Rivers Confluence Area, East Bottoms Unit

The Hawthorne pump plant was constructed in July, 1951, shortly after completion of the East Bottoms Unit. It is located at levee Station 401+00, near the confluence of the Blue River and the Missouri River. Interstate 435 was constructed in this area in the late 1960s and resulted in a significant portion of the original 1,919 acres of drainage area being redirected from the Hawthorn pump plant watershed. At that same

time, development began converting much of the agricultural ground into industrial plants. So while the watershed was reduced in area, much of the drainage area was being covered with impervious surface and undergoing the installation of storm sewer systems. The Chemagro Plant (now the pharmaceutical manufacturing complex known as the Bayer Corporation) was constructed in the middle 1970s at the site of a proposed ponding area for the Hawthorn pump plant. It is evident from engineering reports soon following the construction of the Chemagro plant that flooding at the site was a problem, with documented flooding problems as early as September, 1975.

This location was subject to significant underseepage issues during the flood of 1993. Several sandboils developed on the Bayer site during the 1993 flood. A series of relief wells have been proposed as the chosen alternative in this feasibility study. Eighteen relief wells are proposed between levee Stations 401+00 to Station 422+00. The maximum flow to be discharged from the wells is 1.25 cfs/well for a total discharge of 22 cfs. Bayer Corporation has expressed concerns of adding any flow to the Hawthorne pump station because it has experienced some site flooding during periods of sluice gate closure and pump plant activation. The existing pump plant contains three vertical, axial-flow, propeller-type pumps rated individually at 15,400 gpm (34 cfs) at 18.4 feet of head, the design flood stage. The total capacity of the pump plant is 101 cfs at the design flood stage. The original design is outlined in the definite project report by the Kansas City District titled *East Bottoms Unit Supplement on Interior Drainage,* April 1948. Section 20.(a).3 of the Supplement on Interior Drainage identifies a drainage area of 1,919 acres tributary to the Hawthorne pump plant. The plant was designed to operate in conjunction with 245 acre-ft of ponding in the lowest 213 acres of the protected area to provide interior drainage discharge from the tributary area. For river stages above 38.9 feet at the Hannibal gage, the pump plant was designed to discharge 101 cfs. This discharge consisted of seepage water and no additional capacity was provided for interior stormwater. The pumping plant would not begin to remove interior stormwater from the ponding area until river stages lowered and seepage flows were reduced. It is noted that the Bayer manufacturing complex now occupies this ponding area.

Due to proposed Bayer plant expansion and concerns over past flooding, Bayer hired Delich, Roth & Goodwillie Engineers (DRG) to study the interior drainage tributary to the Hawthorne plant and determine if any upgrades to the pumping plant were necessary. DRG produced a report titled *Bayer Site Drainage Study Phase 1*, April 2000, as a result of that study. The study looks at the drainage area tributary to the pump plant and estimates the flow to the pump plant using a HEC-1 hydrology model. Exhibit A-2.99, copied from the DRG report, identifies a total drainage area of 784 acres, reduced from the original design of 1,919 acres. The report states that "it is believed" that construction in the drainage area has re-directed some of the tributary area. The study also states that while the original design of the Hawthorne plant considered seepage flow from approximately 18,200 feet of levee (Station 297+50 to 479+66), construction has re-directed much of the seepage flow. Seepage from only 6,700 feet of levee (Station 370+00 to 437+00) now reaches the Hawthorne pump plant. This 63% reduction in seepage flow changes the total seepage to the plant to 38 cfs at design flood stage. The DRG report identifies that, at the time of sluice gate closure, a 30-year interior event coincident with a Missouri River low flood stage would result in flooding at the Bayer property.

The findings in the DRG report suggest that the pump station may not be providing the design interior flood protection. The report also states that, at high flood stages on the Missouri River, the pump station does adequately discharge the seepage flow and the interior drainage, since an interior coincident event at design flood stage is much less than at low flood stage when the sluice gate is initially closed. The critical event occurs just at the time of closure of the gravity discharge and the beginning of pumping. This could be partly due to the loss of the 246 ac-ft of ponding area delineated in Exhibit A-2.100 by the construction of the existing Bayer plant in 1974. The pumping plant was designed to utilize the 213-acre ponding area to attenuate the peak of the interior runoff. The 1948 Supplement on Interior Drainage addressed this issue in Section 20.(o) Plans for Future Development by the City of Kansas City, Missouri (page 48 of the Supplement): "At the present time this area is used almost exclusively for agricultural purposes, however, the City anticipates widespread commercial and industrial development upon completion of the proposed protection. City officials have indicated they will enter into an agreement with landowners to provide temporary ponding area in order to reduce the necessary capacity of the pumping plant, and at such time as future development of the area determines the undesirability of ponding therein, they will install additional pumping capacity."

The addition of relief wells should not aggravate the existing situation. No additional flow will reach the pump station due to the addition of relief wells. The relief wells simply provide a safe outlet for seepage water that was previously entering the interior area through the ground causing sandboils. The pumping plant was designed to provide capacity only for seepage removal at design flood stage. As stated in the DRG report, construction has eliminated approximately 63% of the seepage in the original pump plant design. Therefore, the pump plant should have adequate capacity to handle the seepage flow from the relief wells during times of high stages along the Missouri River.

This proposal will have no effect on future condition flood profiles.

A-2.12.3 Rehabilitation/Improvement of Floodwall, Fairfax-Jersey Creek Unit

This proposal will have no effect on future condition flood profiles.

A-2.12.4 Rehabilitation/Improvement of Sheetpile Wall , Fairfax-Jersey Creek Unit

This proposal will have no effect on future condition flood profiles.

A-2.12.5 Seepage Controls, Harlem Area, North Kansas City Unit

This proposal will have no effect on future condition flood profiles.

A-2.12.6 Seepage Controls, National Starch Area, North Kansas City Unit

This proposal will have no effect on future condition flood profiles.

A-2.12.7 Kansas River Tree Removal

The present Kansas Citys levees along the Kansas River are the results of 1962 modifications of the original levee designs. The 1962 modifications were a result of the overtopping of the Kansas Citys units along the Kansas River in the 1951 flood. The

1962 modifications were designed using a water surface profile for the design discharge of 390,000 cfs with a coincident Missouri River flow of 610,000 cfs at the Hannibal gage. The Kansas River channel through the Kansas Citys reach was analyzed at that time using a channel n-value of 0.025. This n-value is representative of a clean channel as left in the aftermath of the 1951 flood. Exhibit A-2.84 and Exhibit A-2.85 display typical channel geometry and vegetation present at the time of the 1962 modification.

The overbanks along the reach extending from RM 3.5 to the upstream end of the Argentine Unit have now become overgrown with mature trees (Exhibit A-2.86). The mature stand of trees along both the left and right overbanks has reduced the conveyance of the Kansas River from the 1962 design. The alternative of removing all trees throughout the Kansas Citys reach of the Kansas River has been investigated to determine the potential reduction in water surface profiles by restoring the Kansas River channel to a condition similar to that of 1962. The future conditions without project HEC-RAS model used three n-values (left overbank, channel, and right overbank) for modeling the Kansas River. The 1962 channel n-value of 0.025 for the entire Kansas River section is not considered applicable because of the 1993 flood experience. The calibrated existing conditions model used channel n-values ranging from 0.035-0.042.

These n-values were selected to calibrate the existing conditions HEC-RAS model to known 1993 high water marks. For the purpose of estimating the effect of tree removal on the Kansas River, an overbank n value of 0.045 was selected. This value is reasonably representative of non-forested, slightly overgrown overbank areas. The resulting water surface elevations are summarized in Exhibit A-2.114, located in the Supplemental Exhibits section. The future conditions with tree removal 0.2% (500-year) chance of exceedance water surface profile is plotted for the Kansas River study reach in Exhibit A-2.101. The future conditions with tree removal 0.2% (500-year) chance of exceedance water surface profile is 0.35-ft lower than the future conditions without project profile at the downstream end of the Argentine Unit and 0.80-ft lower at the upstream end of the Argentine Unit.

A-2.12.8 Kansas River Tree Removal and Channel Modification

Channel modification has also been evaluated as an alternative. The channel modification alternative assumes that any channel modifications will be in conjunction with tree clearing. The channel modifications would consist of removing the island extending from RM 5.1 to 5.6, cutting approximately 200 feet from the large left foreshore from RM 5.9 to 7.6, and cutting an average of 250 feet from the right foreshore from RM 6.4 to 9.0. Exhibit A-2.115 in the Supplemental Exhibits section summarizes water surface elevations resulting from the combined tree removal and channel modification. Exhibit A-2.102 shows the water surface profile plotted for the 0.2% (500-year) chance of exceedance future conditions in the Kansas River study reach with tree removal and channel modification That water surface profile is 0.35-ft lower than the future conditions without project profile at the downstream end of the Argentine Unit and 1.53-ft lower at the upstream end of the Argentine Unit.

The removal of various amounts of tree/vegetation growth in the channel and along accreted foreshore areas will be evaluated within alternative solutions for the Argentine Unit. While removal may lead to improvement in conveyance, modeling results indicate that improvement is limited. This may also be true of combinations of

vegetation removal and channel cross-section enlargement. It is not anticipated that such measures will be fully adequate to form the NED plan. We are also aware and cognizant of concerns that vegetation removal and channel modification may have significant potential impact on habitat quality along the lower Kansas River. All aspects of these hydraulic, economic, and environmental issues will be fully addressed in the upcoming plan formulation process.

A-2.13 REFERENCES

1. Hydrologic Engineering Center, River Analysis System (HEC-RAS) 2001, User's Manual, U.S Army Corps of Engineers, Version 3.0, Davis, California, January 2001.

2. Kansas City District (KCD) (KCD 2001), Upper Mississippi River System Flow Frequency Study (UMRFFS) - Appendix E, Kansas City District – HYDROLOGY, December 2001.

3. Congress 1943, Missouri River and Tributaries at Kansas Citys, MO and KS, 78th Congress, 1st Session, House Document No. 342, October 21, 1943.

4. KCD 2002, Kansas River Hydrology - with Special Attention to: Kansas River Hydrology near Topeka, KS, March 2002.

5. Kansas City District (KCD) 1999, Reconnaissance Report - Kansas Citys, Missouri and Kansas Flood Damage Reduction Project (Section 216 Study - Review of Completed Civil Works Projects), August 1999.

6. USACE 1994, The Great Flood of 1993 Post Flood Report, Lower Missouri River Basin, Appendix E, U.S. Army Corps of Engineers Kansas City District, September 1994.

7. Engineering Manual (EM) 1996, Engineering and Design – Risk-Based Analysis for Flood Damage Reduction Studies, EM 110-2-1619, U.S. Army Corps of Engineers, Washington, DC. August 1996.

8. Federal Emergency Management Agency (FEMA) 1990, Flood Insurance Study, Kansas City, Missouri, Clay, Platte and Jackson Counties, Revised September 14, 1990.

9. HNTB 2002, Blue River Channel Project - Flood Insurance Study Revision, Post-Project Hydraulic Analysis, Existing Conditions, March 2002.

10. Hydrologic Engineering Center, Hydrologic Modeling System (HEC-HMS) 2000, User's Manual. U.S Army Corps of Engineers, Version 2.2.0, Davis, California, March 2000

11. Herschfield, D.M. 1961, Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. Technical Paper 40. Weather Bureau, U.S. Department of Commerce, Washington, DC.

12. Engineering Technical Letter (ETL) 1995, Engineering and Design – Interior Flood Hydrology, ETL 1110-2-367, U.S. Army Corps of Engineers, Washington, DC. March 1995.

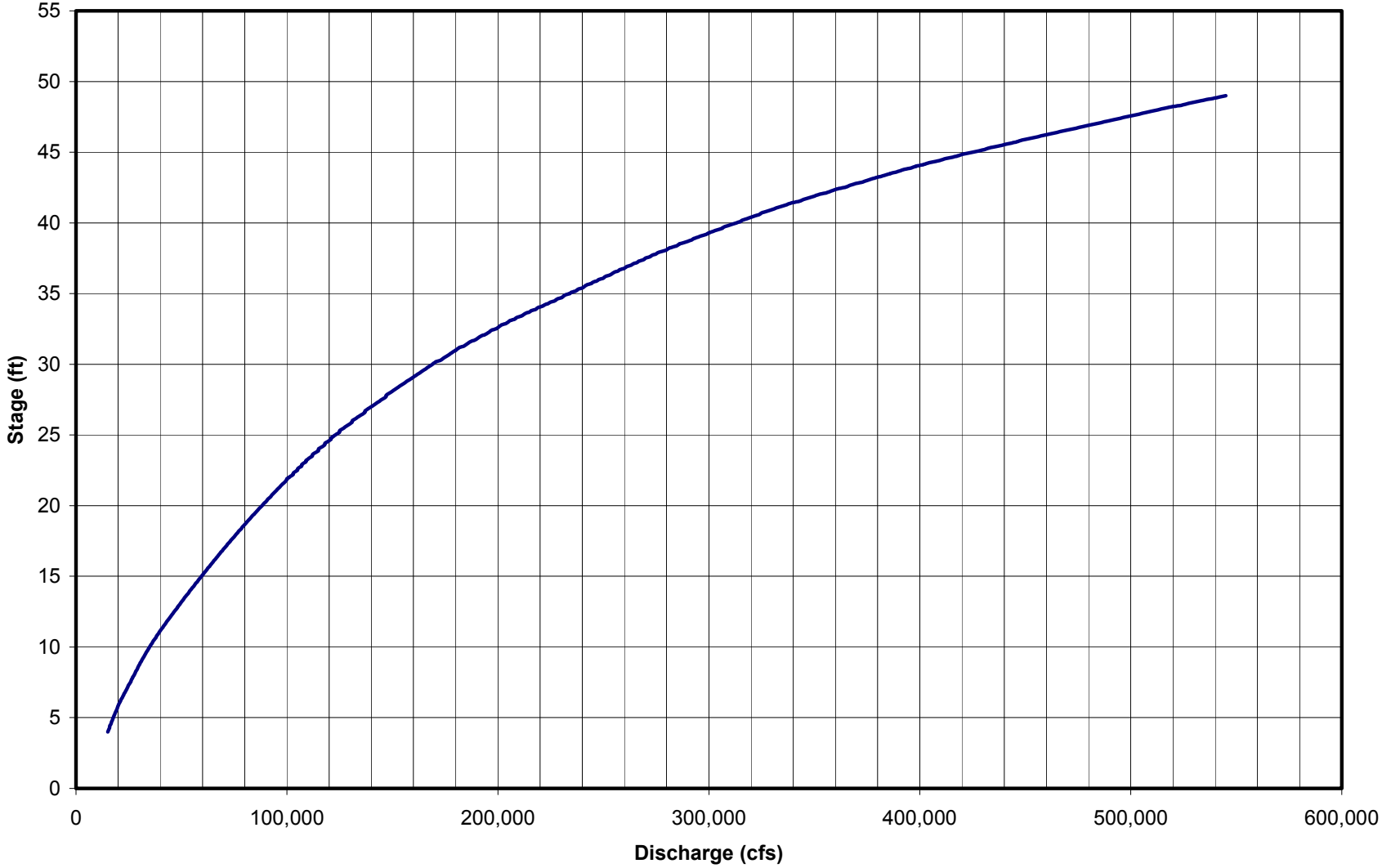
13. USACE Missouri River Region Reservoir Control Center 2004, Missouri River Stage Trends RCC Technical Report A-04, April 2004.

14. USACE Kansas City District 1948, Definite Project Report East Bottoms Unit – Supplement on Interior Drainage, April 1948.

15. Delich, Roth & Goodwillie Engineers (DRG) 2000, Bayer Site Drainage Study, April 2000.

A-2.14 SUPPLEMENTAL EXHIBITS

EXHIBIT A-2.1
USGS Rating Curve #13 – Kansas City Gage



Gage Datum = 706.4 (NGVD 1929)

Design By: RAN
Checked By: GRL
8/17/2004

EXHIBIT A-2.2
Discharge- Frequency Curve- Missouri River just Downstream of Blue River

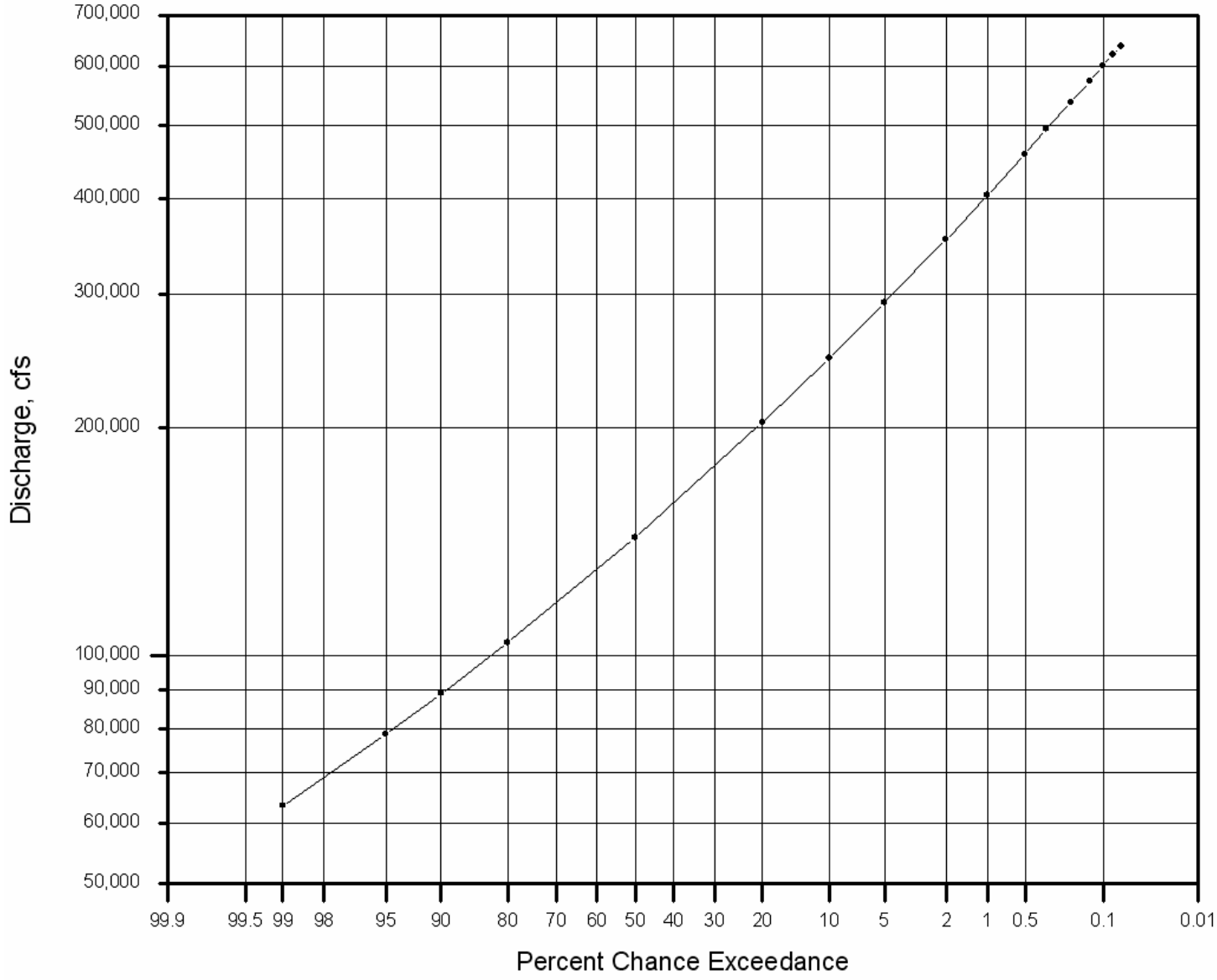


EXHIBIT A-2.3

Discharge- Frequency Curve- Missouri River just Downstream of Kansas River

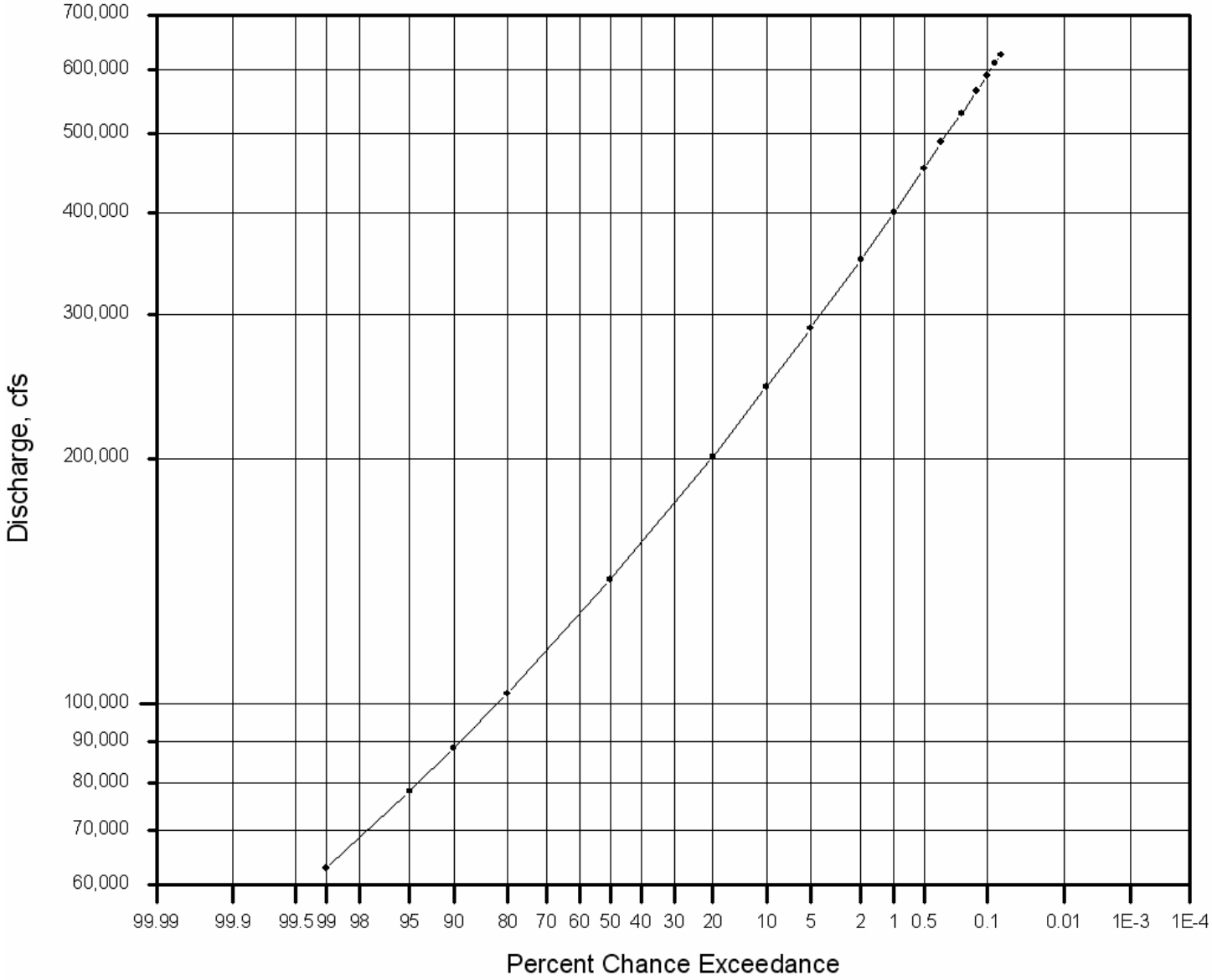


EXHIBIT A-2.4
Discharge- Frequency Curve- Missouri River just Upstream of Kansas River

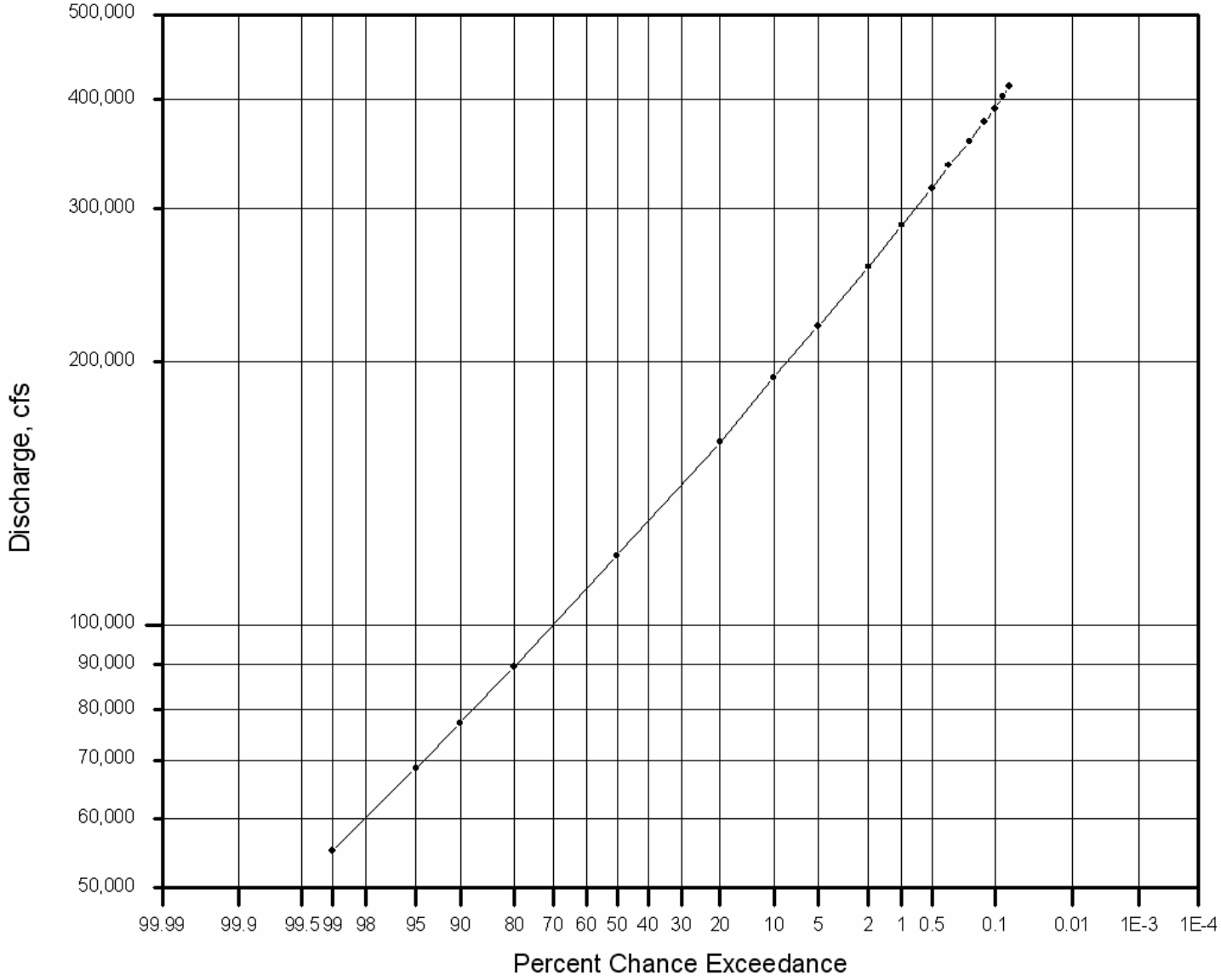


EXHIBIT A-2.5
Discharge- Frequency Curve- Kansas River at Mouth

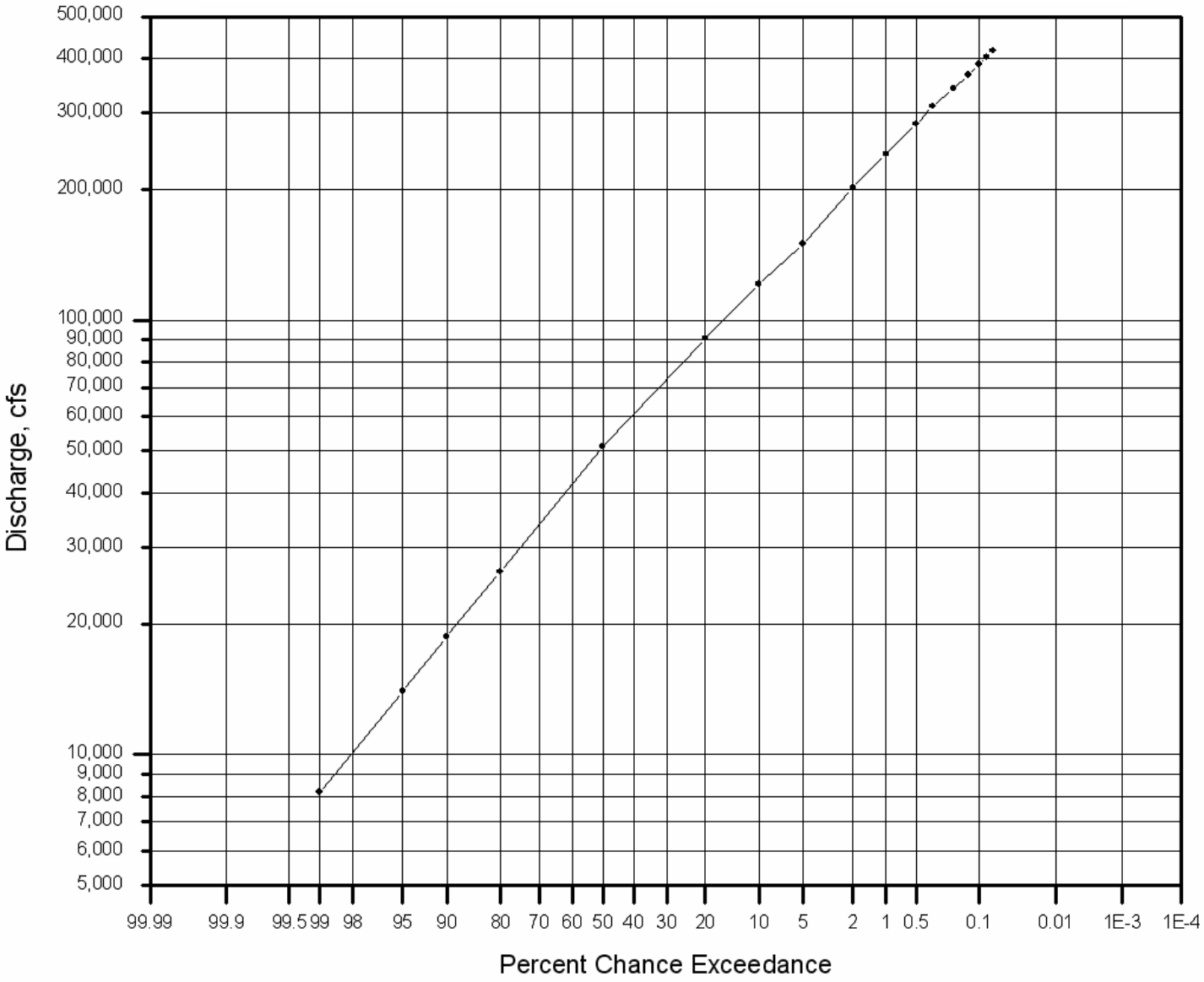
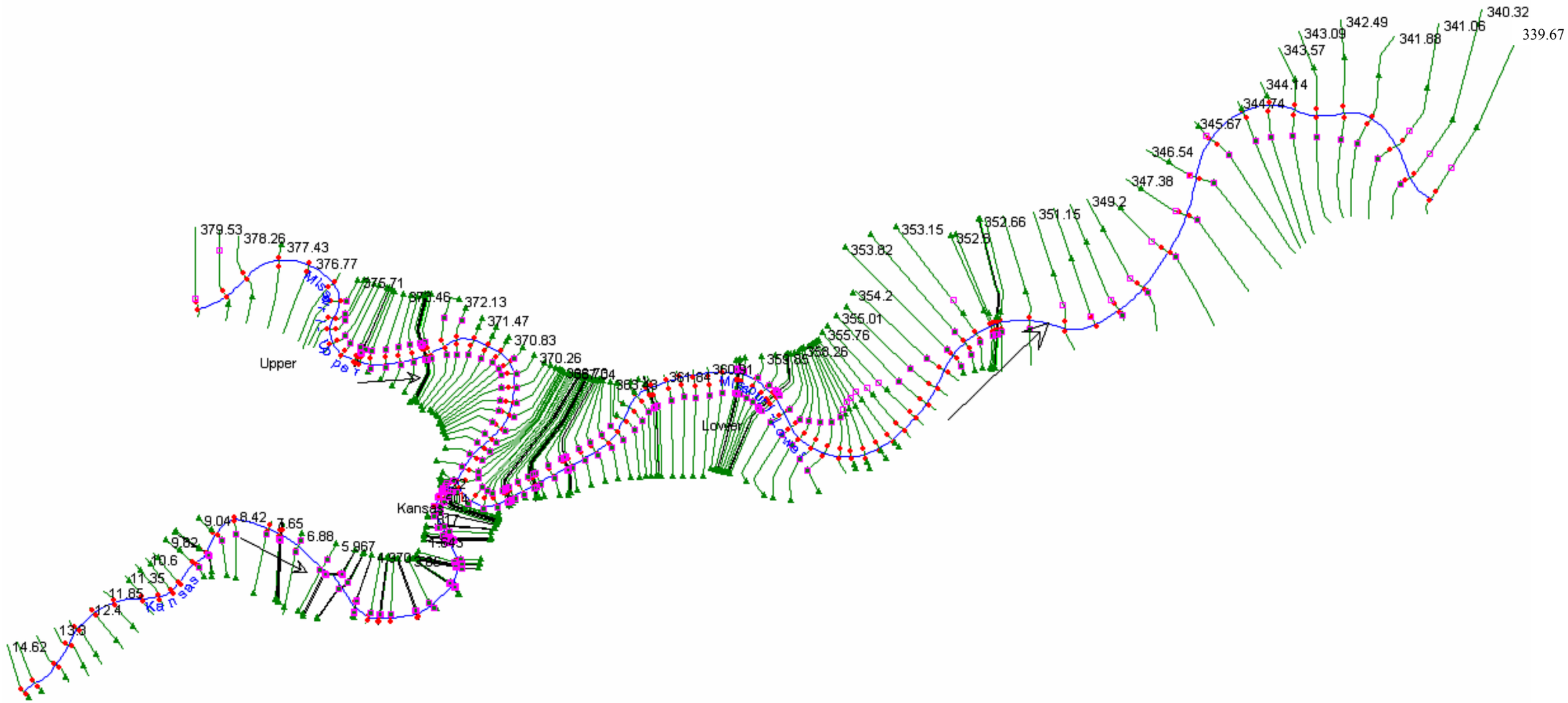


EXHIBIT A-2.6

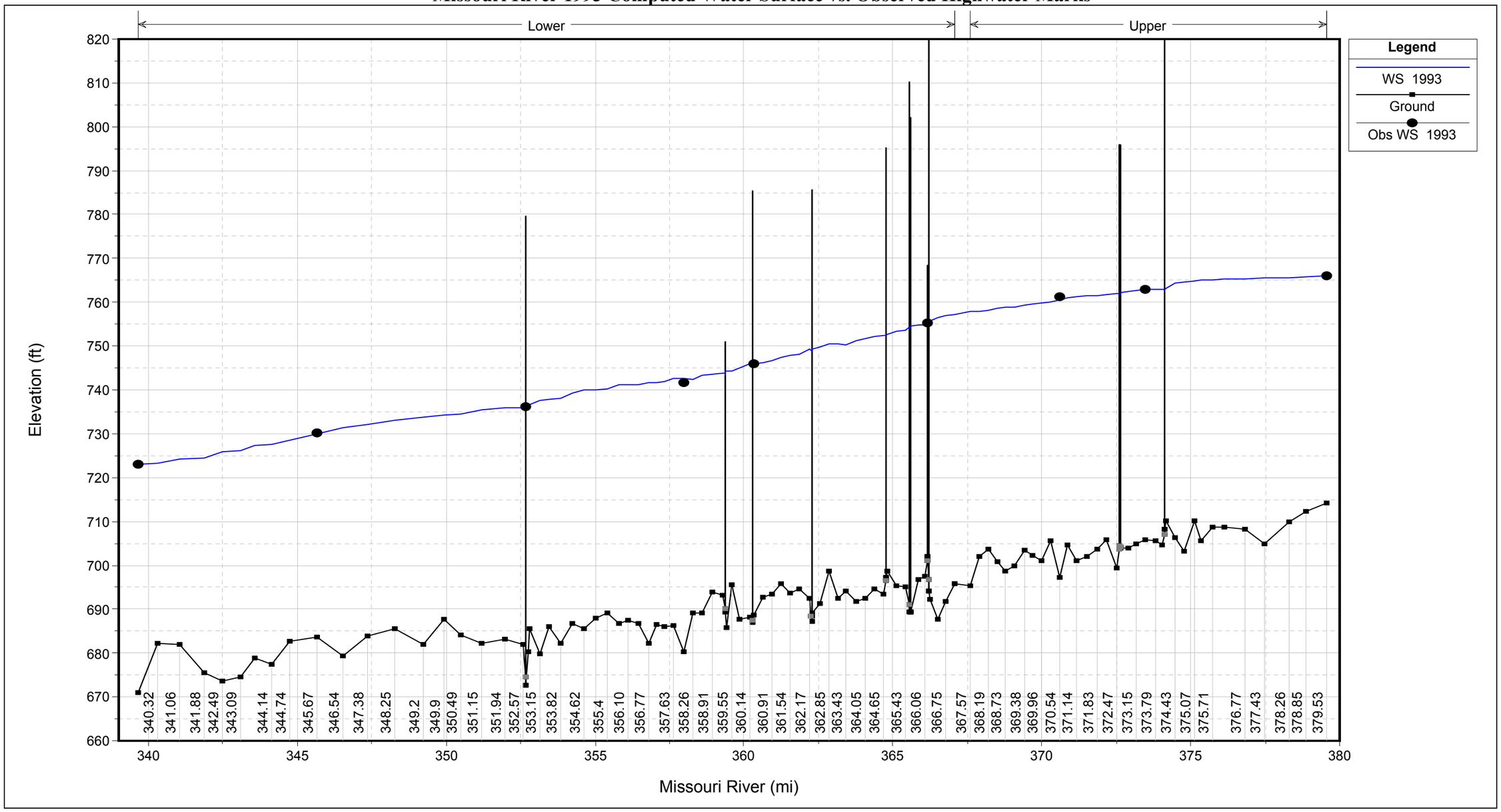
HEC-RAS Schematic of Reaches



Designed By: EDS
Checked By: GRL
February 2006

EXHIBIT A-2.7

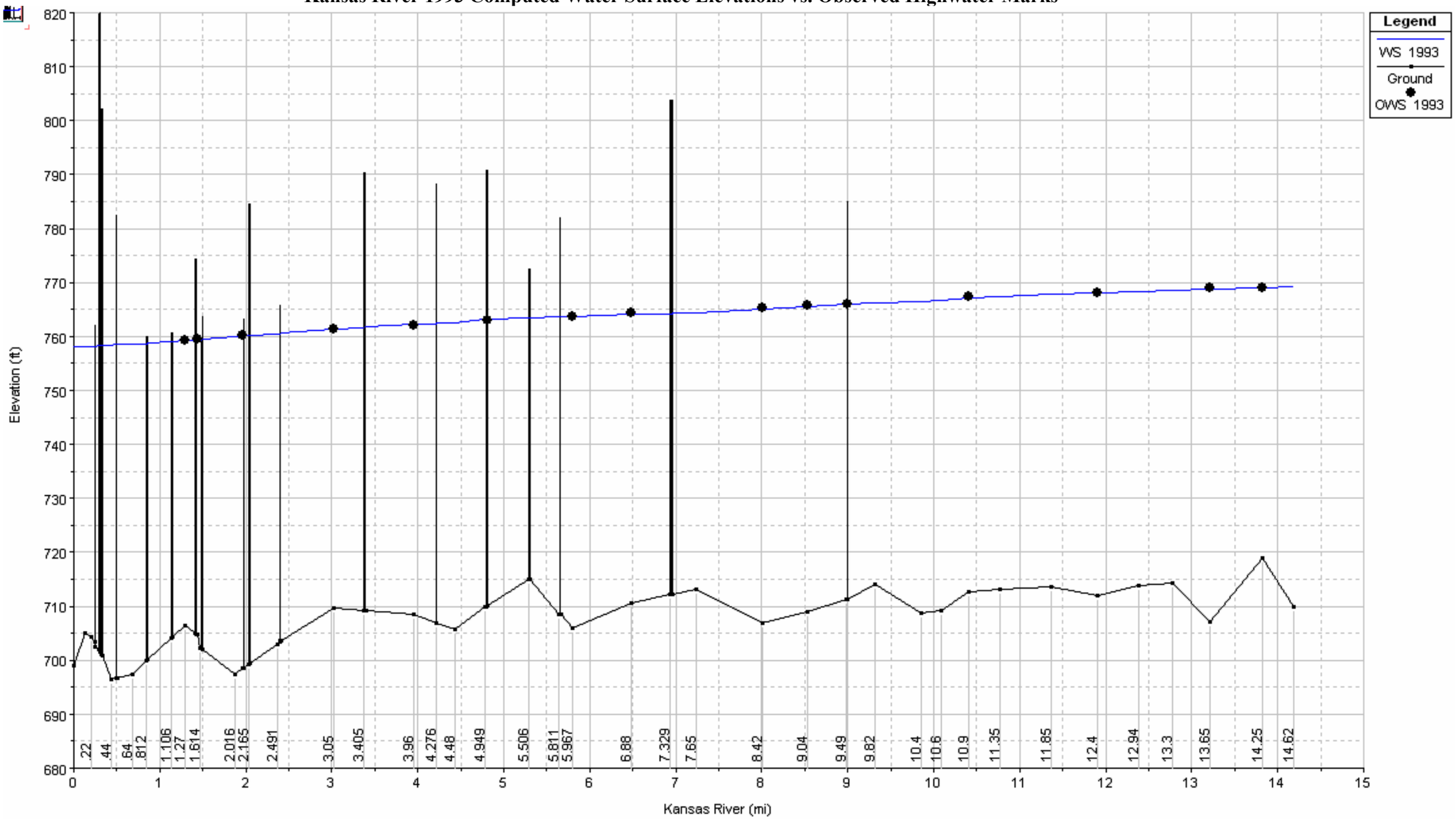
Missouri River 1993 Computed Water Surface vs. Observed Highwater Marks



Designed By: MWW
Checked By: GRL
February 2003

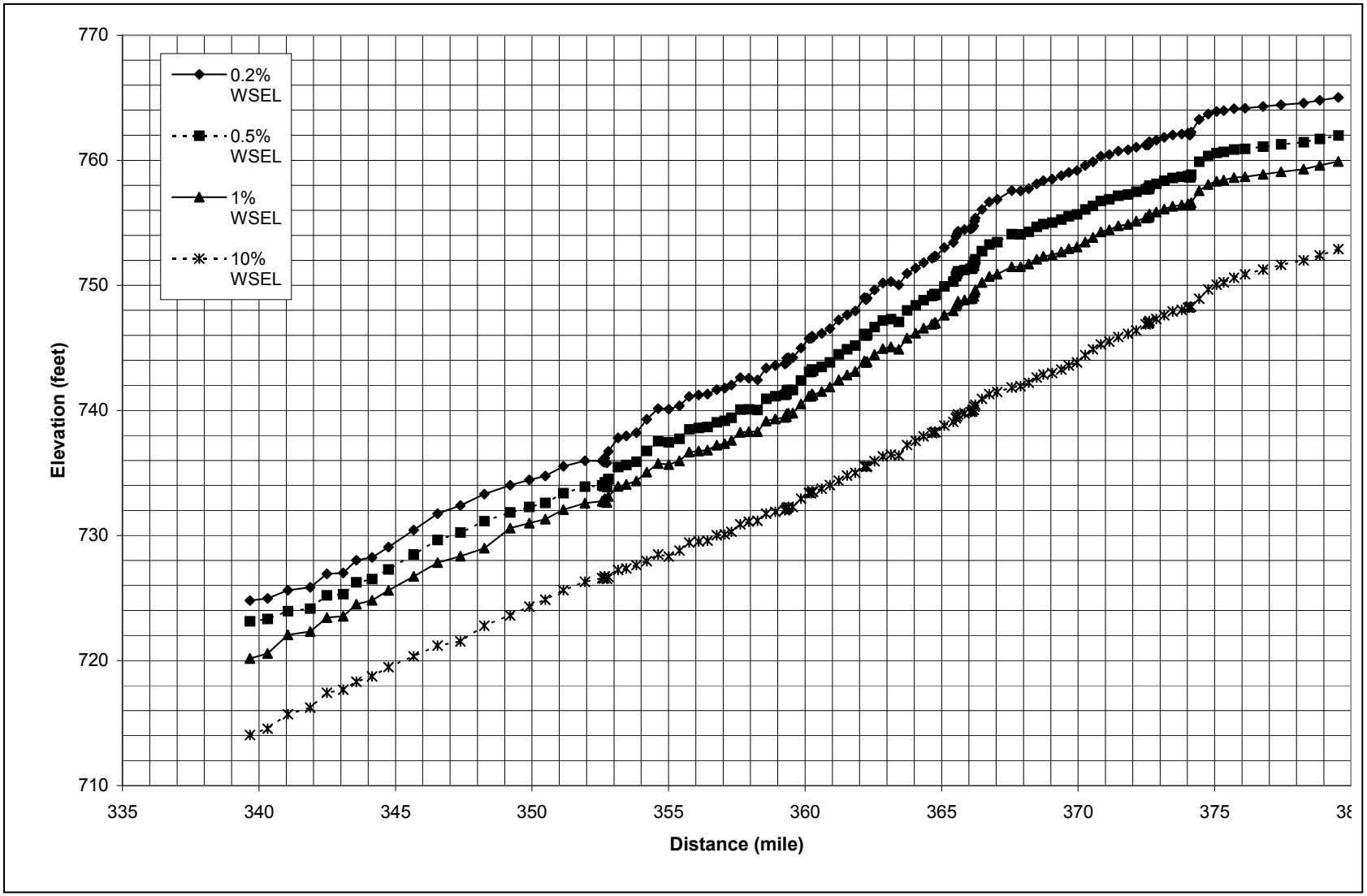
EXHIBIT A-2.8

Kansas River 1993 Computed Water Surface Elevations vs. Observed Highwater Marks



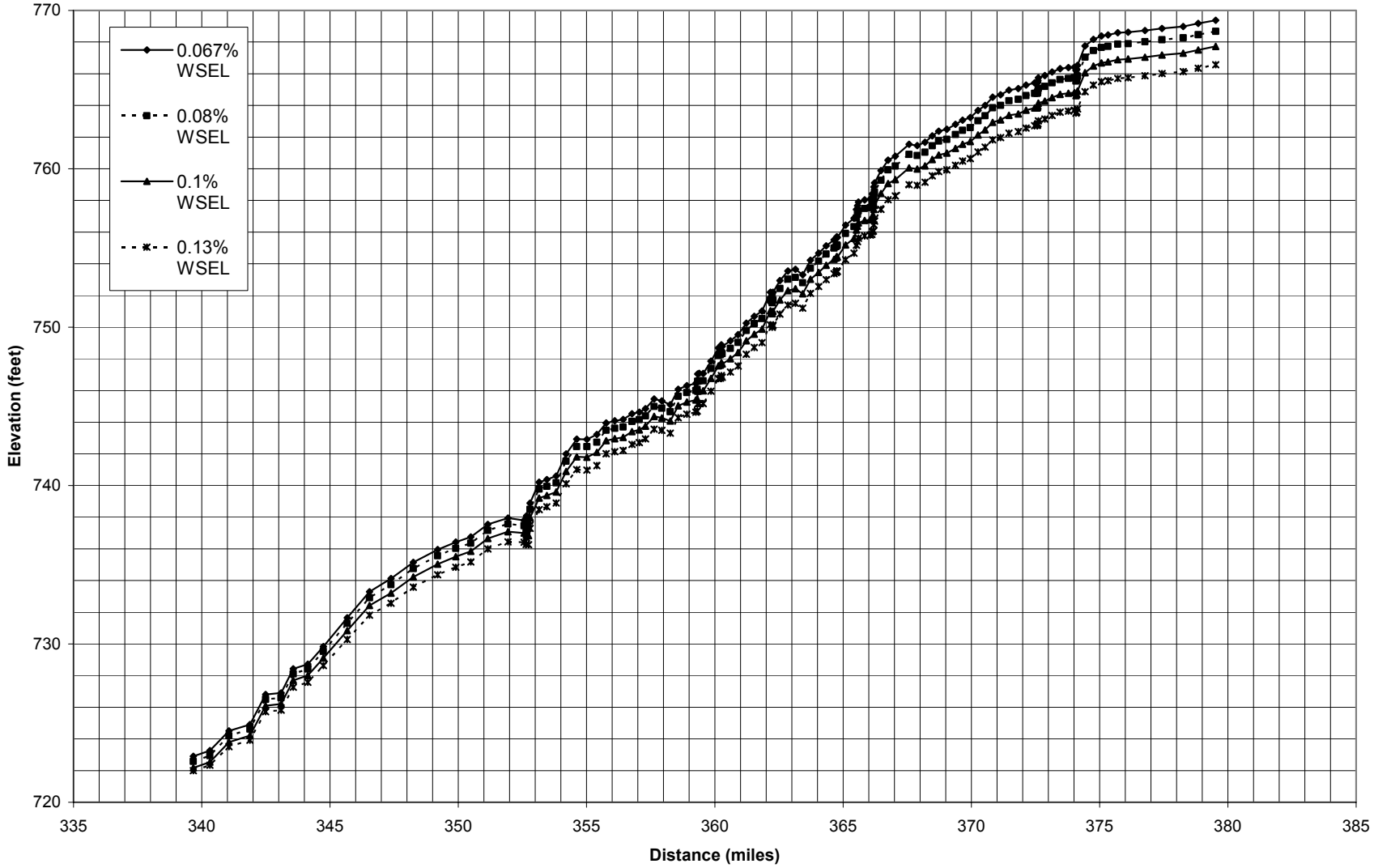
Designed By: EDS
Checked By: GRL
February 2006

EXHIBIT A-2.9
Missouri River Existing Conditions Higher Probability Water Surface Profiles



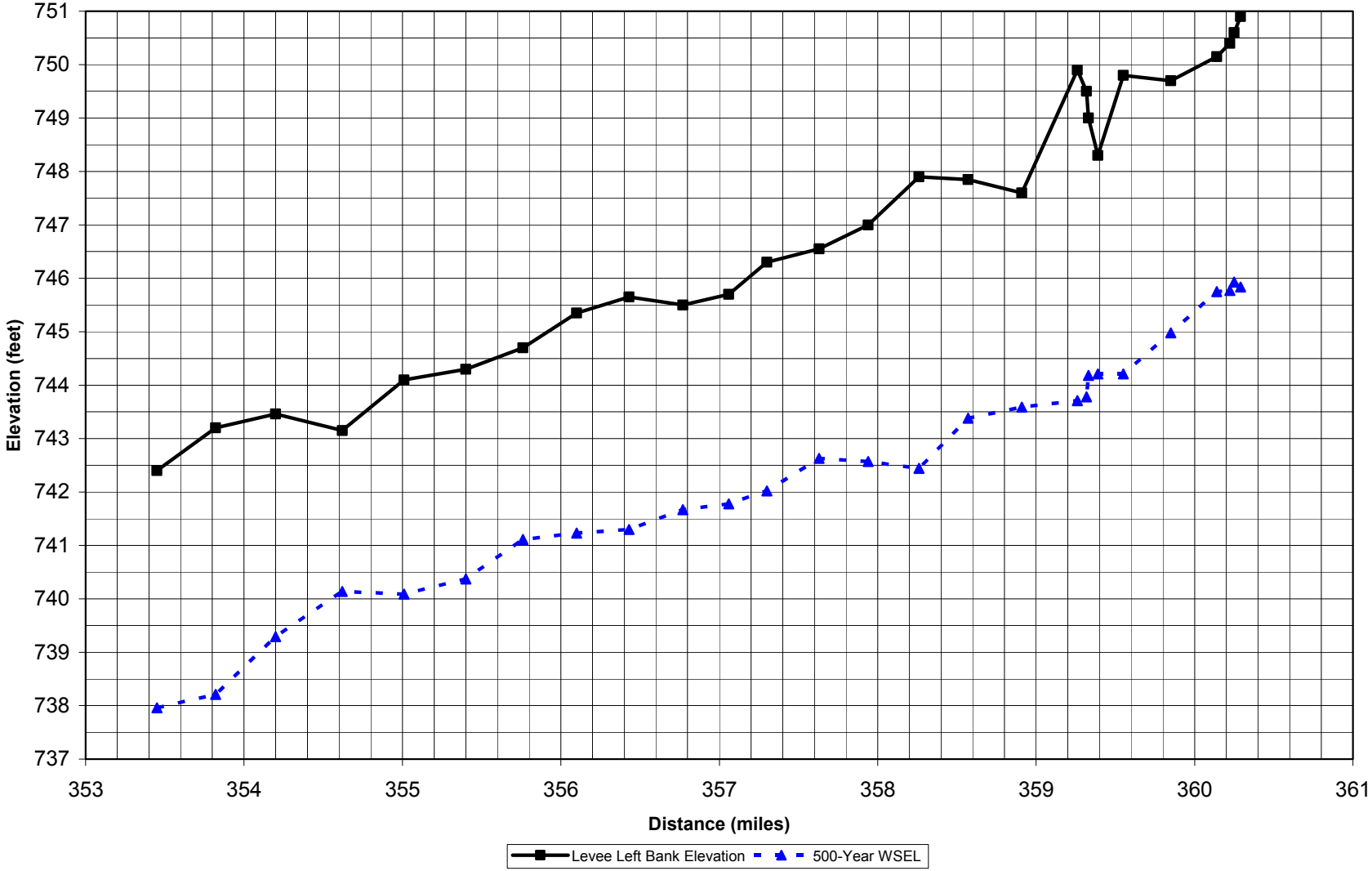
Design By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.10
Missouri River Existing Conditions Lower Probability Water Surface Problems



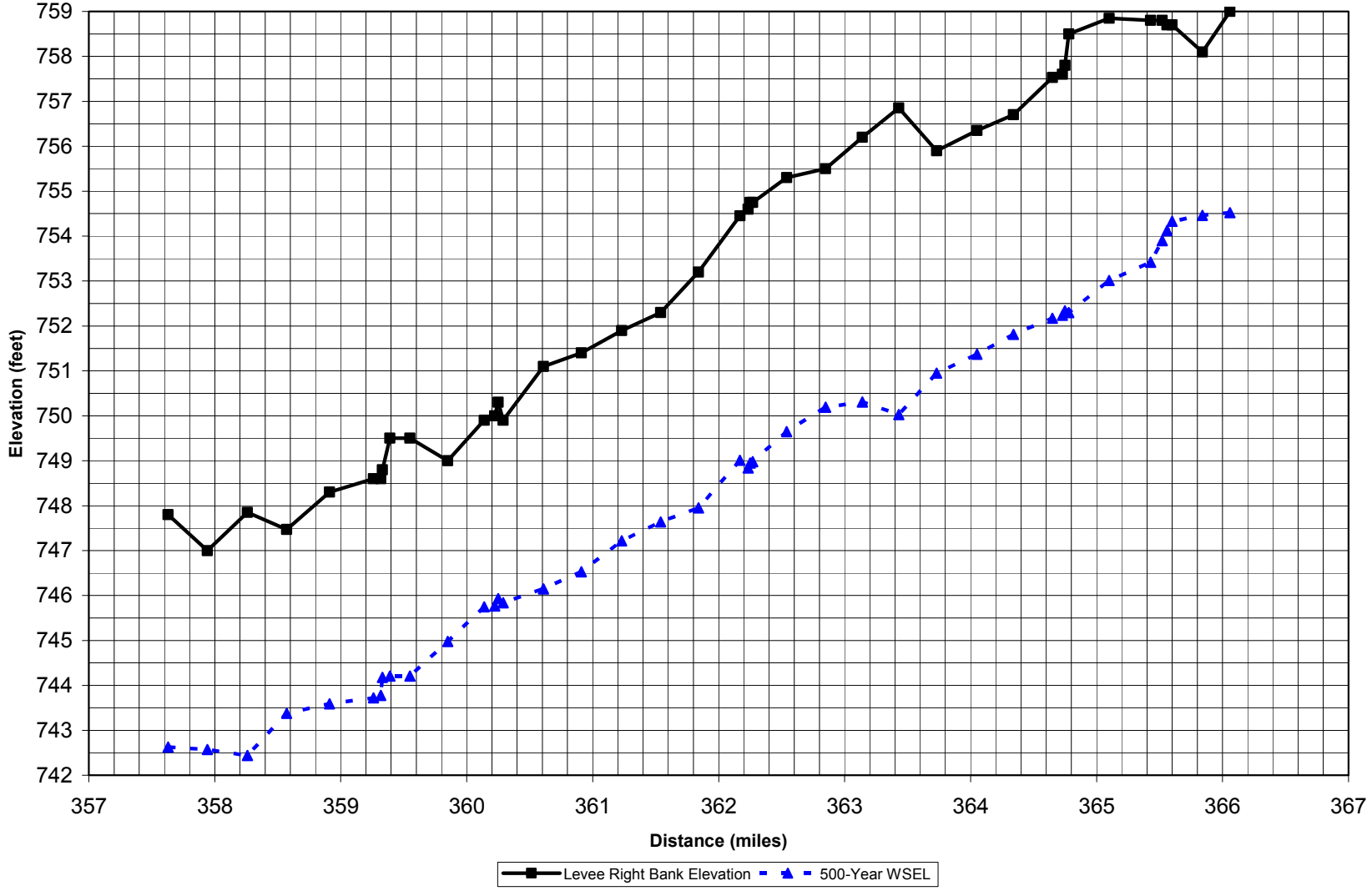
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.11
Birmingham Levee Unit 0.2% (500-Year) Chance of Exceedance Water Surface Profile



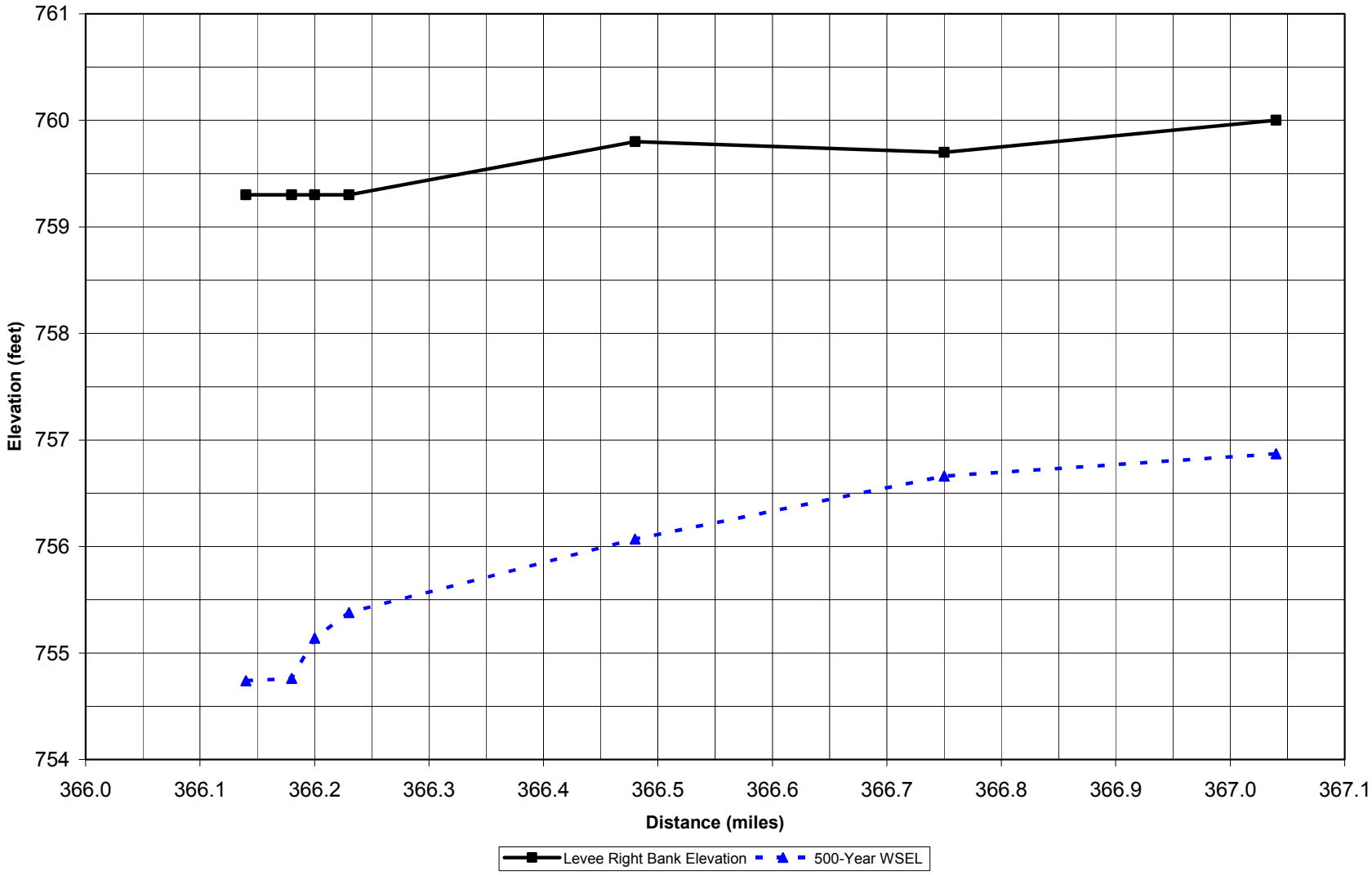
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.12
East Bottoms Levee Unit 0.2% (500-Year) Chance of Exceedance Water Surface Profile



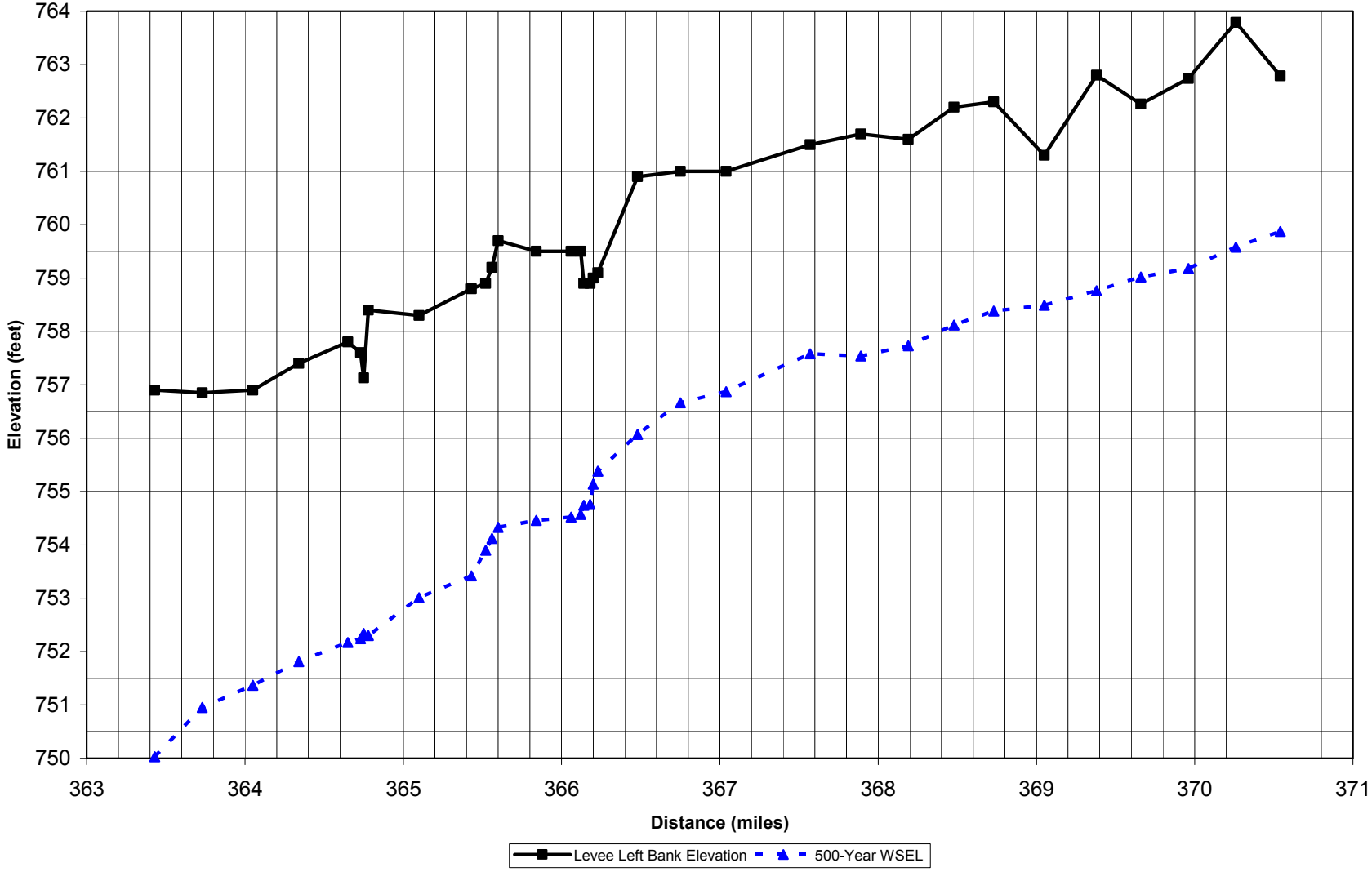
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.13
Central Industrial District (Missouri) 0.2% (500-Year) Chance of Exceedance Water Surface Profile



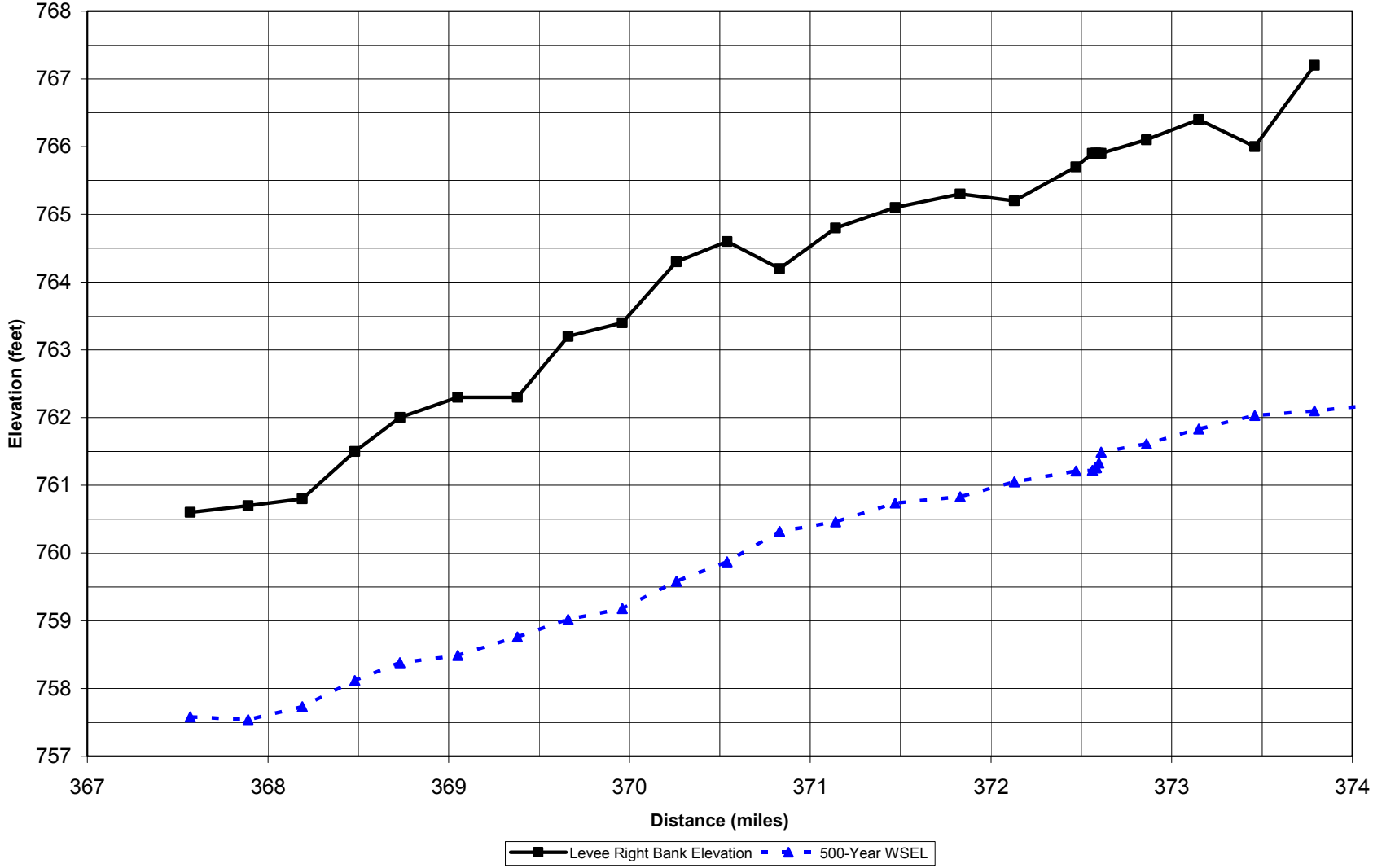
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.14
North Kansas City Airport Levee Unit 0.2% (500-Year) Chance of Exceedance Water Surface Profile



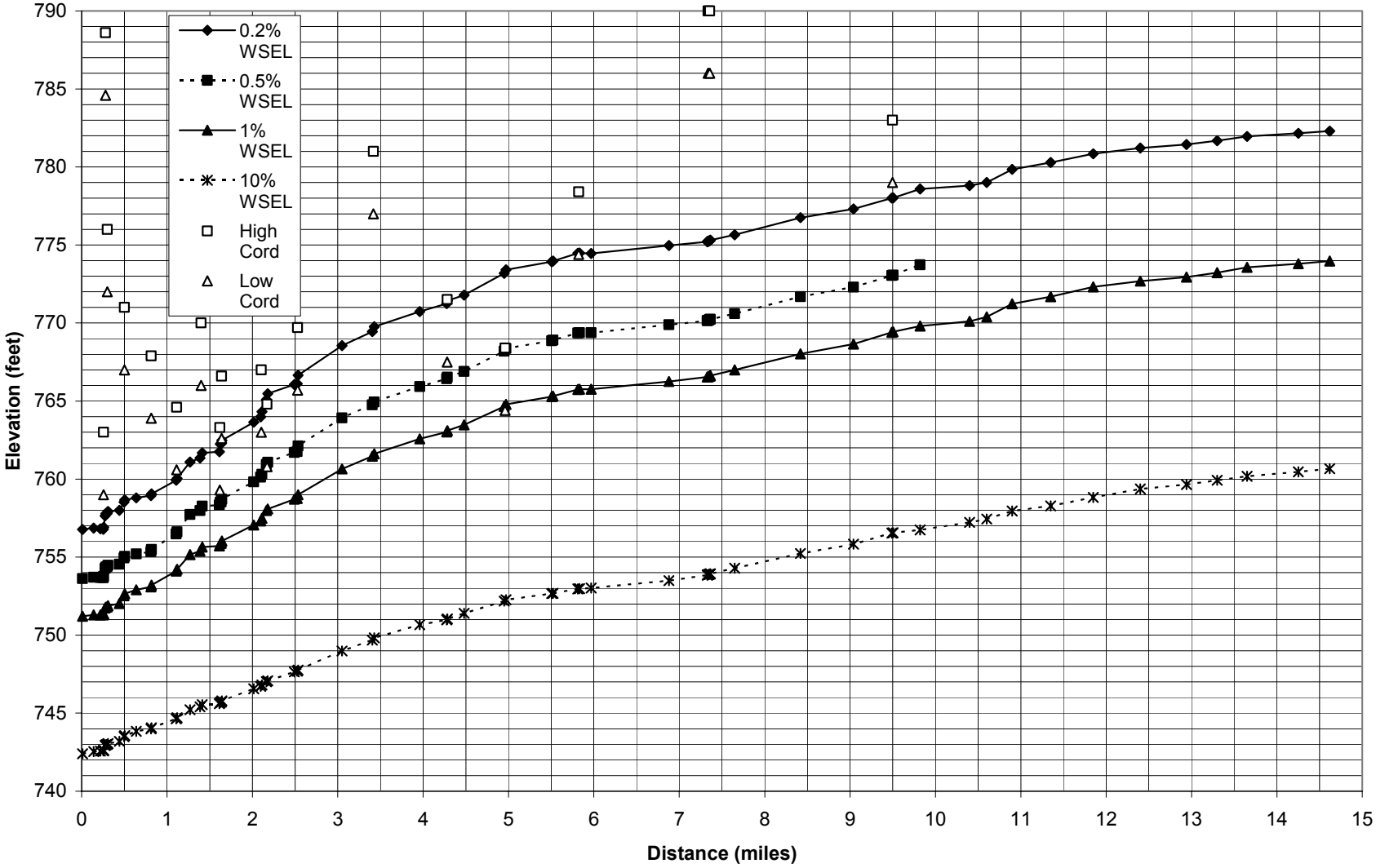
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.15
Fairfax-Jersey Creek Levee Unit 0.2% (500-Year) Chance of Exceedance Water Surface Profile



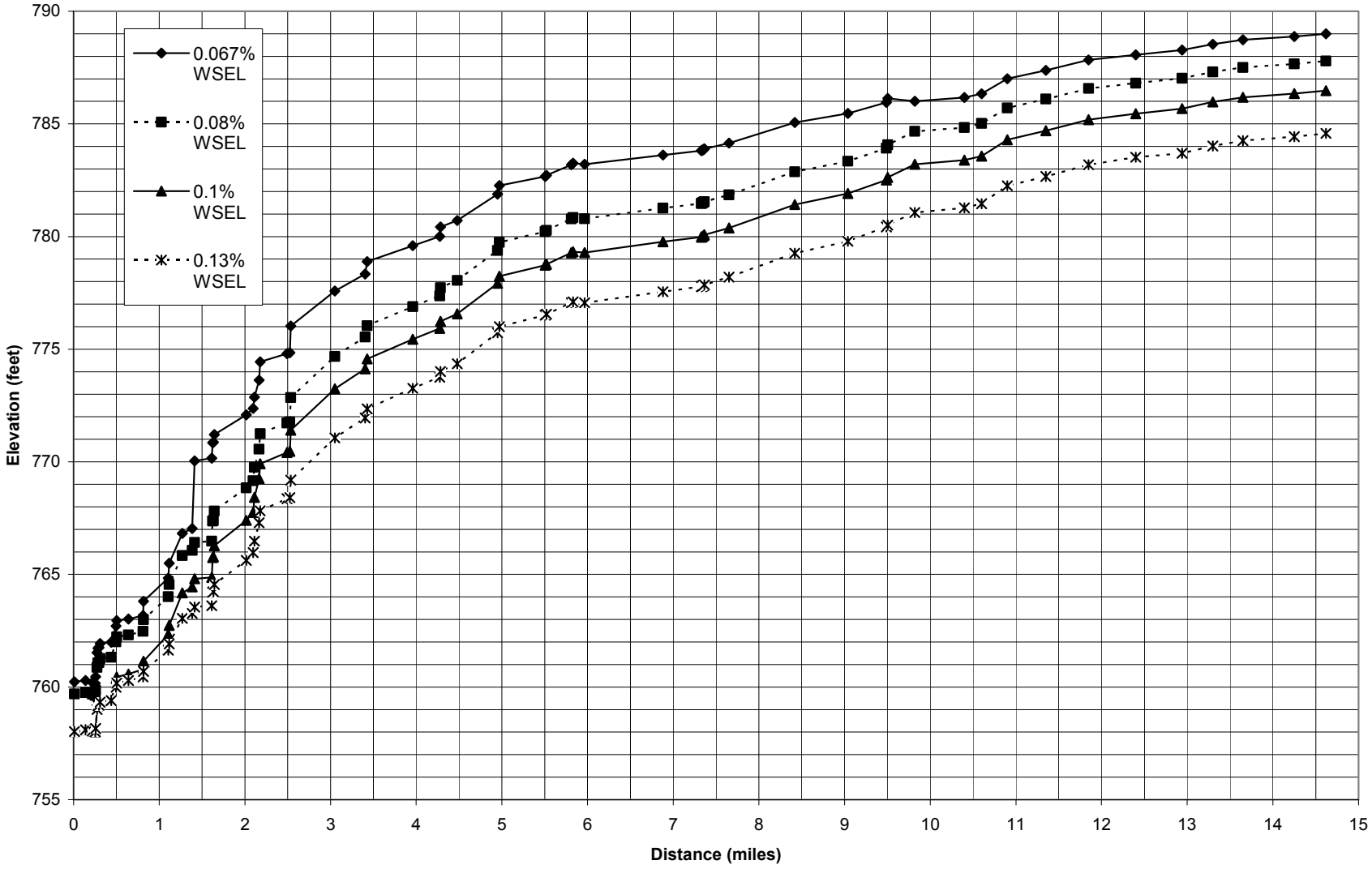
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.16
Kansas River Existing Conditions Higher Probability Water Surface Profiles



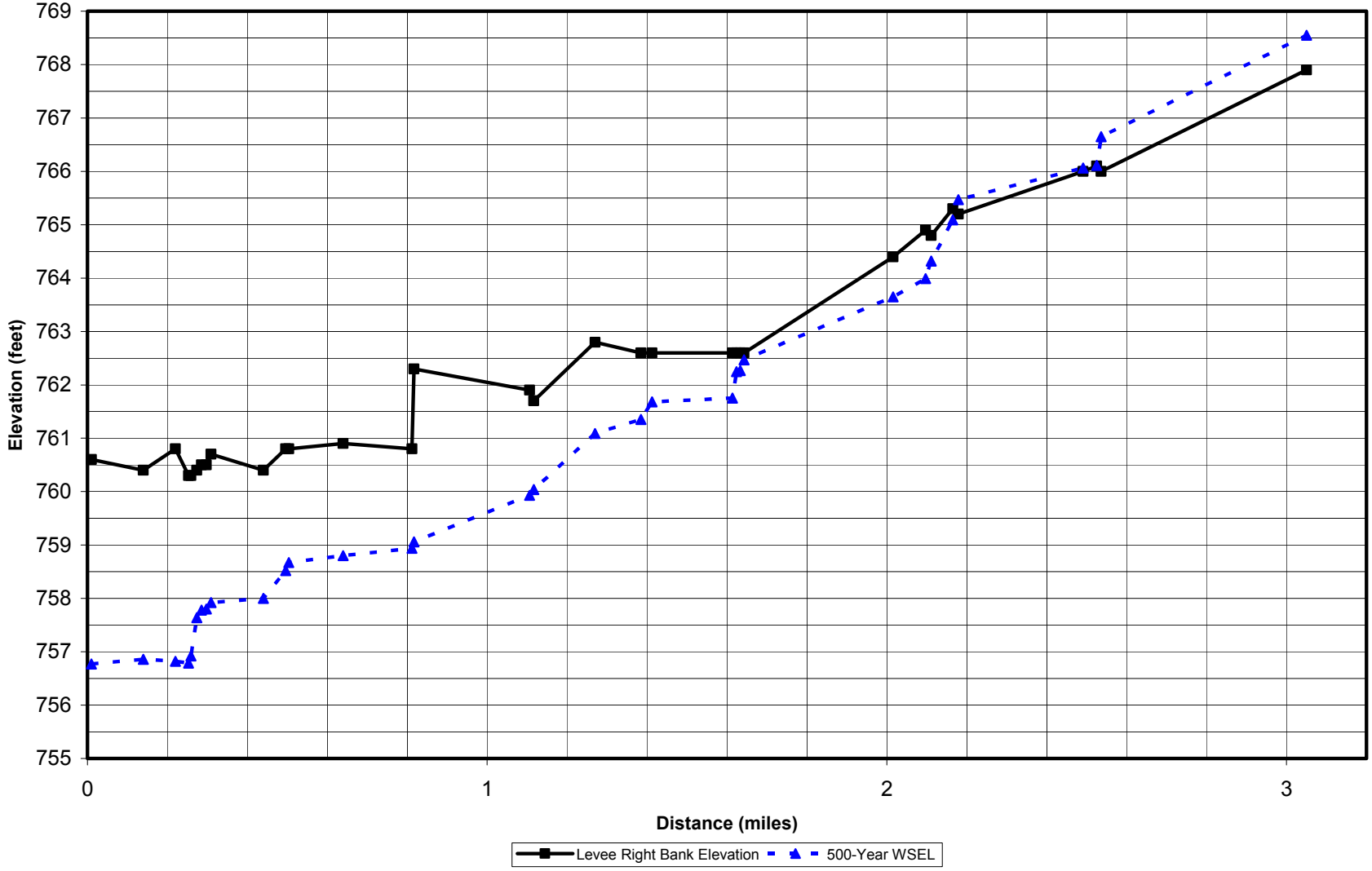
Designed By: EDS
Checked By: GRL
2/1/2006

EXHIBIT A-2.17
Kansas River Lower Probability Water Surface Profile



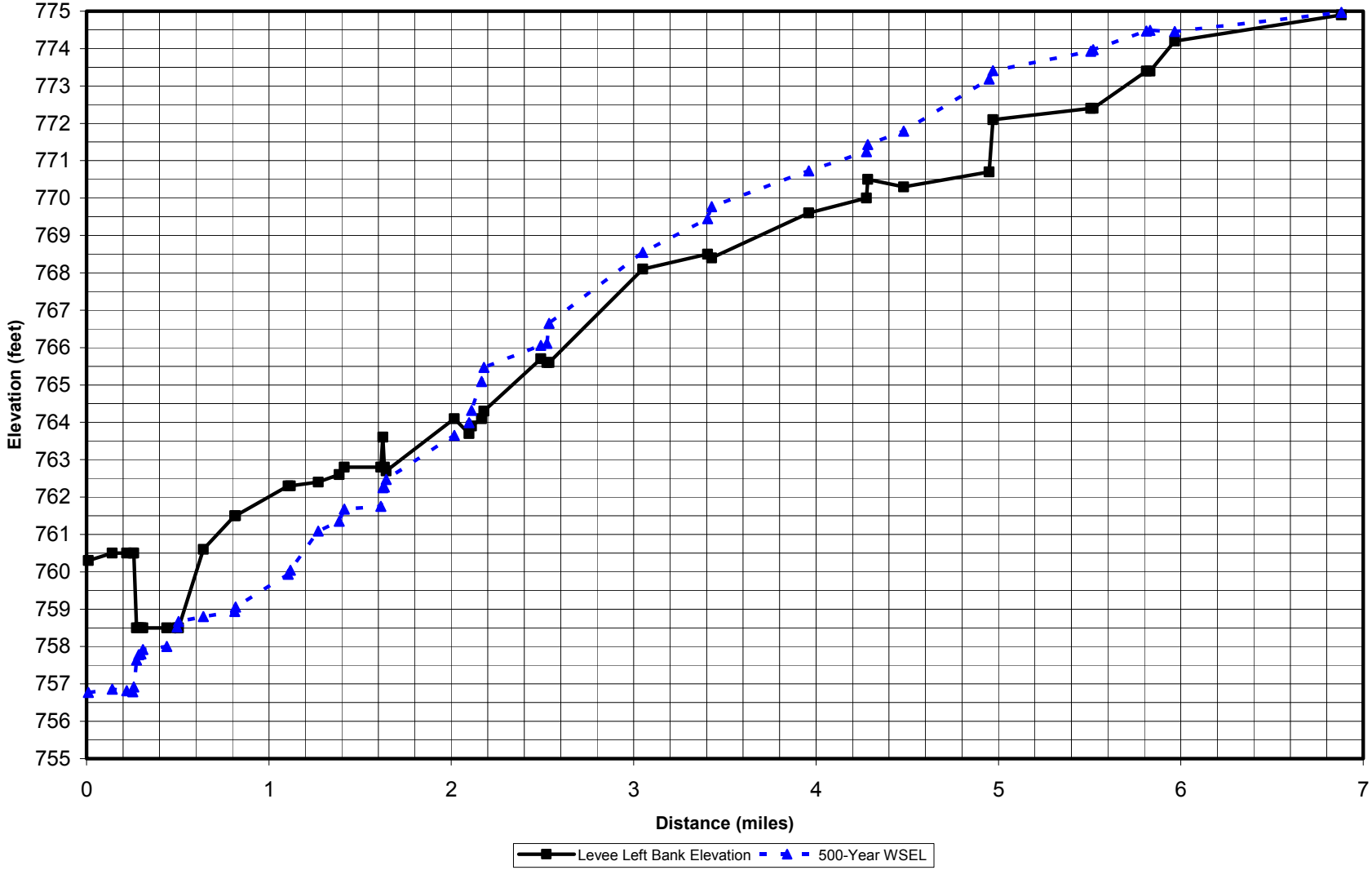
Designed By: EDS
Checked By: GRL
2/1/2006

EXHIBIT A-2.18
Central Industrial District (Kansas) Levee Unit 0.2% (500-Year) Chance of Exceedance Water Surface Profile



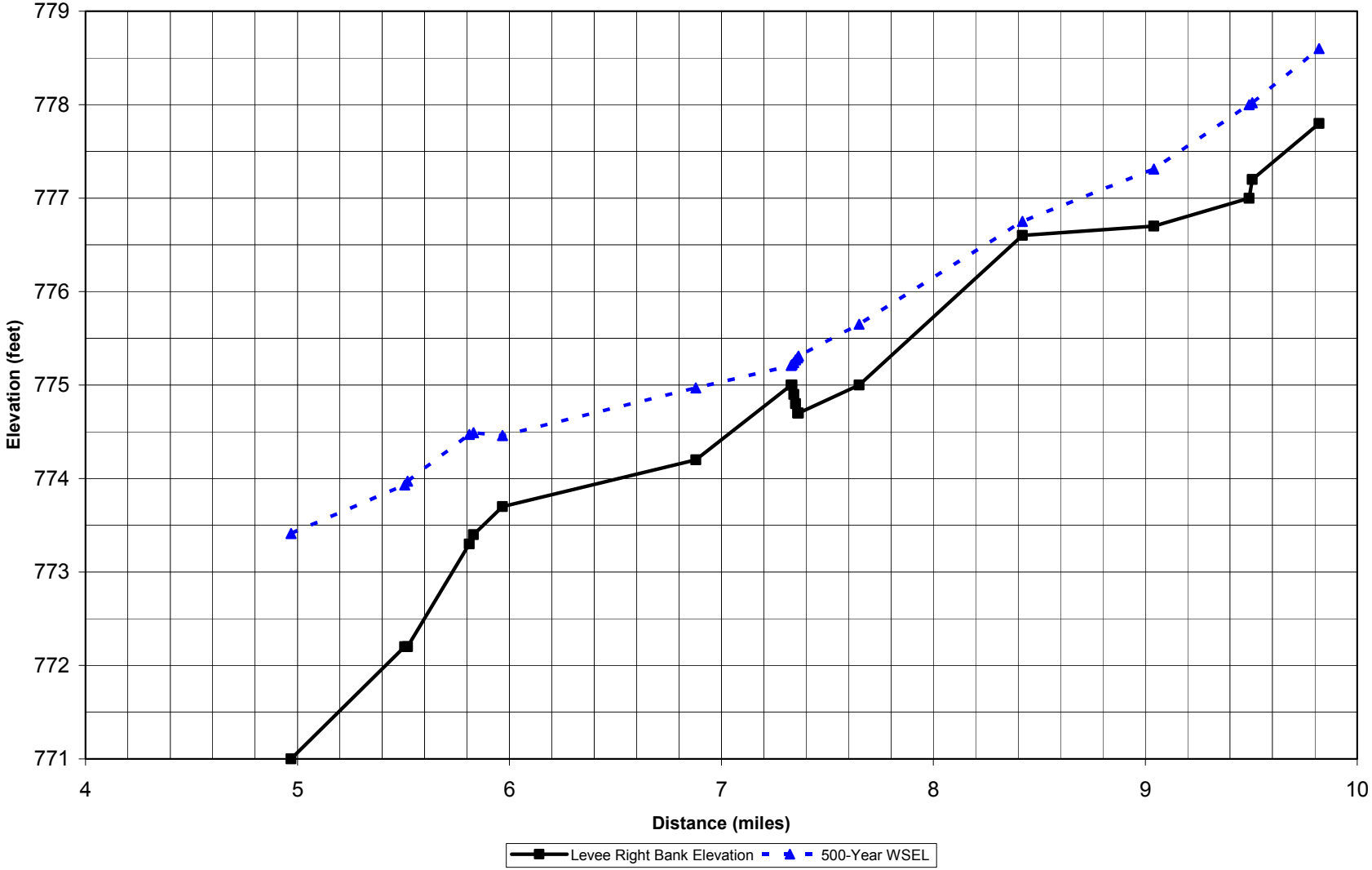
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.19
Armourdale Levee Unit 0.2% (500-Year) Chance of Exceedance Water Surface Profile



Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.20
Argentine Levee Unit 0.2% (500-Year) Chance of Exceedance Water Surface Profile



Designed By: RAN
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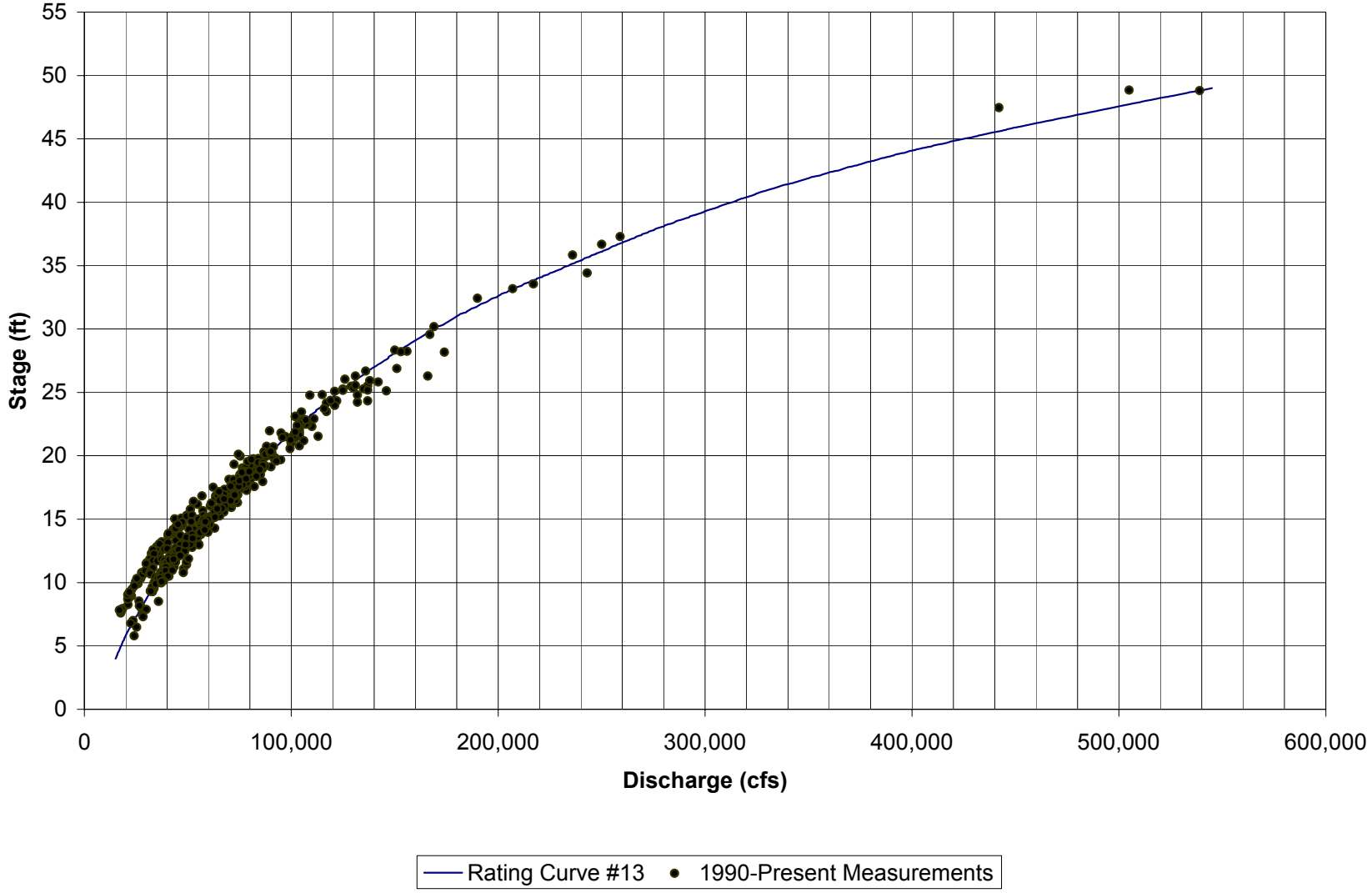
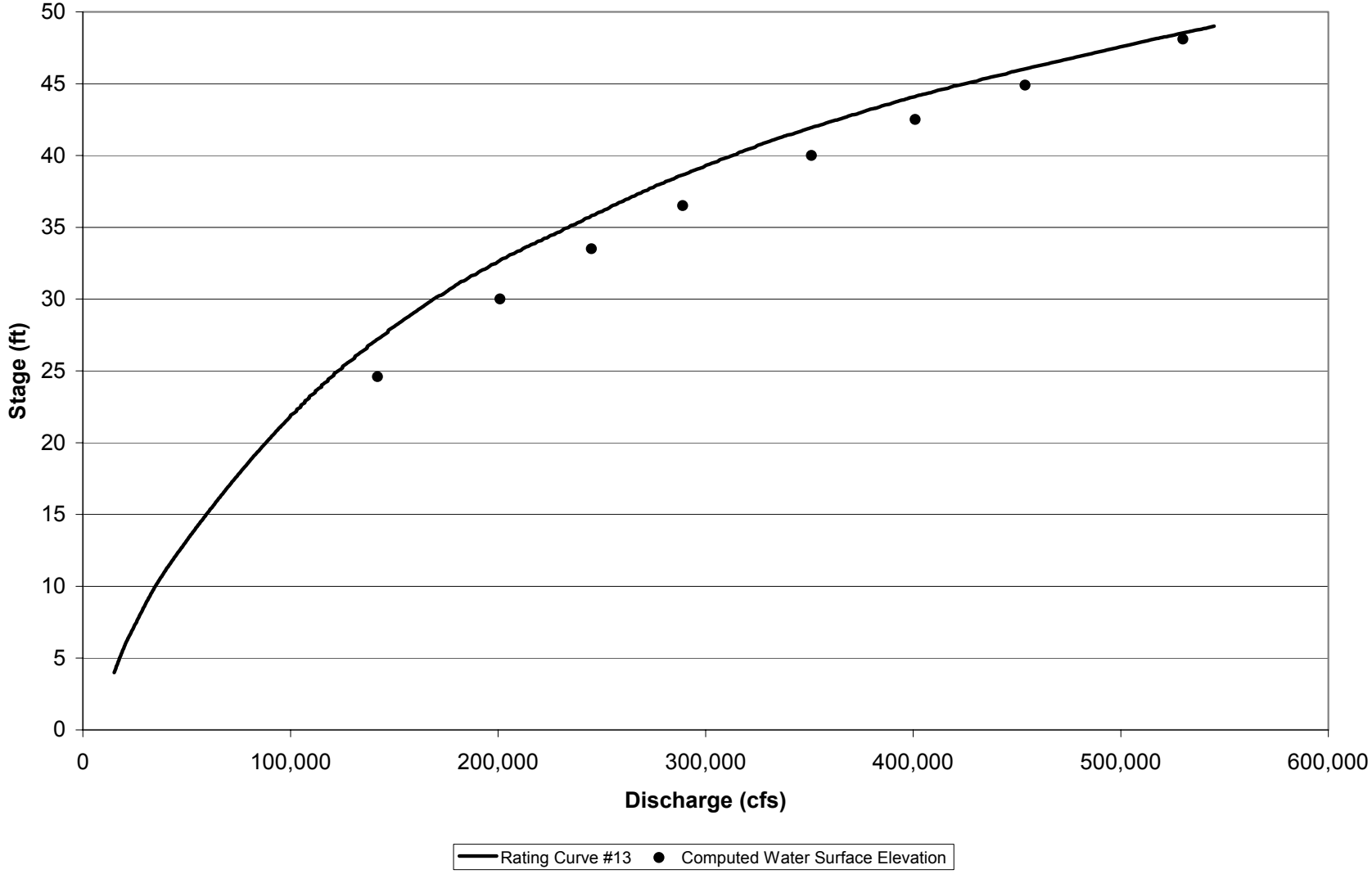
8/19/2004

EXHIBIT A-2.21
Comparison of Rating Curve #13 and Observed Measurements (1990 – Present)



Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.22
Comparison of Rating Curve #13 and Computed Water Surface Elevations

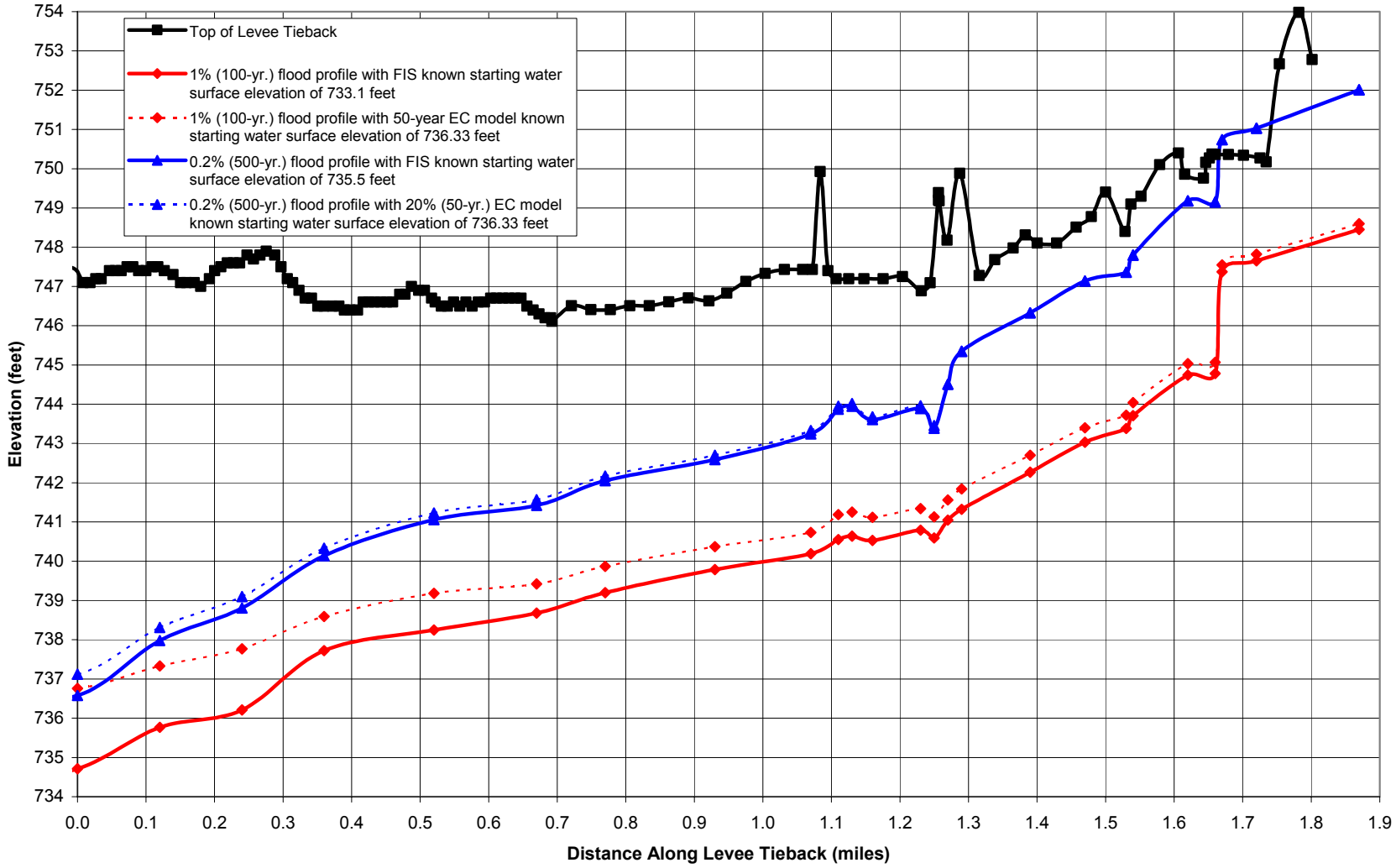


Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.23
Birmingham Levee Unit Levee Tieback Water Surface Profile

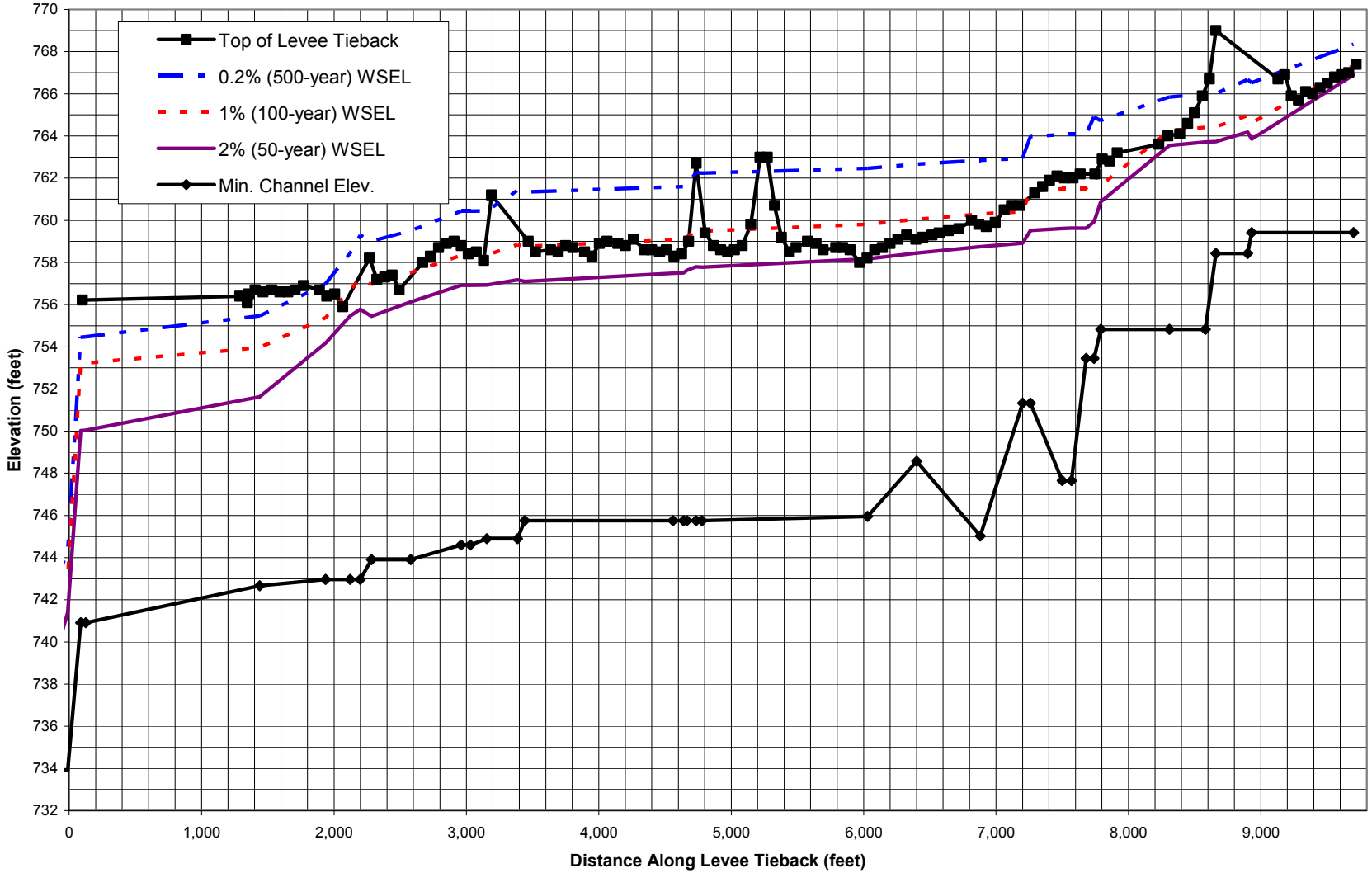
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.24
East Bottom Levee Unit Tieback Water Surface Profiles



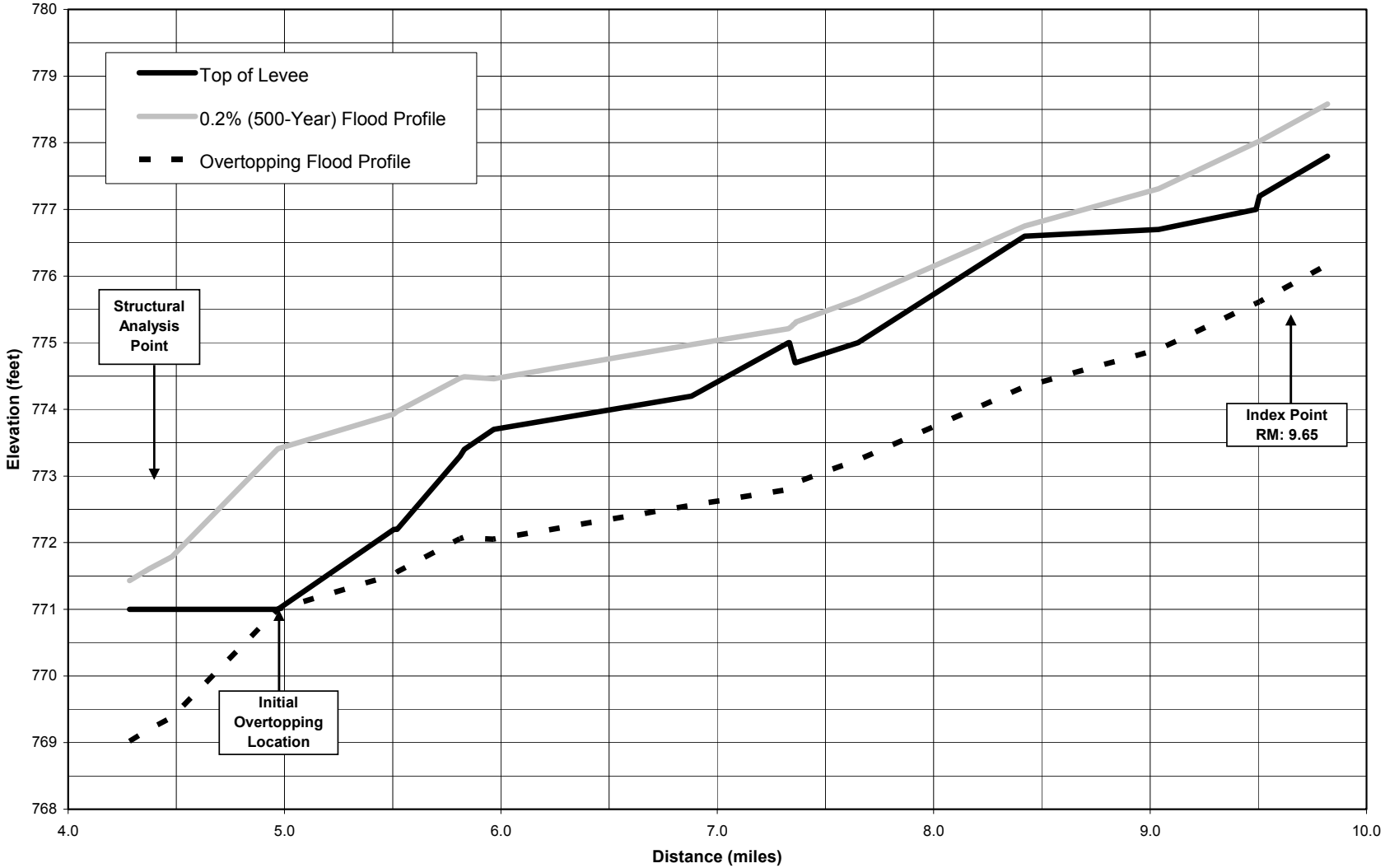
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.25
North Kansas City Levee Unit Levee Tieback Water Surface Profile



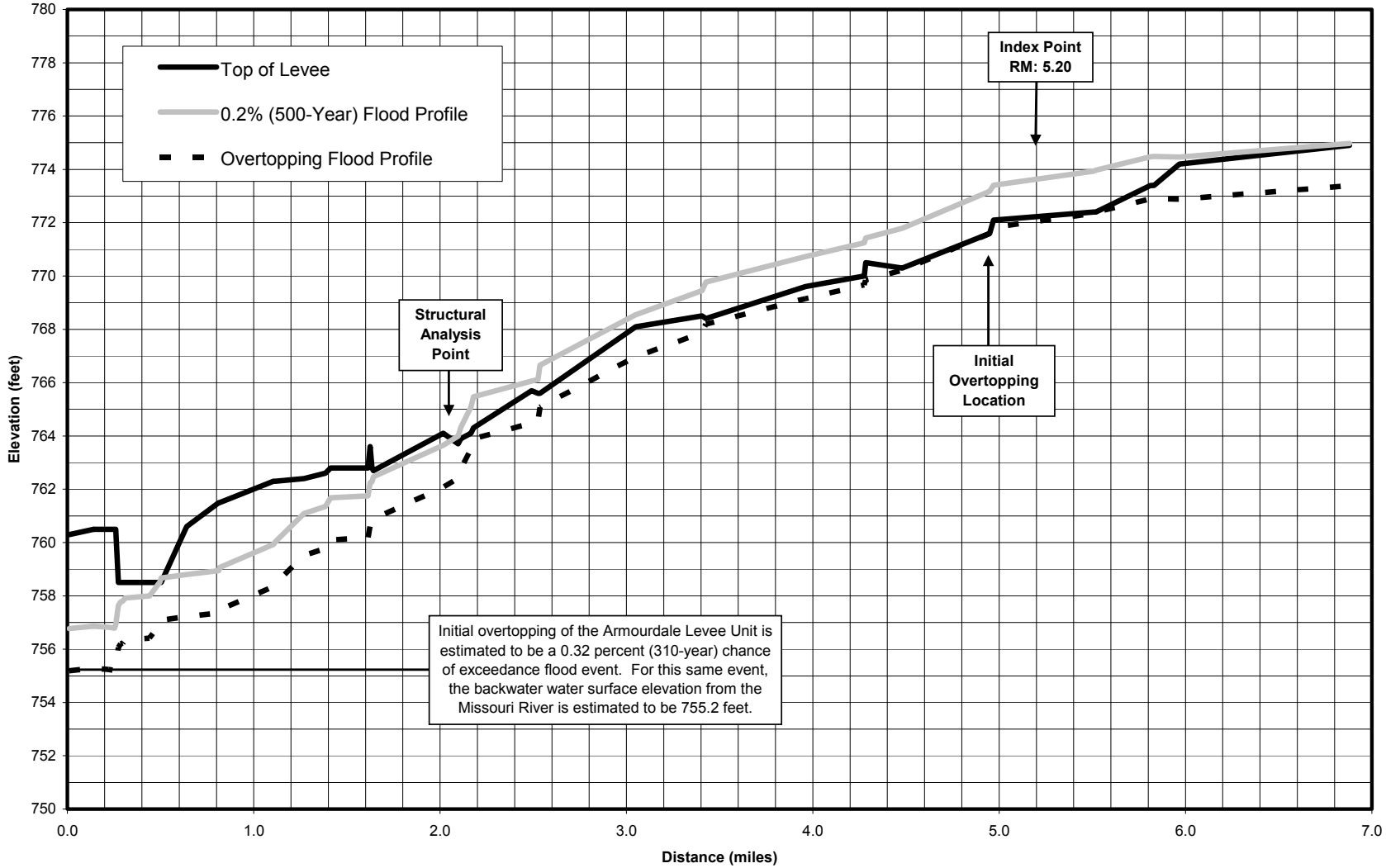
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.26
Argentine Levee Unit Interior/Exterior Relationship Source Data



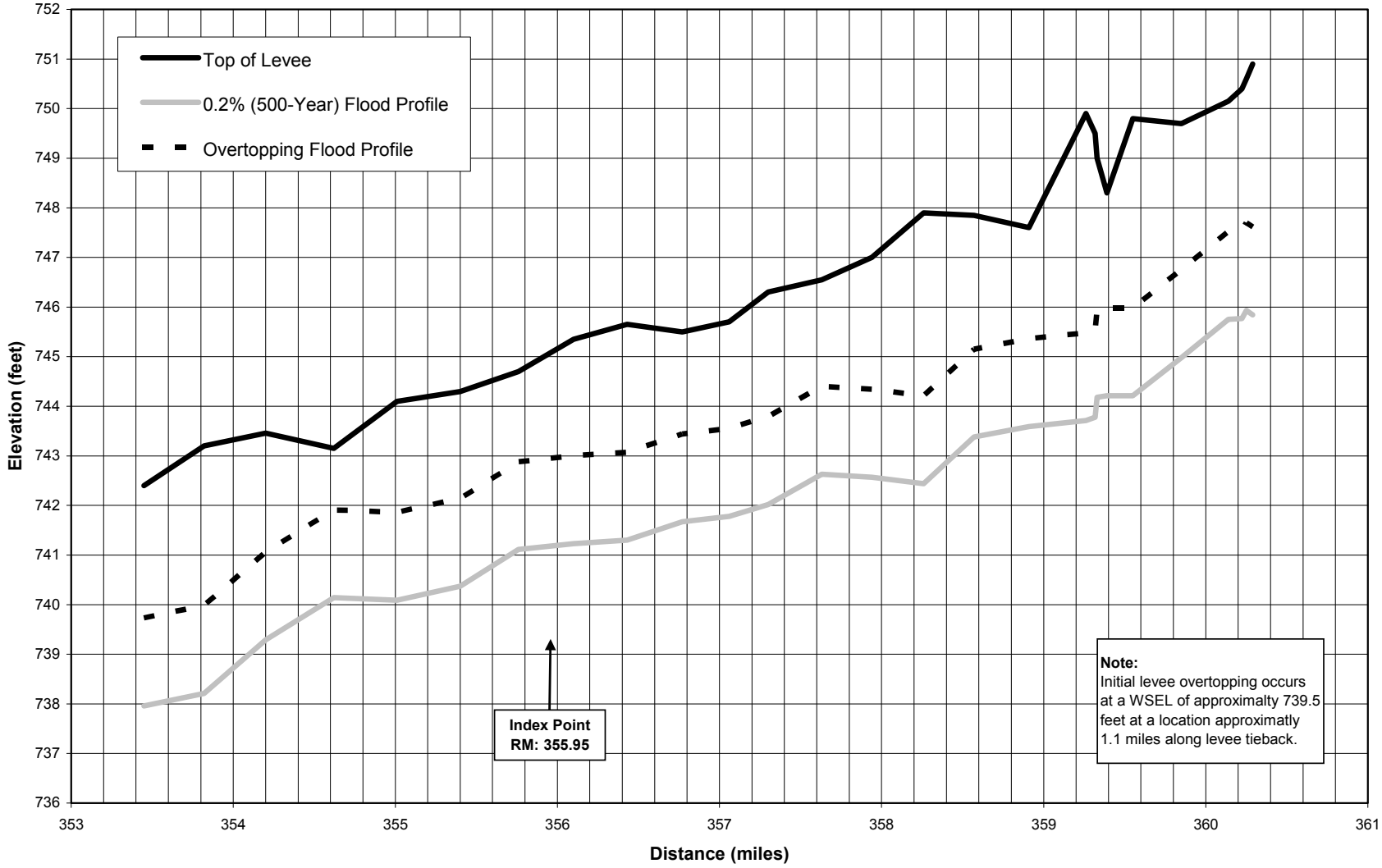
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.27
Armourdale Levee Unit Interior/Exterior Relationships Source Data



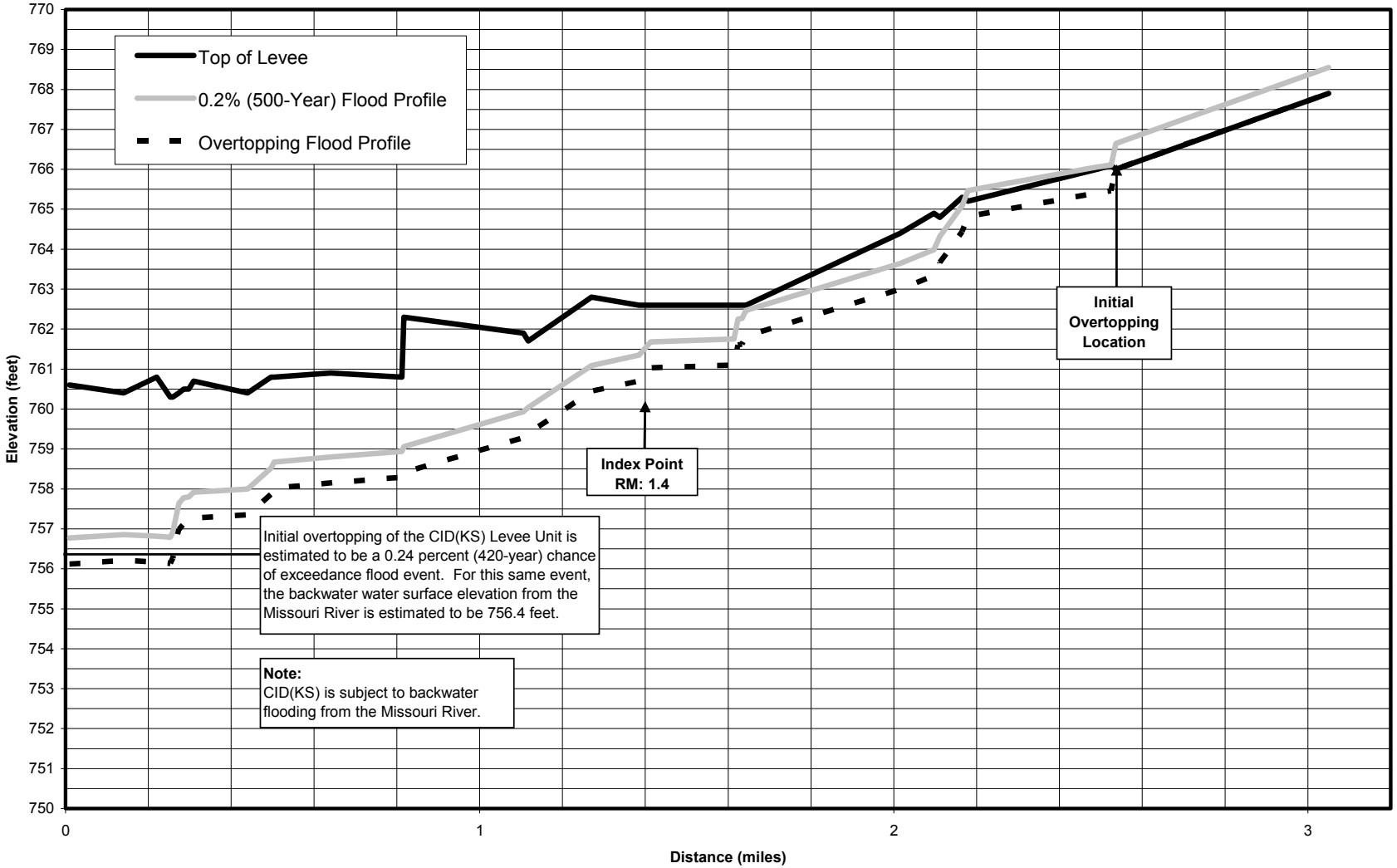
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.28
Birmingham Levee Unit Interior/Exterior Relationship Source Data



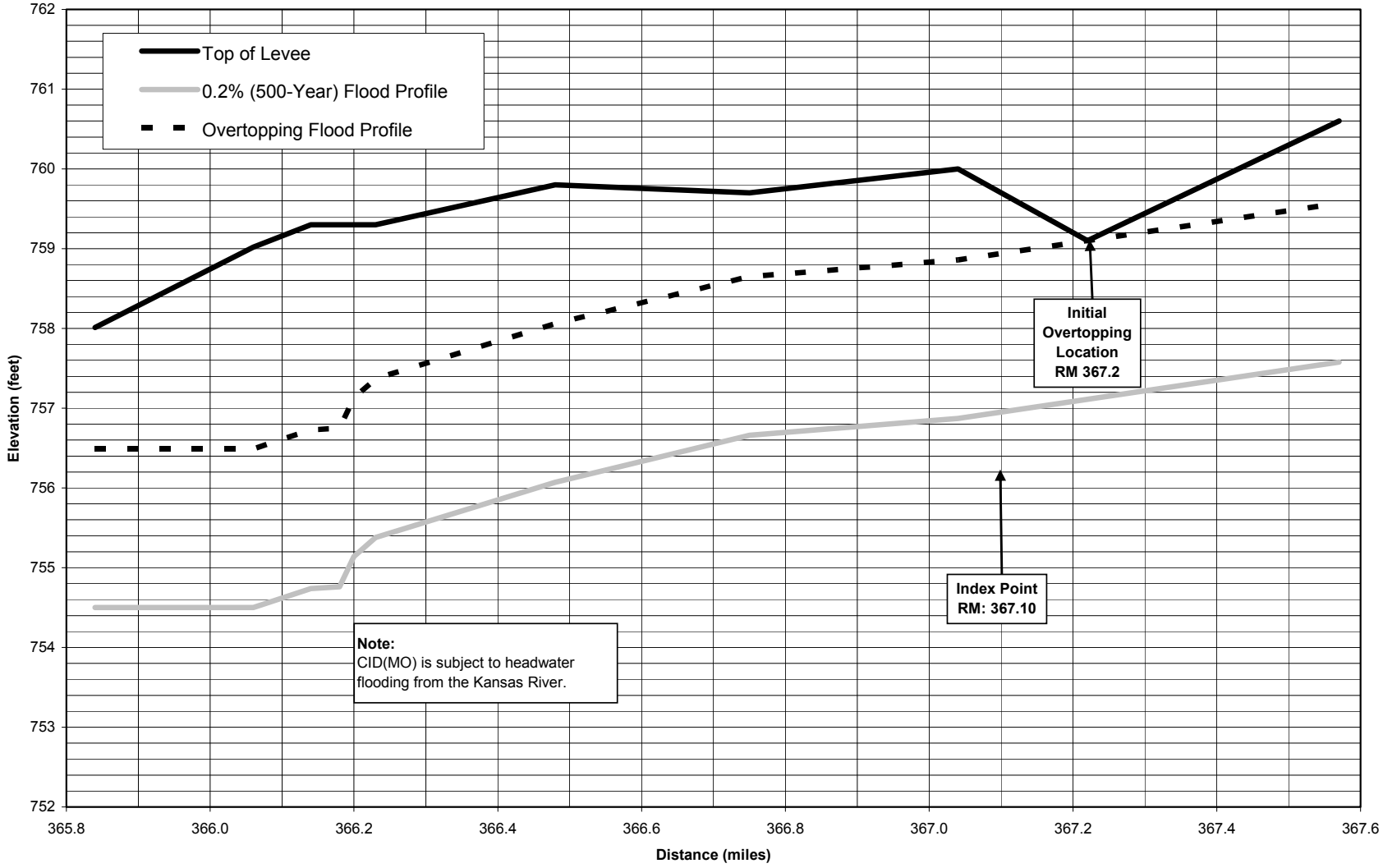
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.29
Central Industrial District (Kansas) Levee Unit Interior/Exterior Relationships Source Data



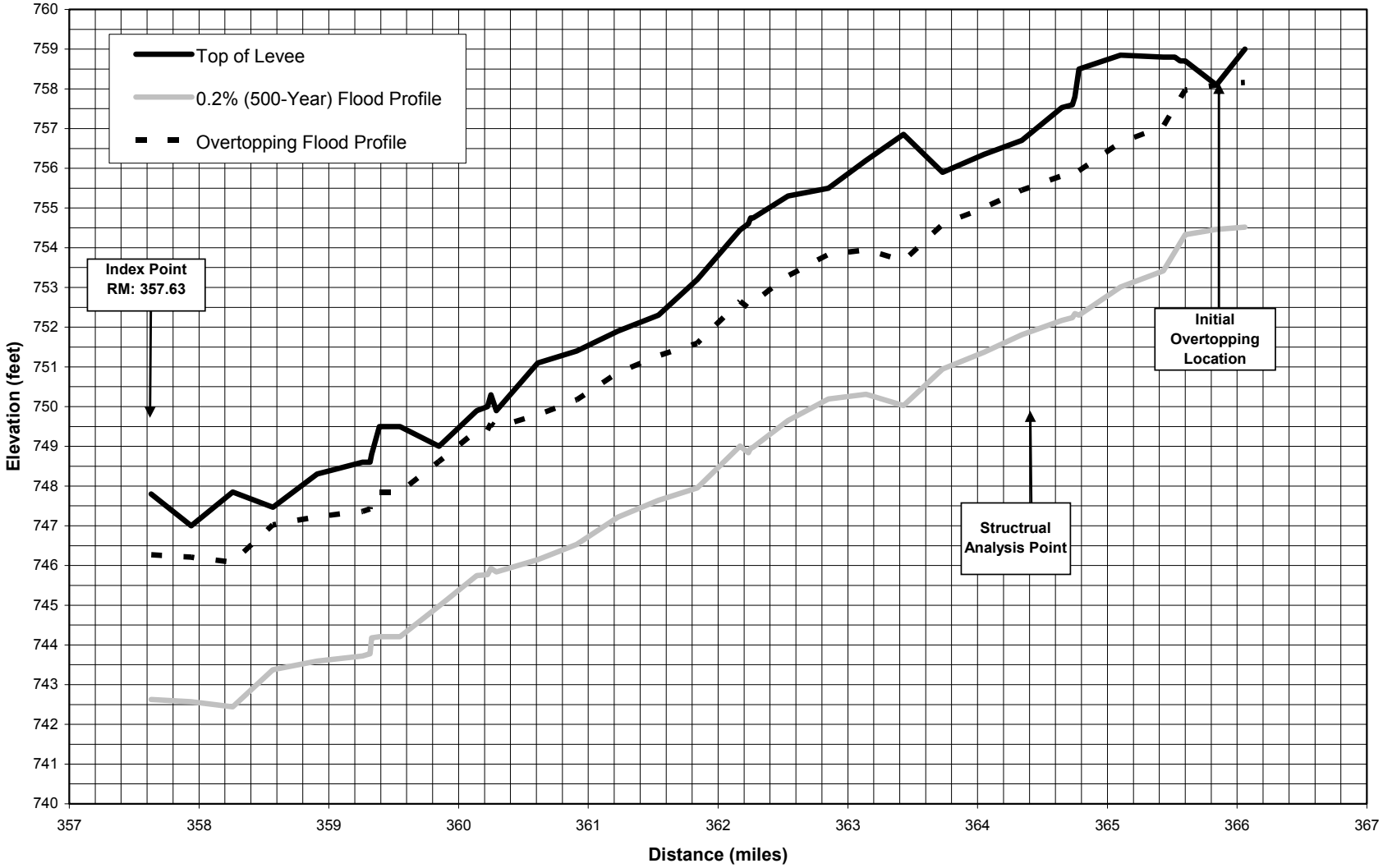
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.30
Central Industrial District (Missouri) Levee Unit Interior/Exterior Relationships Source Data



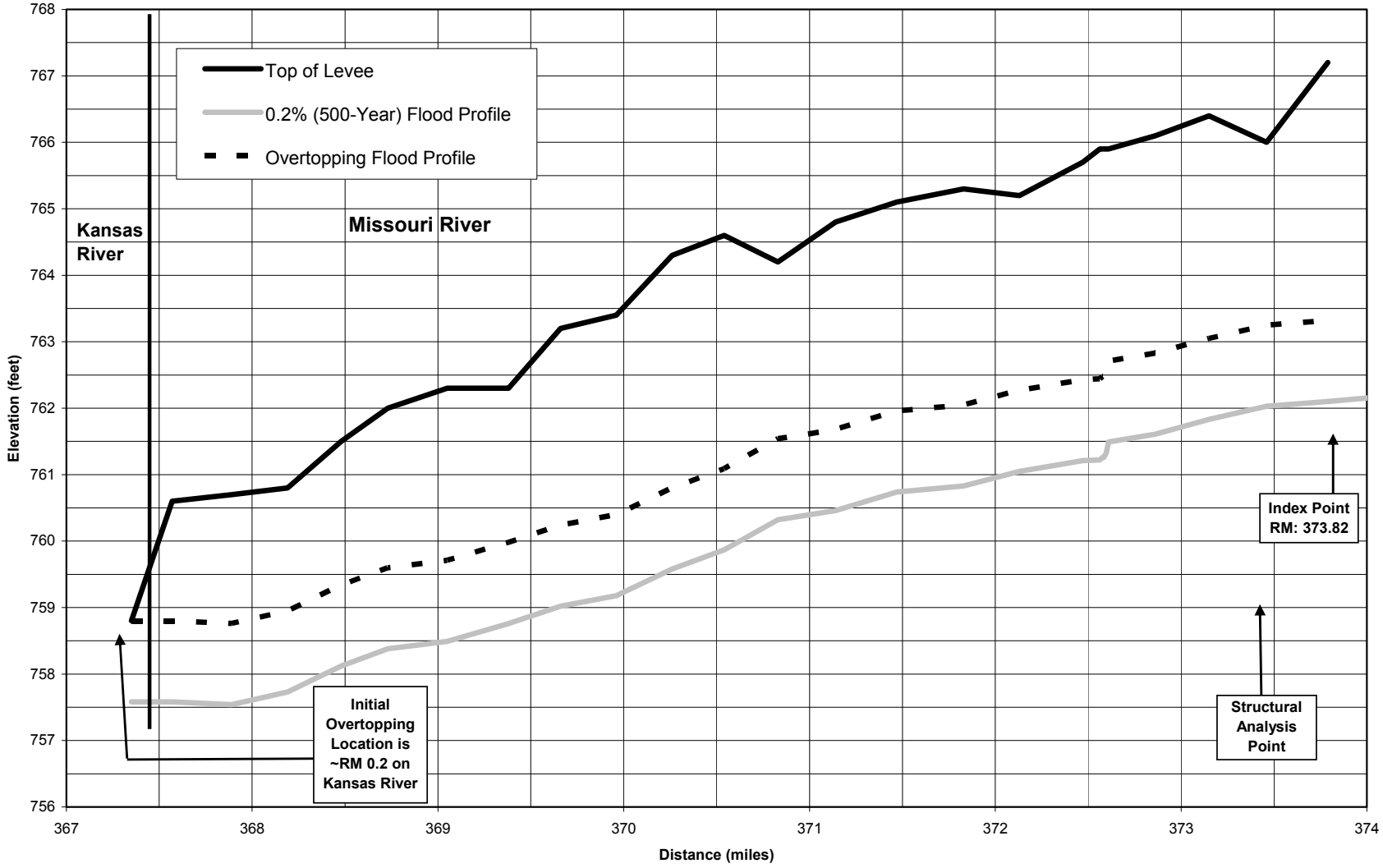
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.31
East Bottoms Levee Unit Interior/Exterior Relationships Source Data



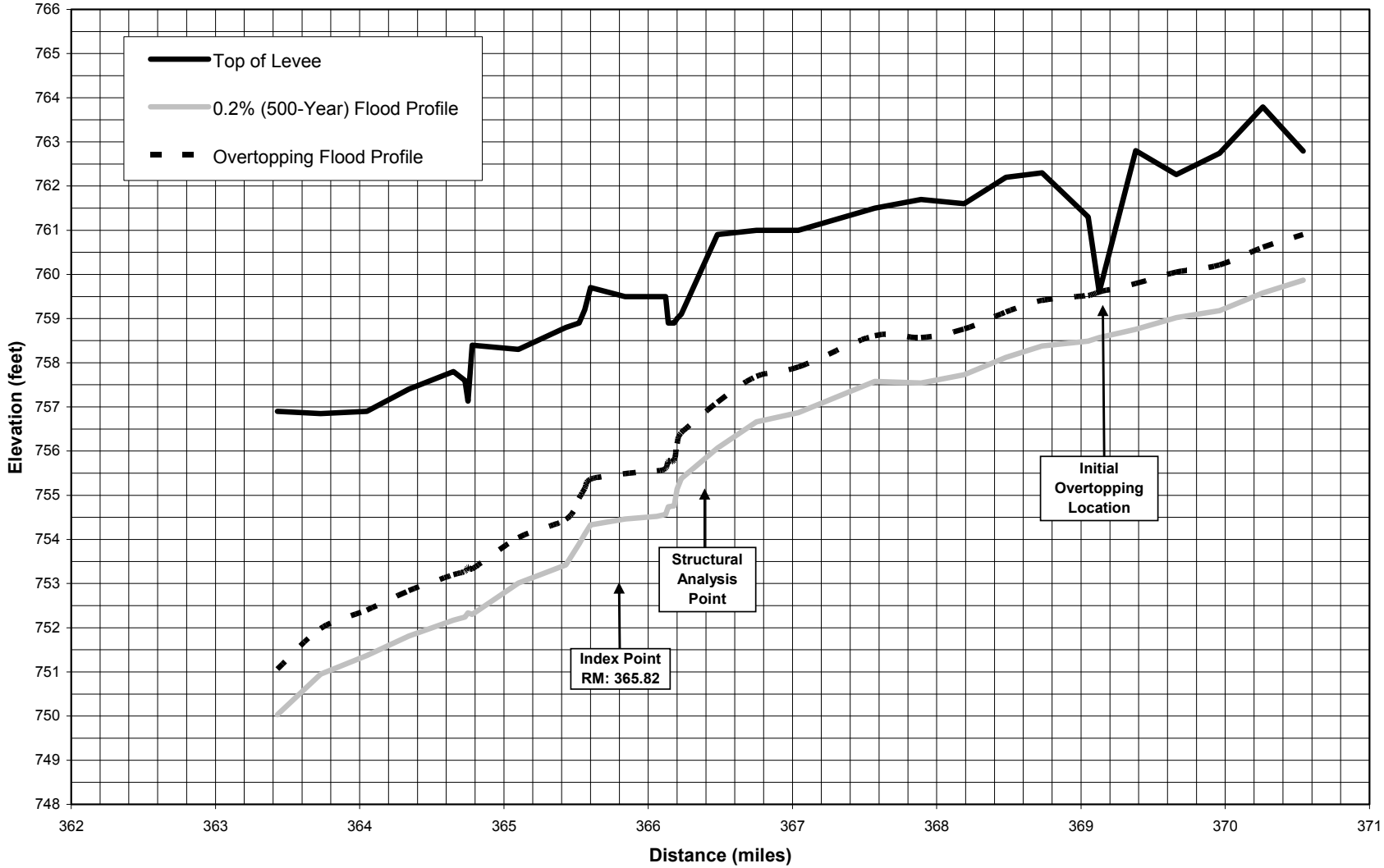
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.32
Fairfax-Jersey Creek Levee Unit Interior/Exterior Relationships Source Data



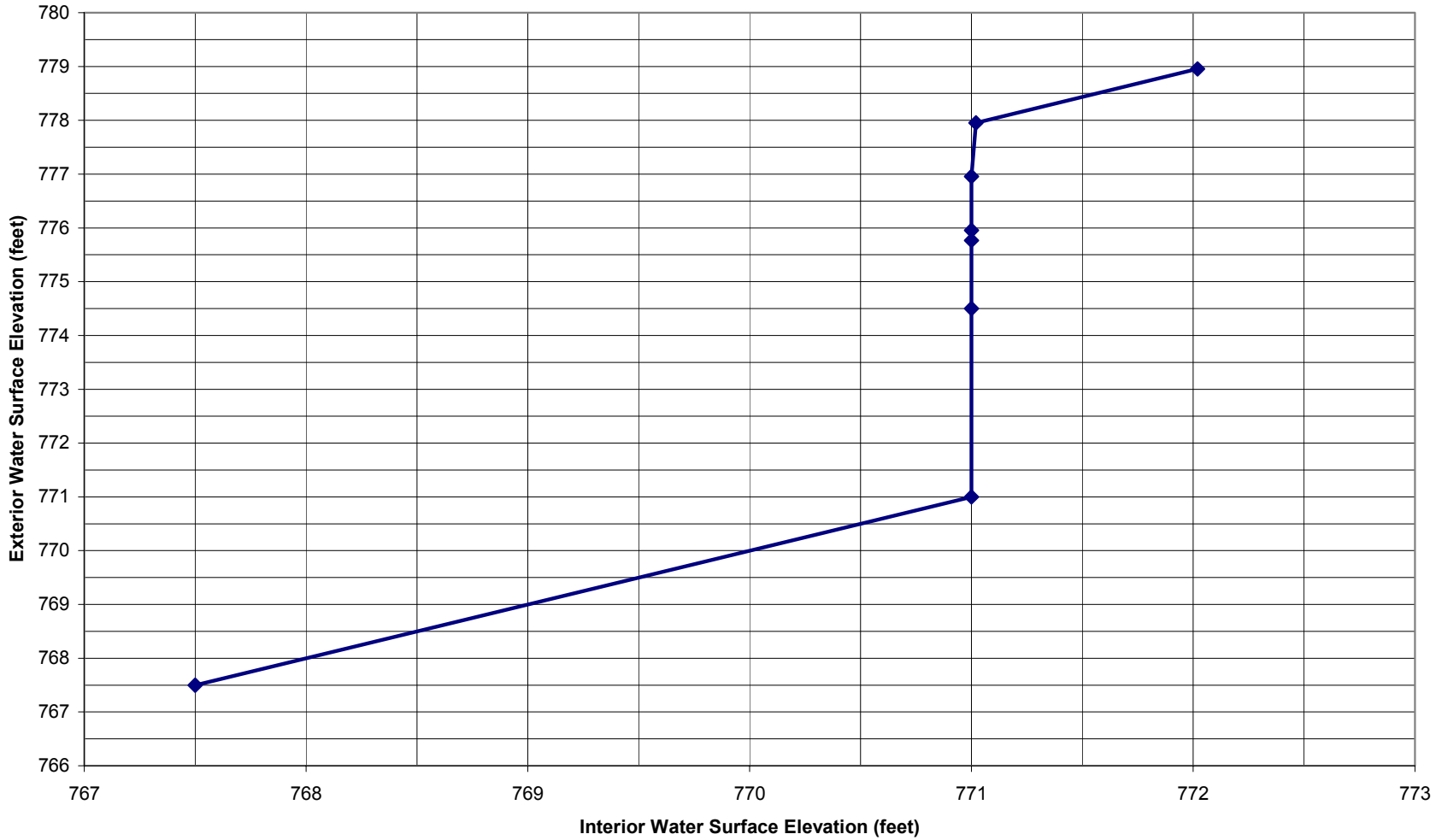
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.33
North Kansas City Levee Unit Interior/Exterior Relationships Source Data



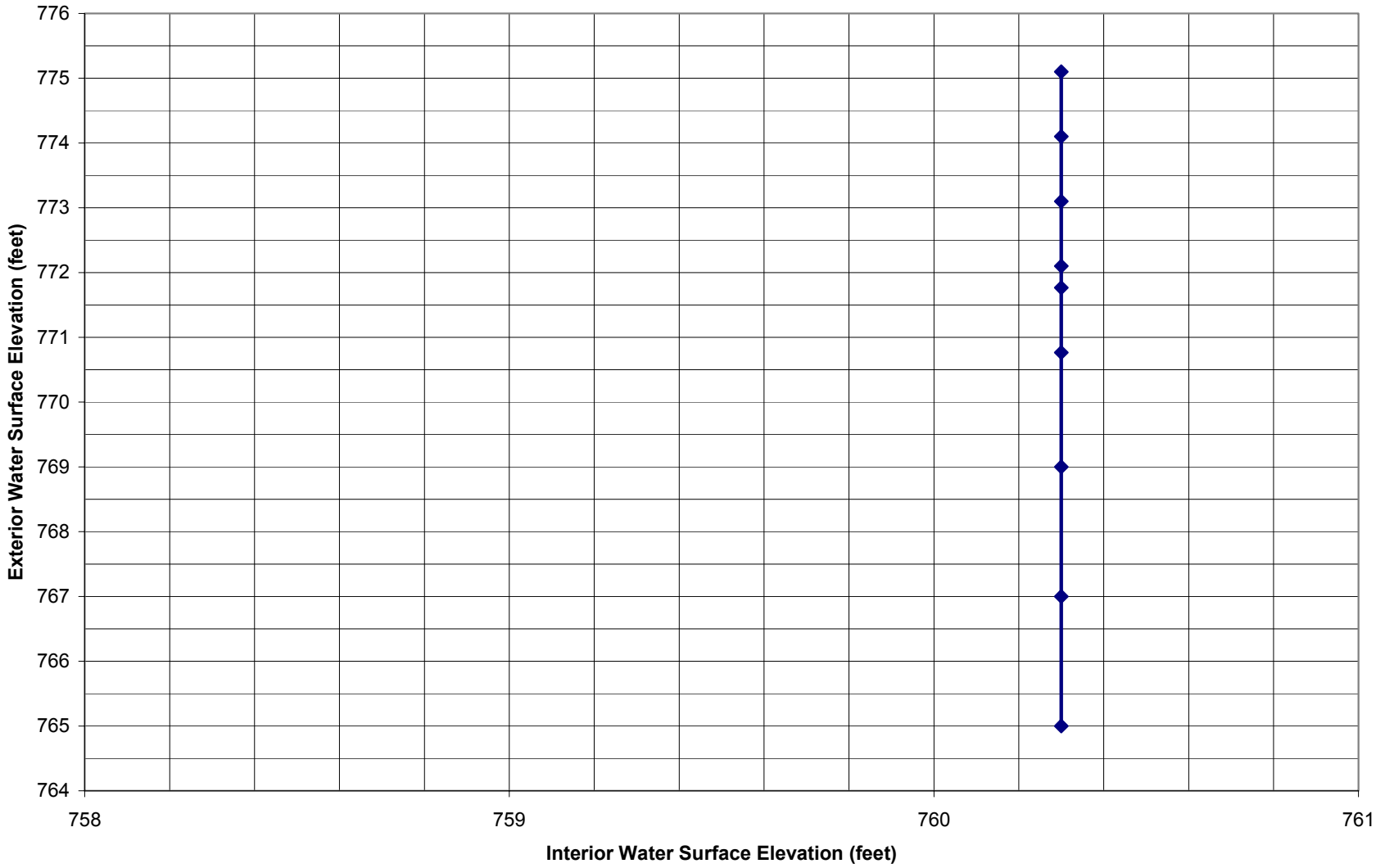
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.34
Argentine Levee Unit – Combined Levee Failure and Overtopping Interior/Exterior Water Surface Elevation Relationship



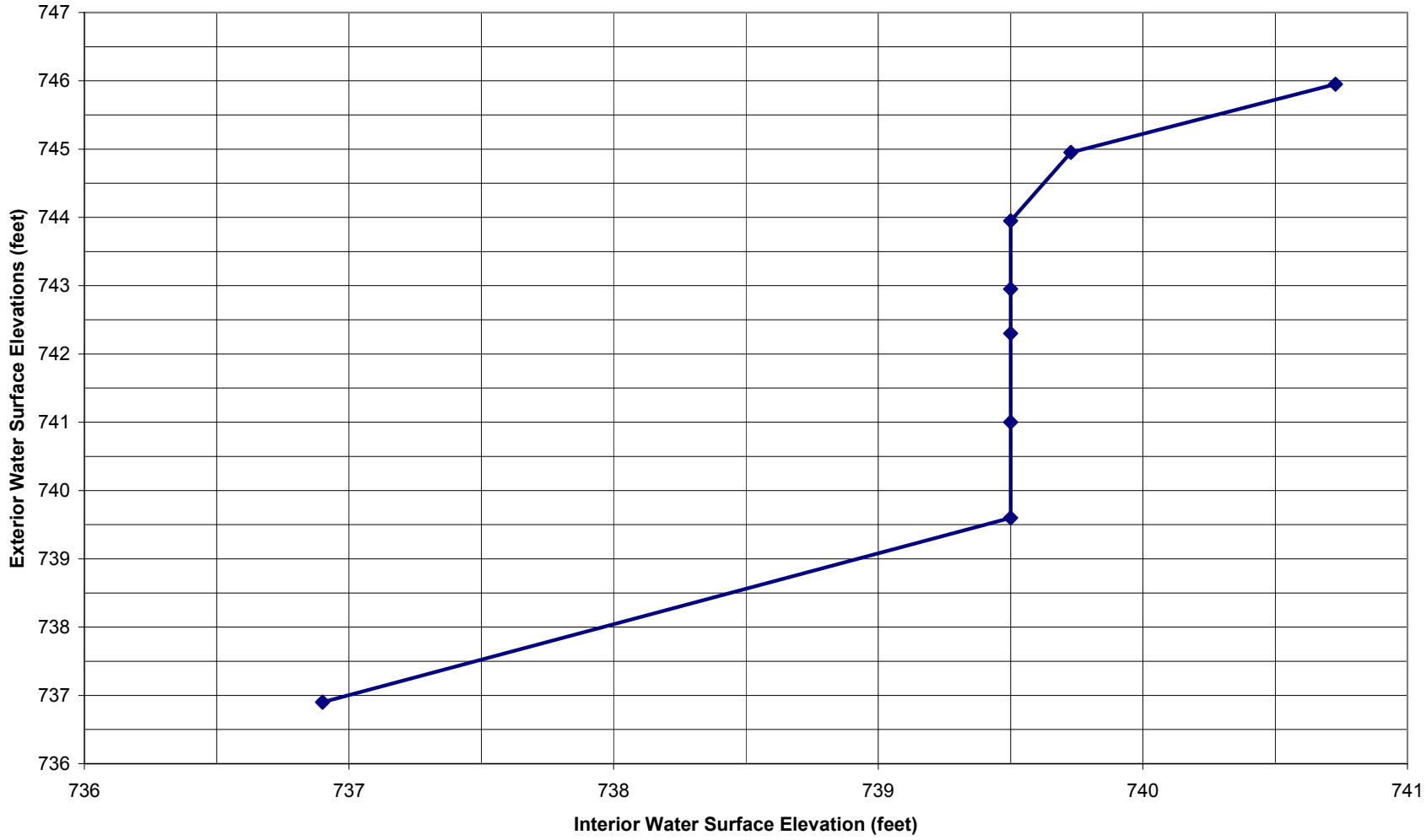
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.35
Armourdale Levee Unit - Combined Levee Failure and Overtopping Interior/Exterior Water Surface Elevation Relationship



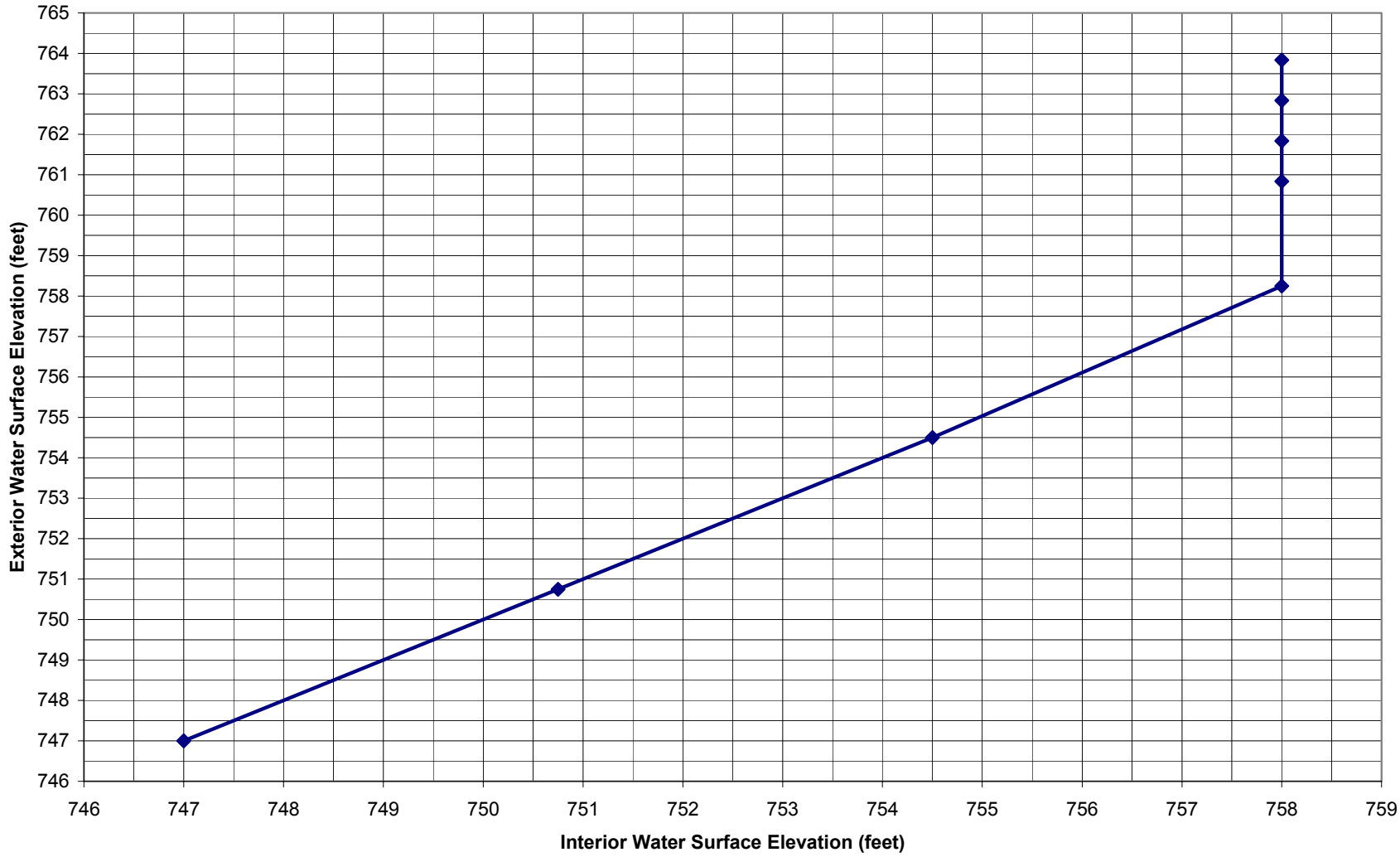
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.36
Birmingham Levee Unit - Combined Levee Failure and Overtopping Interior/Exterior Water Surface Elevation Relationship



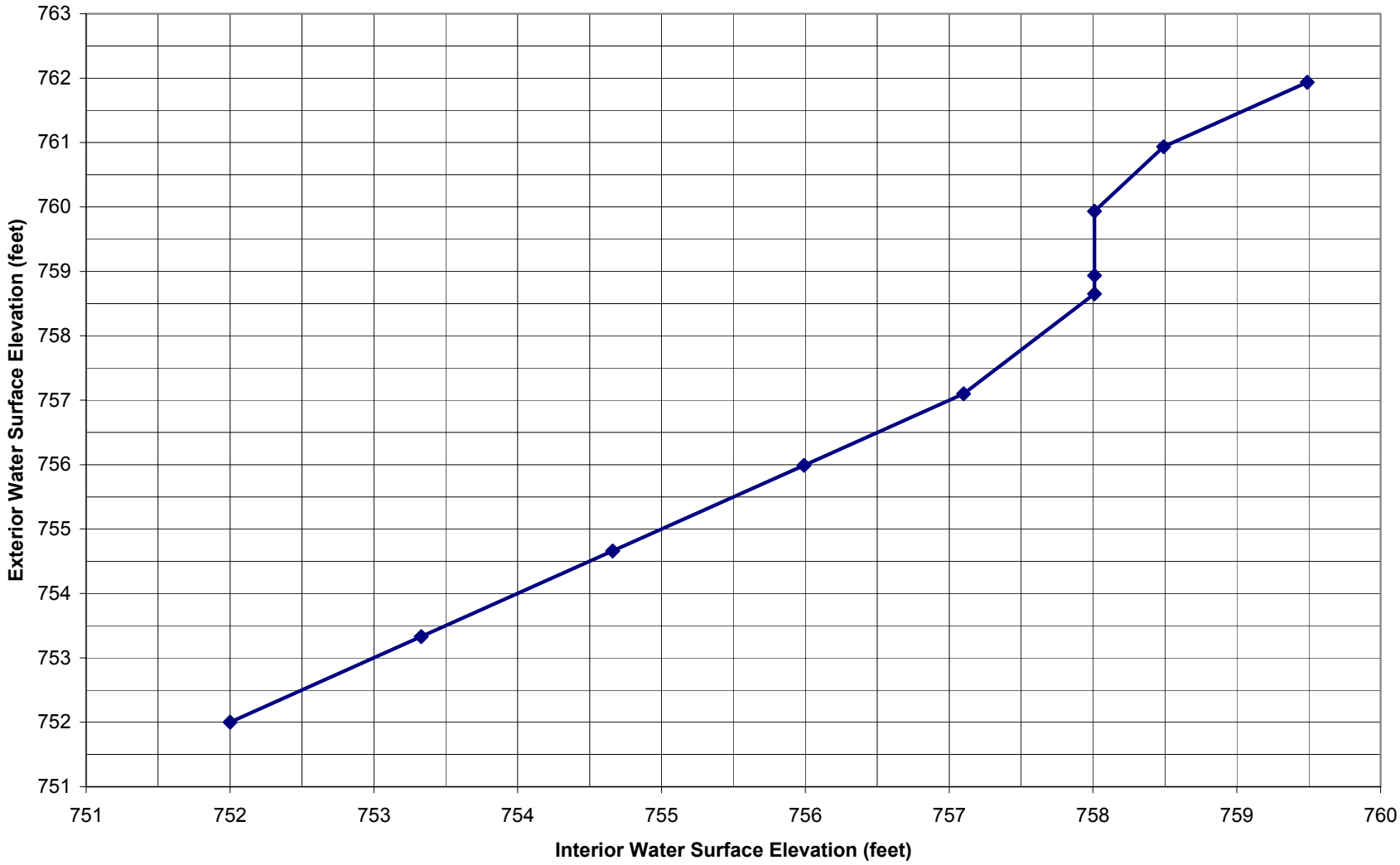
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.37
Central Industrial District (Kansas) Levee Unit - Combined Levee Failure and Overtopping Interior/Exterior Water Surface Elevation Relationship



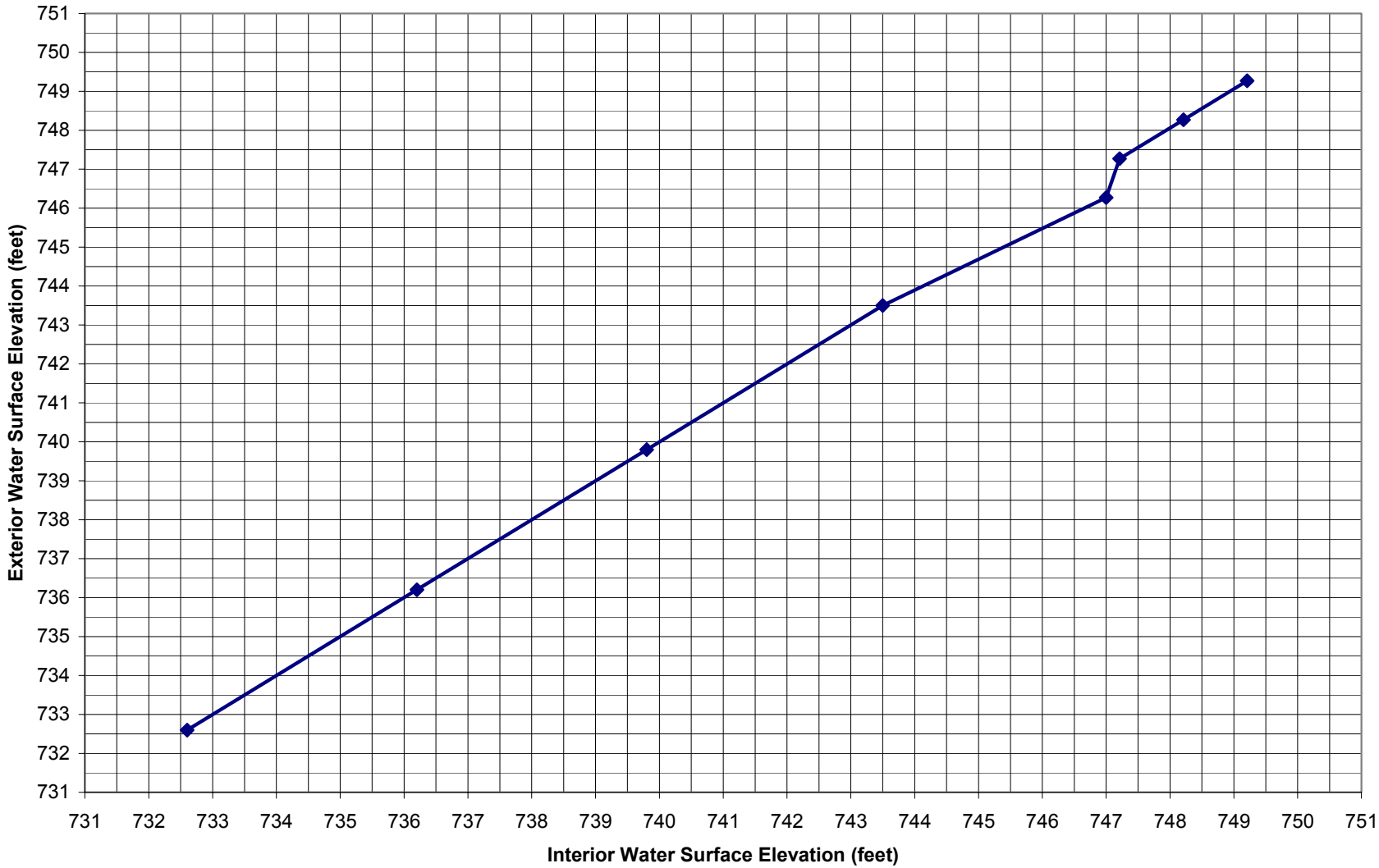
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.38
Central Industrial District (Missouri) Levee Unit - Combined Levee Failure and Overtopping
Interior/Exterior Water Surface Elevation Relationship



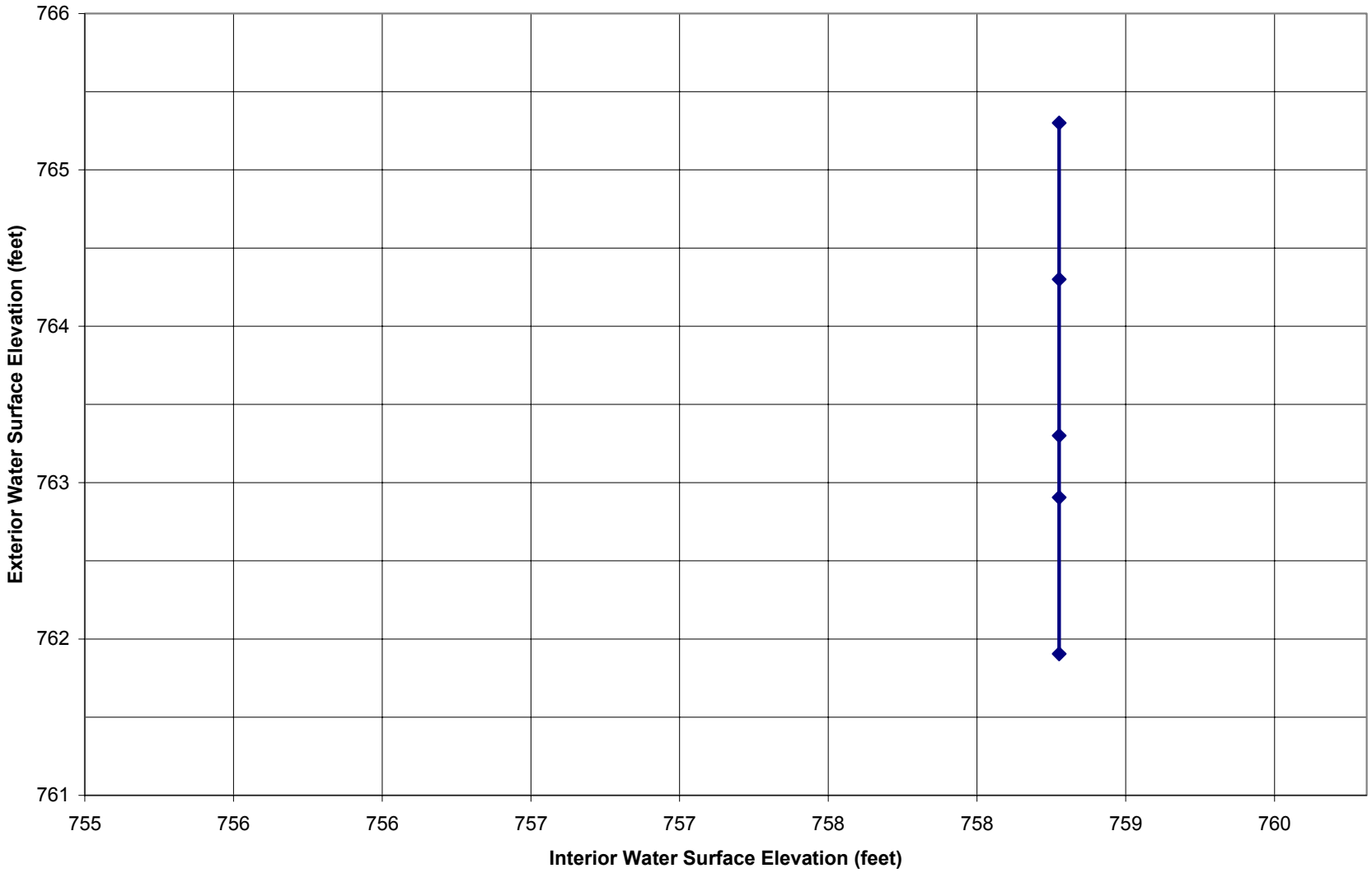
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.39
East Bottoms Levee Unit - Combined Levee Failure and Overtopping Interior/Exterior Water Surface Elevation Relationship



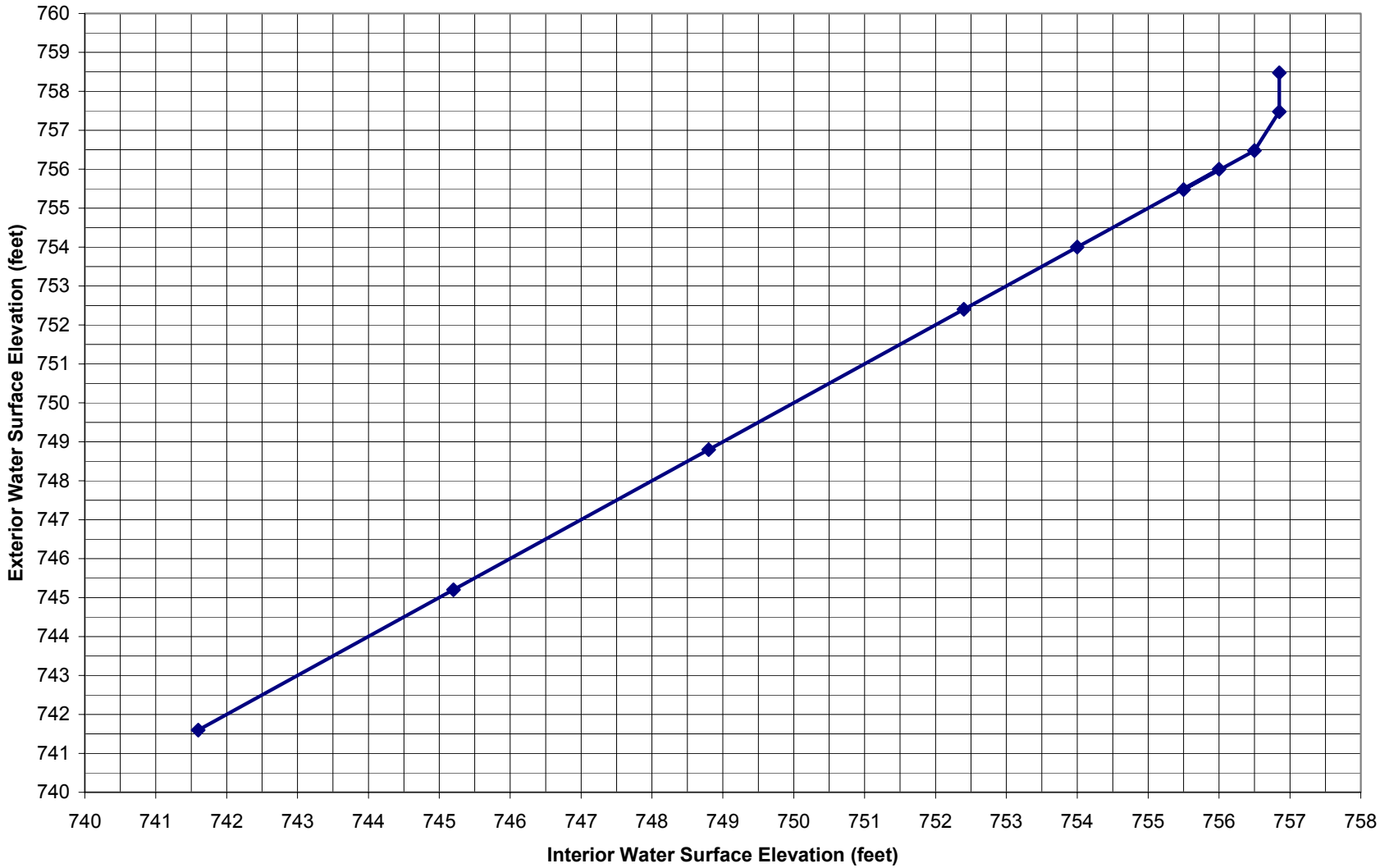
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.40
Fairfax-Jersey Creek Levee Unit - Combined Levee Failure and Overtopping Interior/Exterior Water Surface Elevation Relationship



Designed By: RAN
Checked By: GRL
8/19/2004

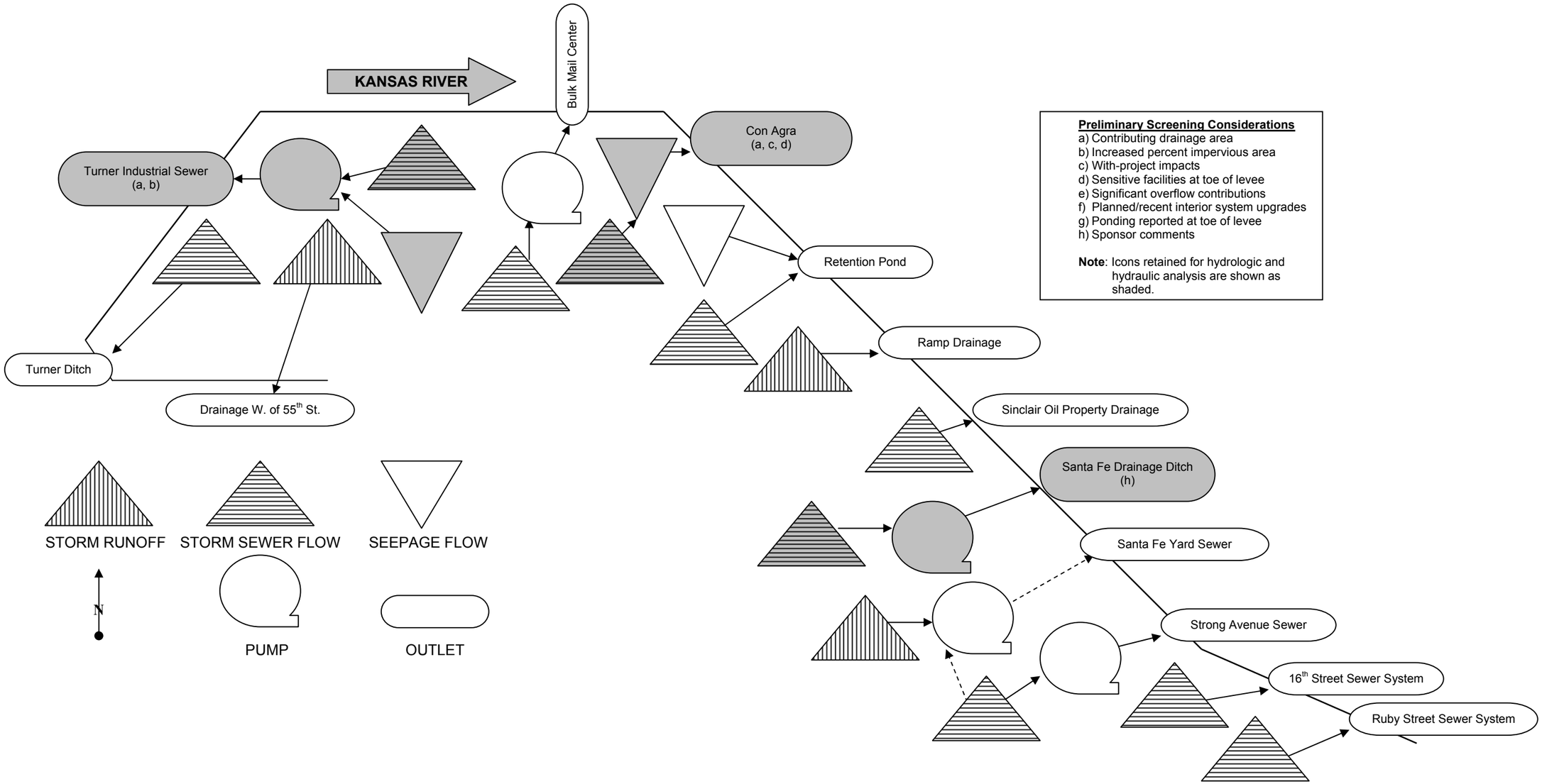
EXHIBIT A-2.41
North Kansas City Levee Unit - Combined Levee Failure and Overtopping Interior/Exterior Water Surface Elevation Relationship



Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.42

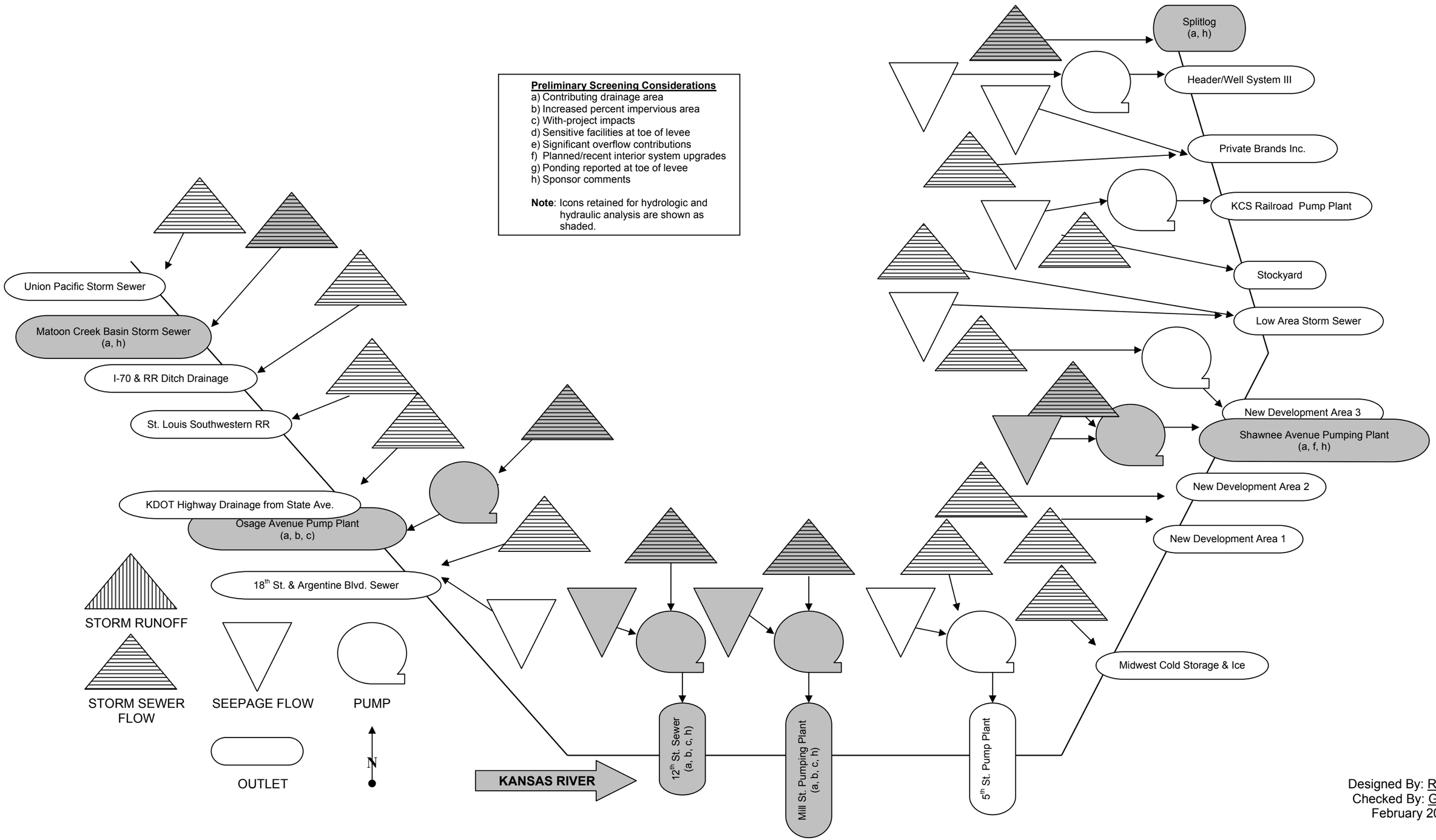
Schematic of Argentine Levee Unit Interior Hydrology



Designed By: RAN
Checked By: GRL
February 2003

EXHIBIT A-2.43

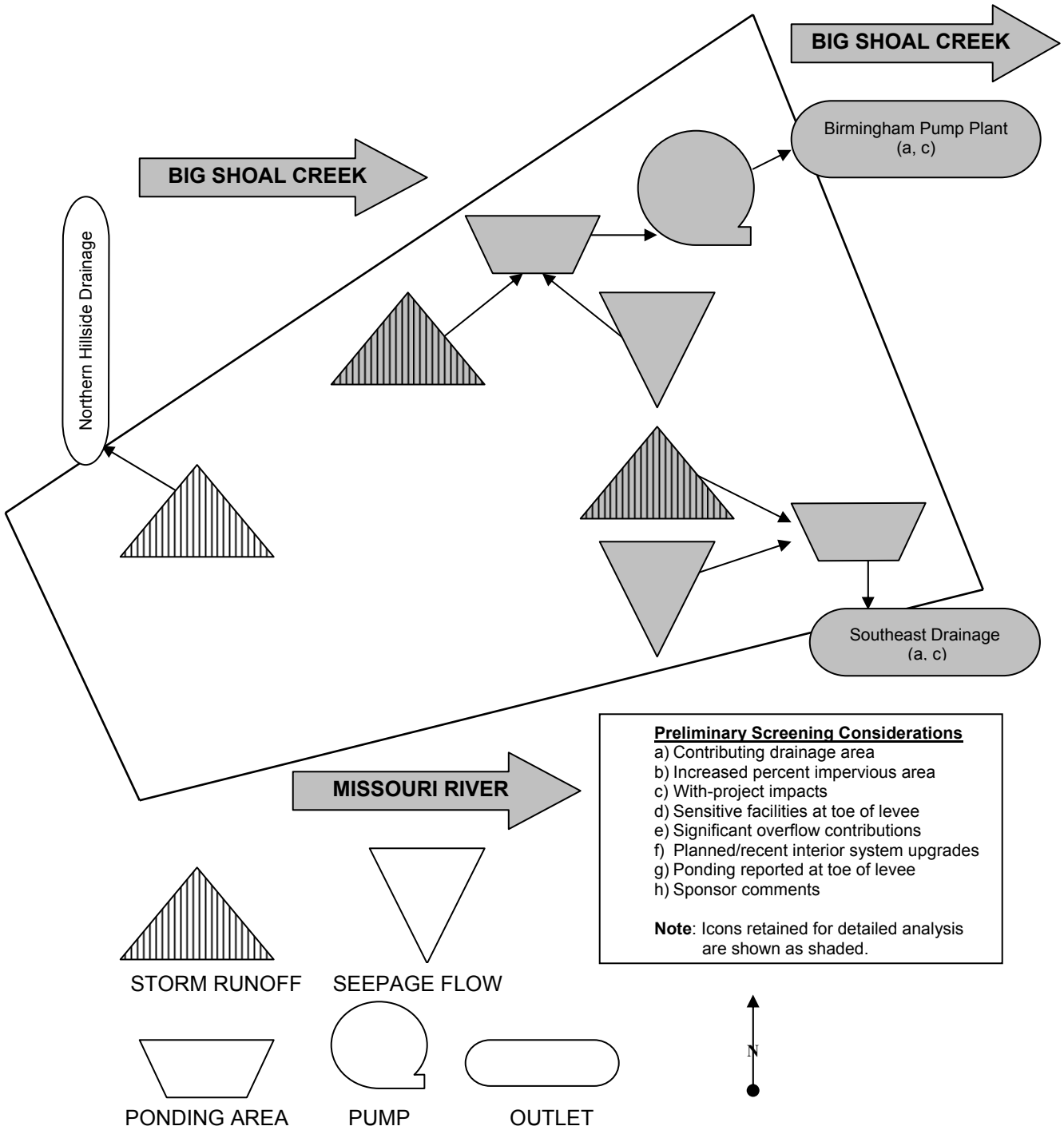
Schematic of Armourdale Levee Unit Interior Hydrology



Designed By: RAN
Checked By: GRL
February 2003

EXHIBIT A-2.44

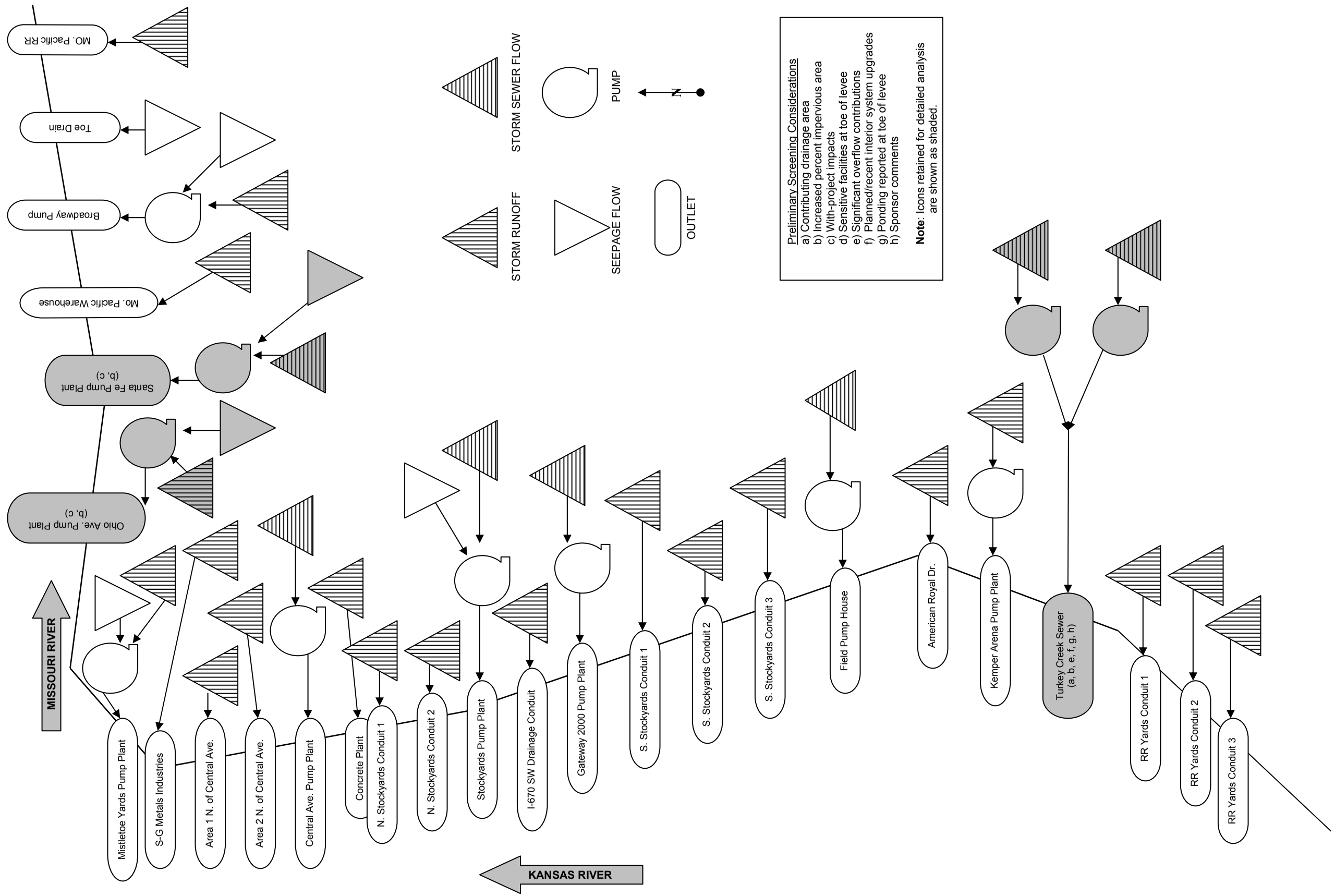
Schematic of Birmingham Levee Unit Interior Hydrology



Designed By: RAN
Checked By: GRL
February 2003

EXHIBITS A-2.45

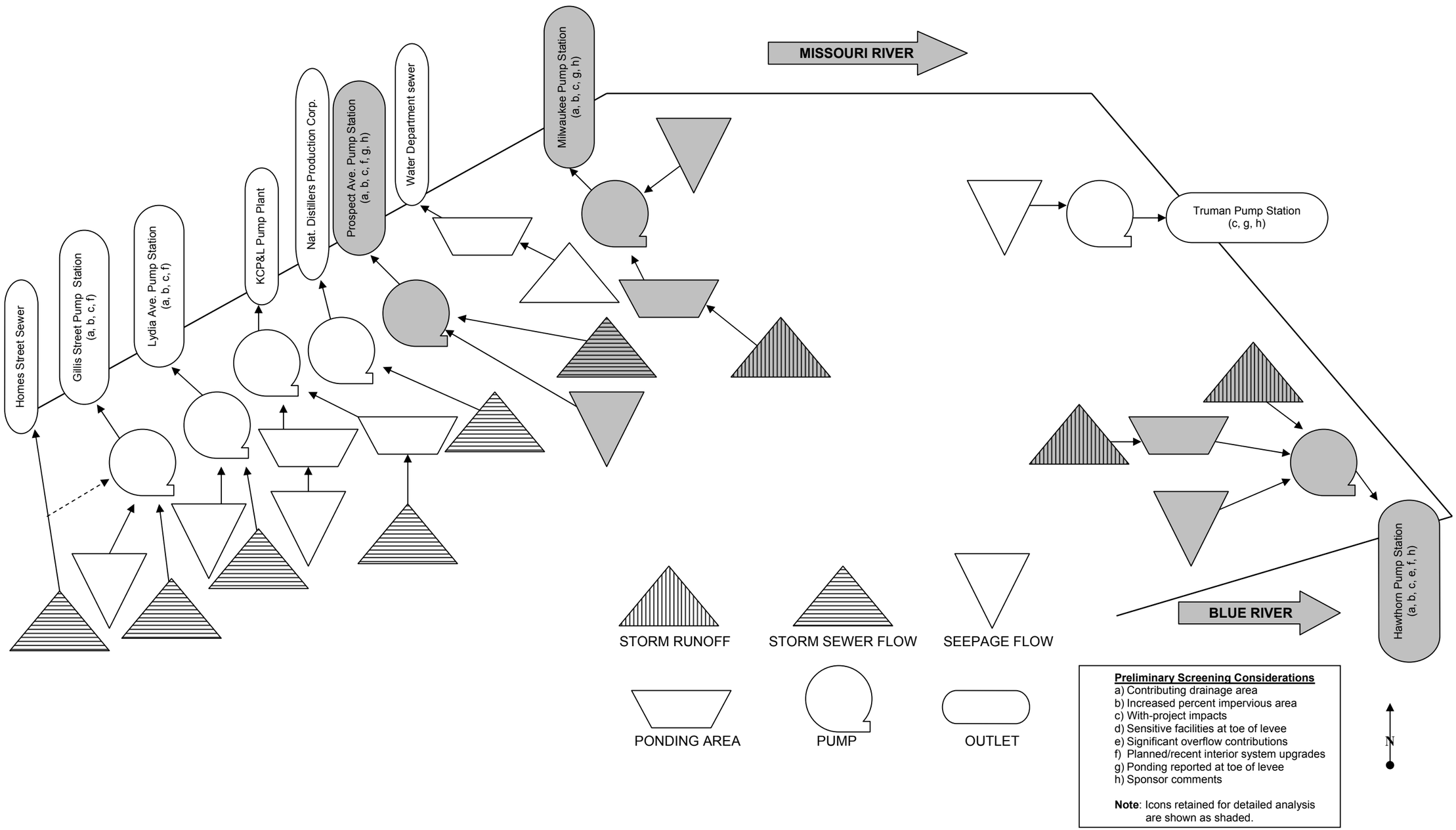
Schematic of Central Industrial District Levee Unit Interior Hydrology



Designed By: RAN
Checked By: GRL
February 2003

EXHIBIT A-2.46

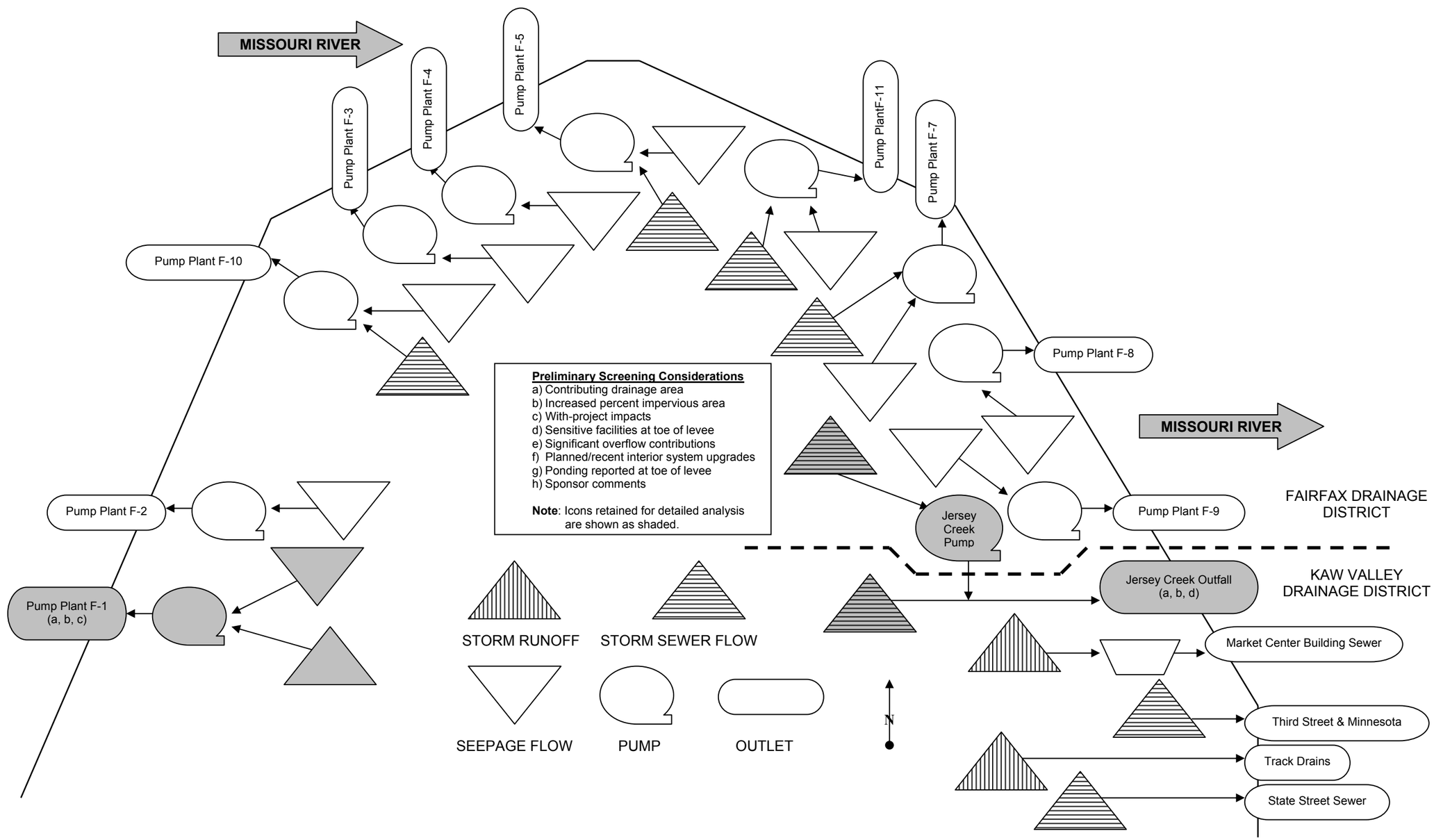
Schematic of East Bottoms Levee Unit Interior Hydrology



Designed By: RAN
Checked By: GRL
February 2003

EXHIBIT A-2.47

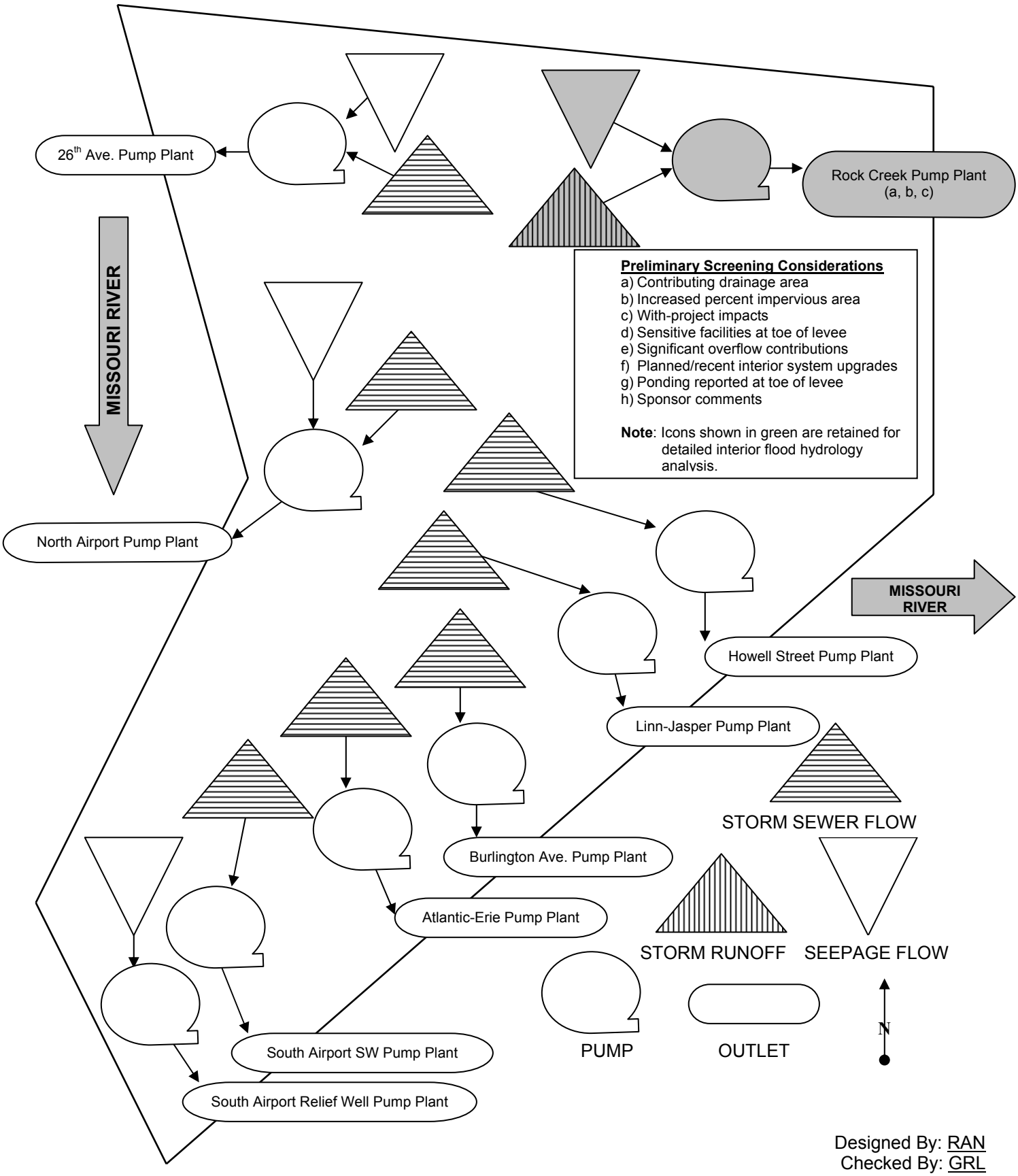
Schematic of Fairfax-Jersey Creek Levee Unit Interior Hydrology



Designed By: RAN
Checked By: GRL
February 2003

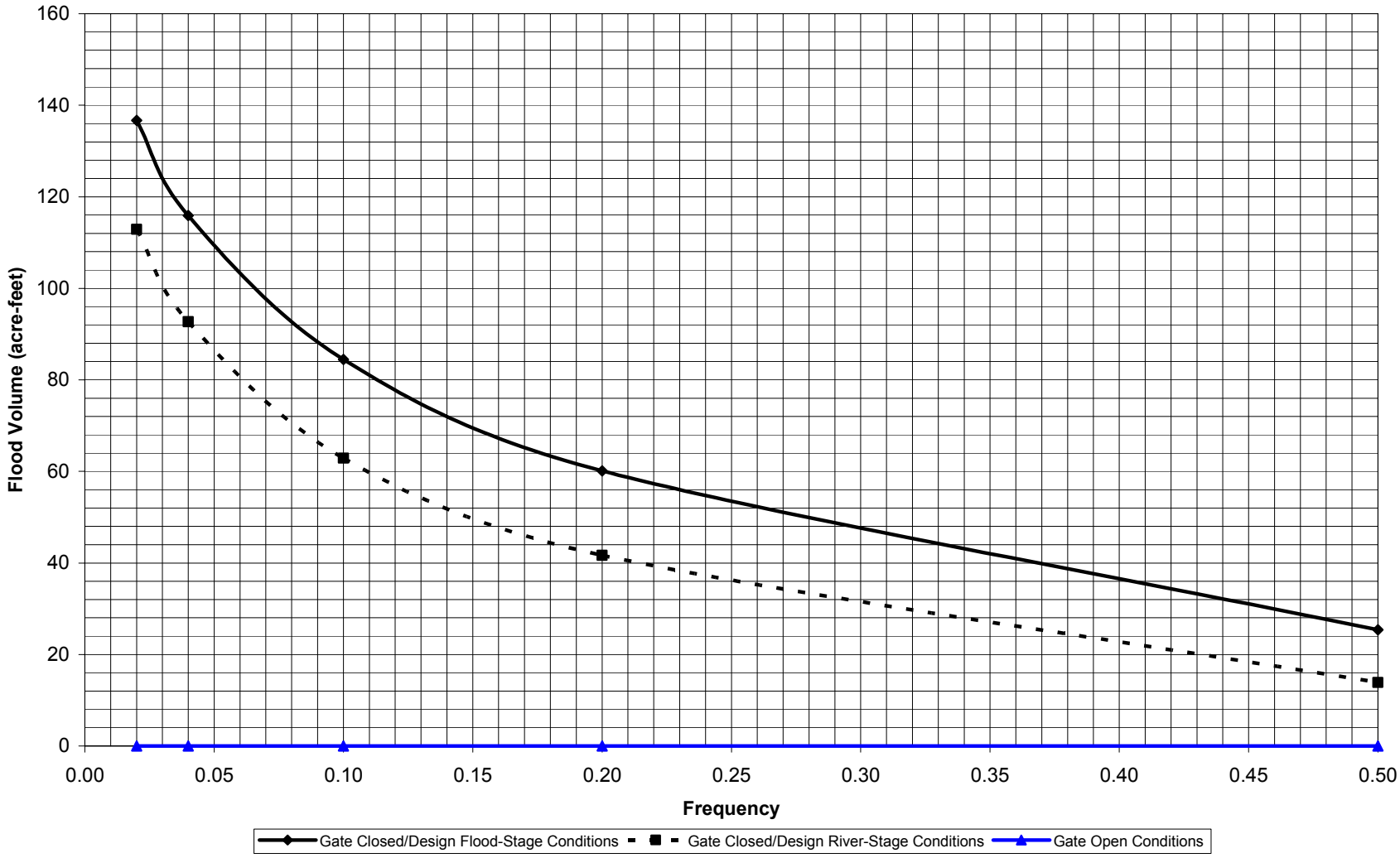
EXHIBIT A-2.48

Schematic of North Kansas City Levee Unit Interior Hydrology



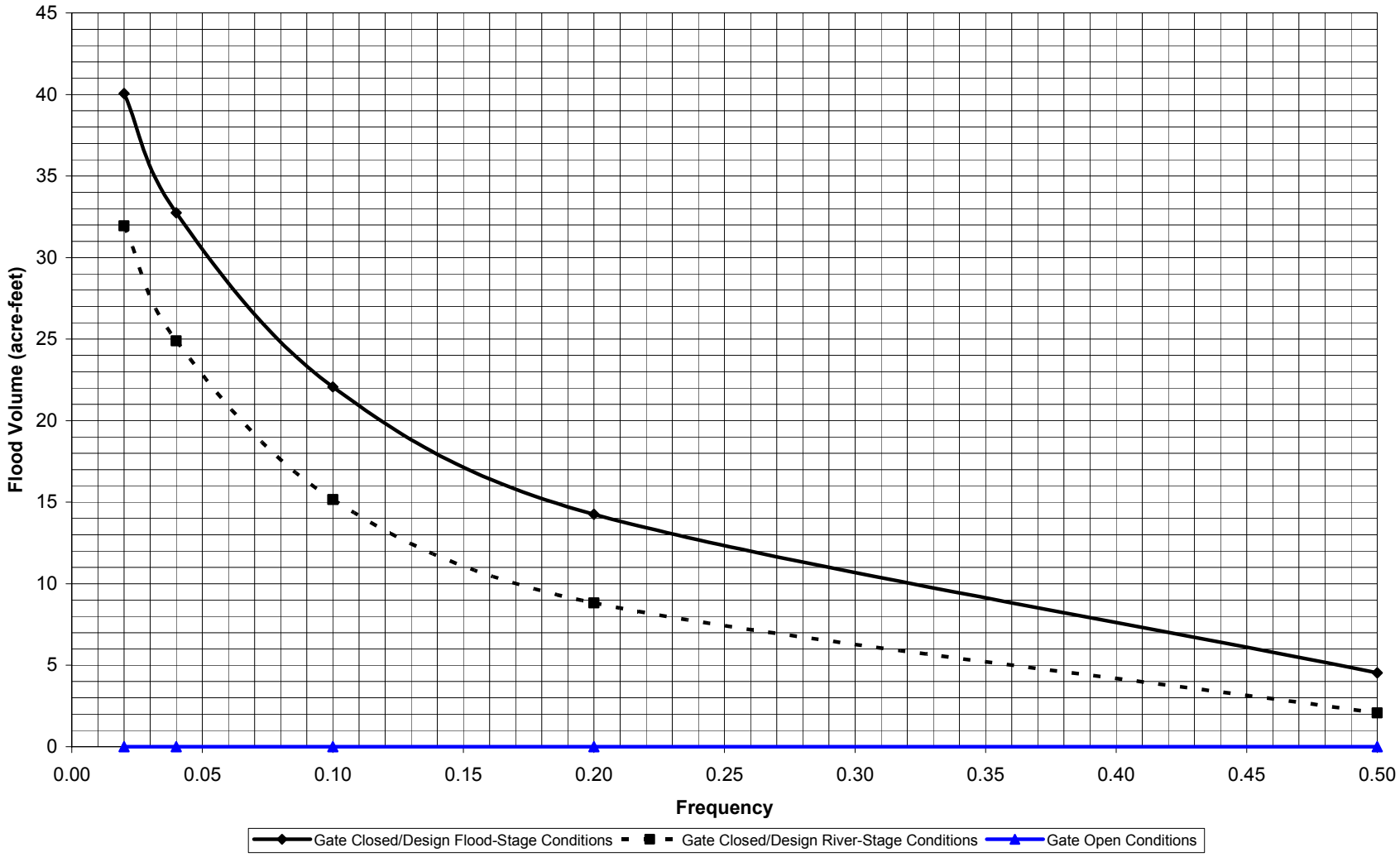
Designed By: RAN
Checked By: GRL
February 2003

EXHIBIT A-2.49
Argentine Levee Unit Interior Stormwater Flood Volumes – Turner Station 60+40



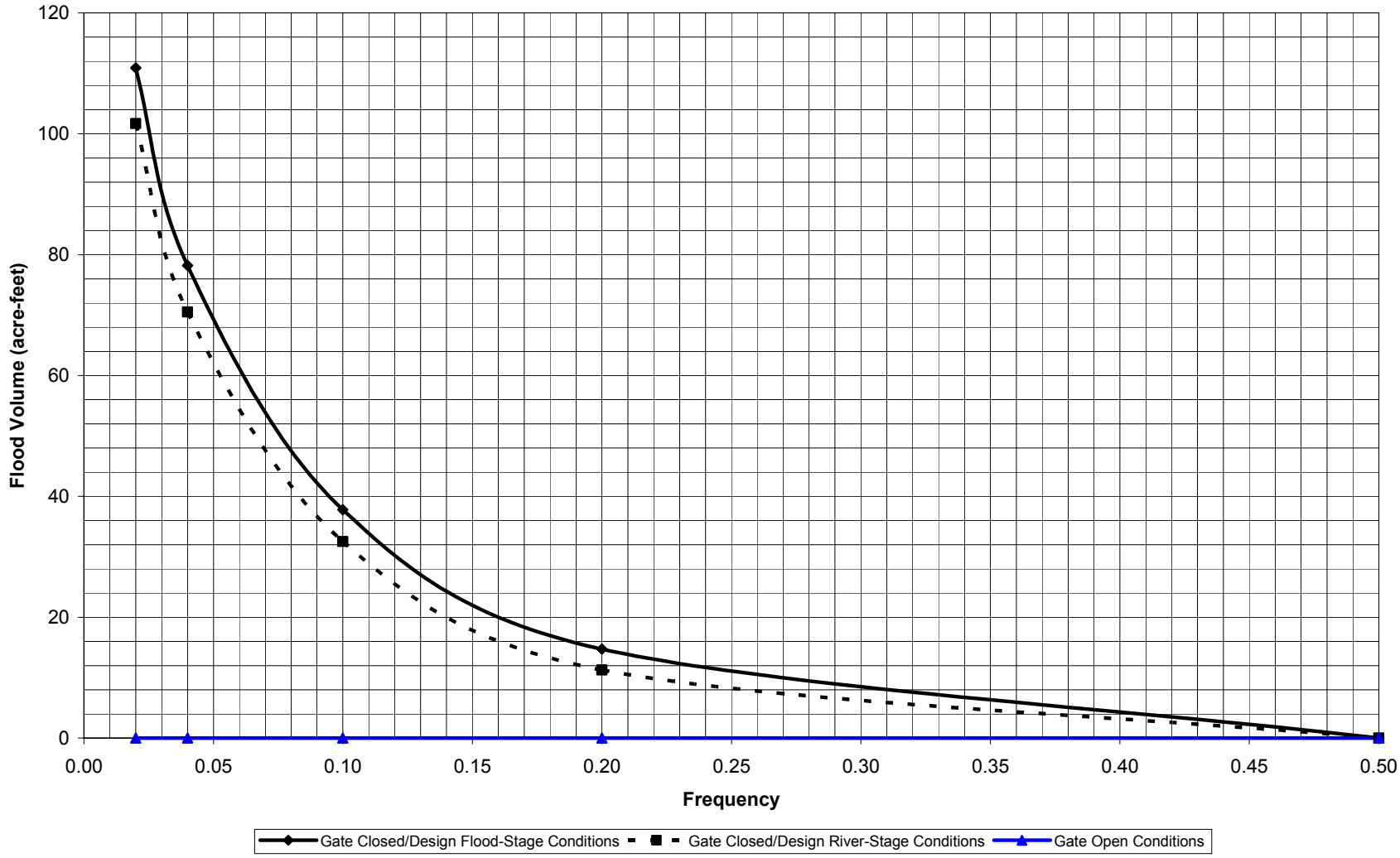
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.50
Argentine Levee Unit Interior Stormwater Flood Volumes – Con Agra Pump Plant 145+00



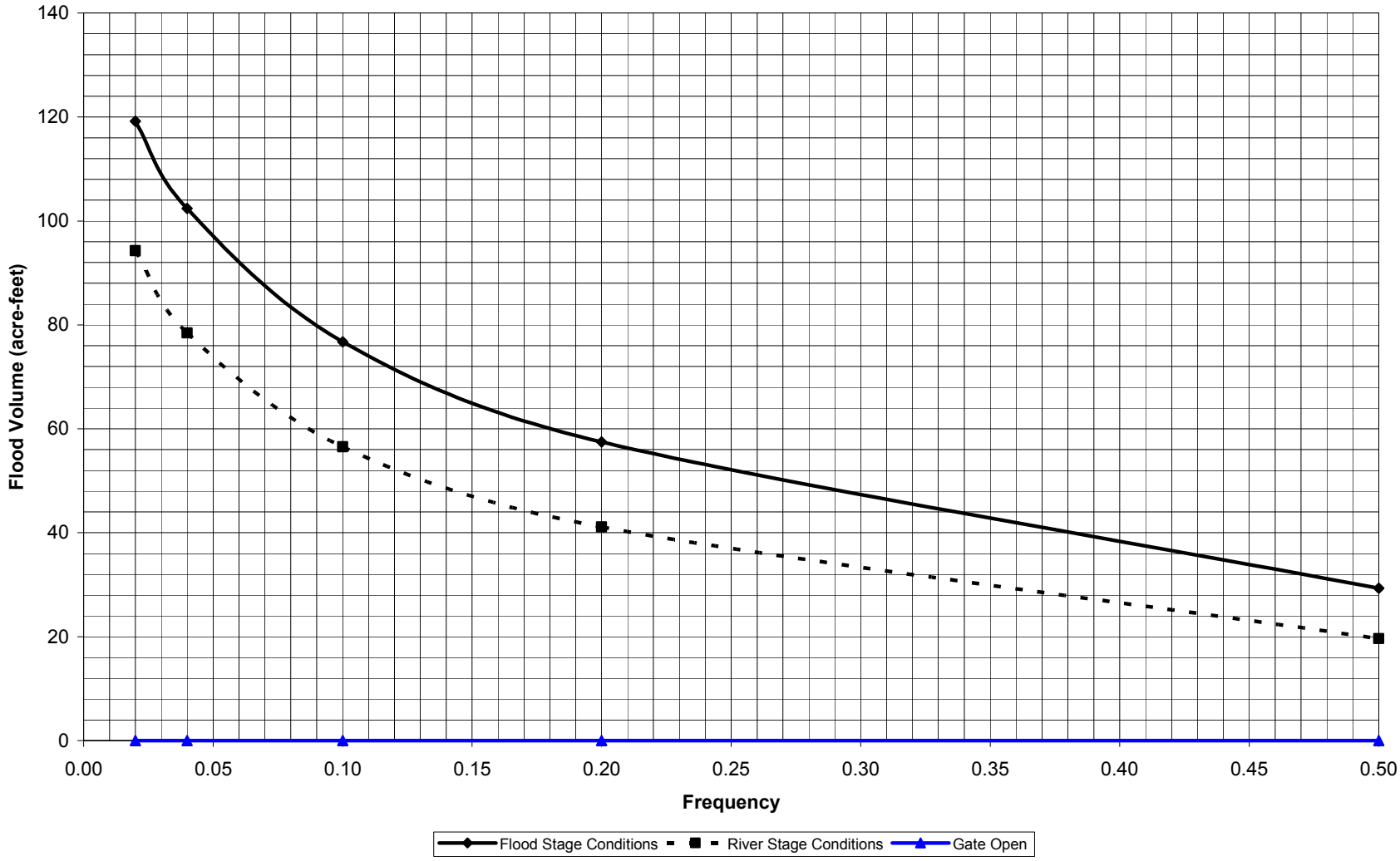
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.51
Argentine Levee Unit Interior Stormwater Flood Volumes – Santa Fe Drainage Ditch 253+14



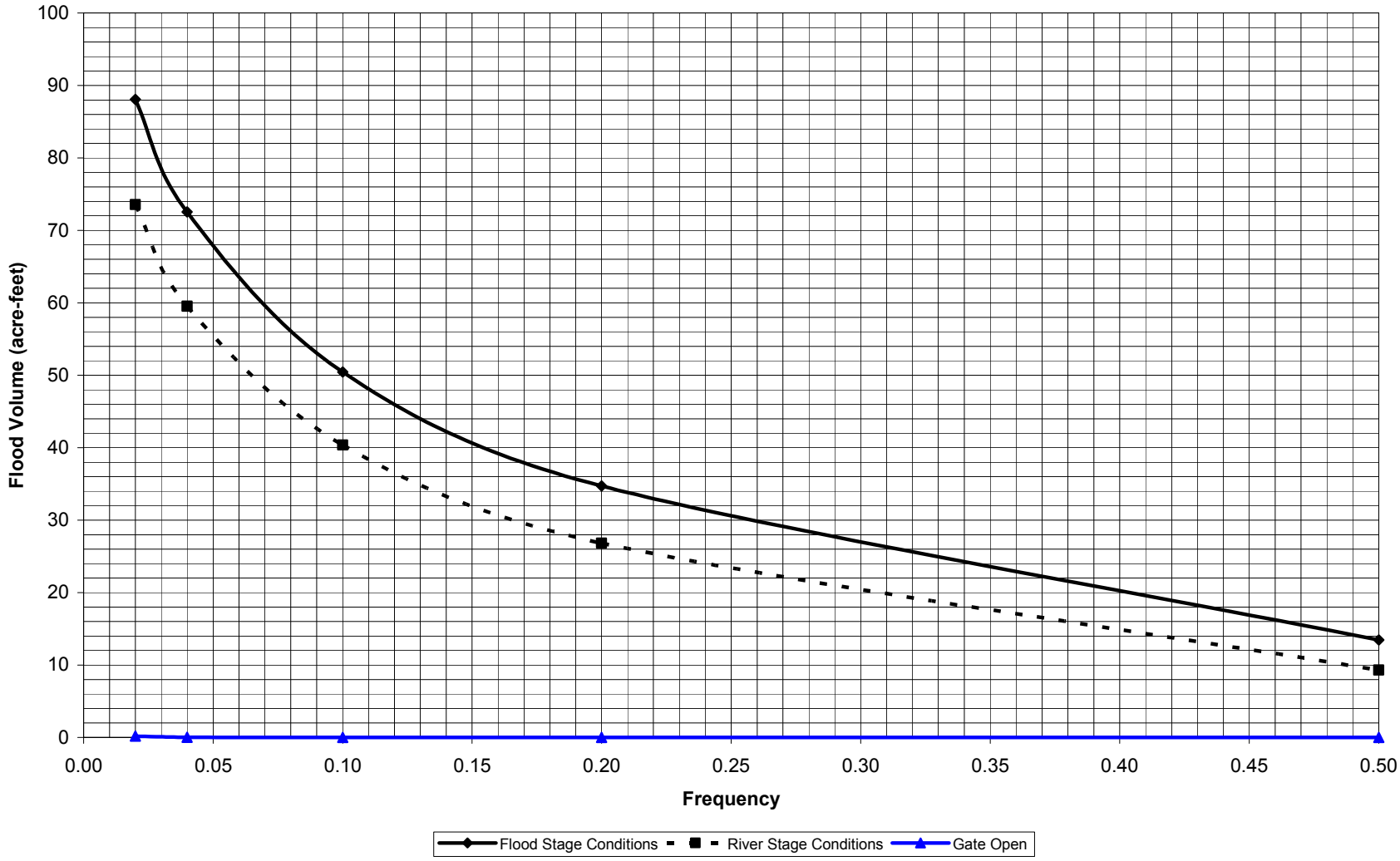
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.52
Armourdale Levee Unit Interior Stormwater Flood Volumes – Osage Avenue Pumping Plant 82+30



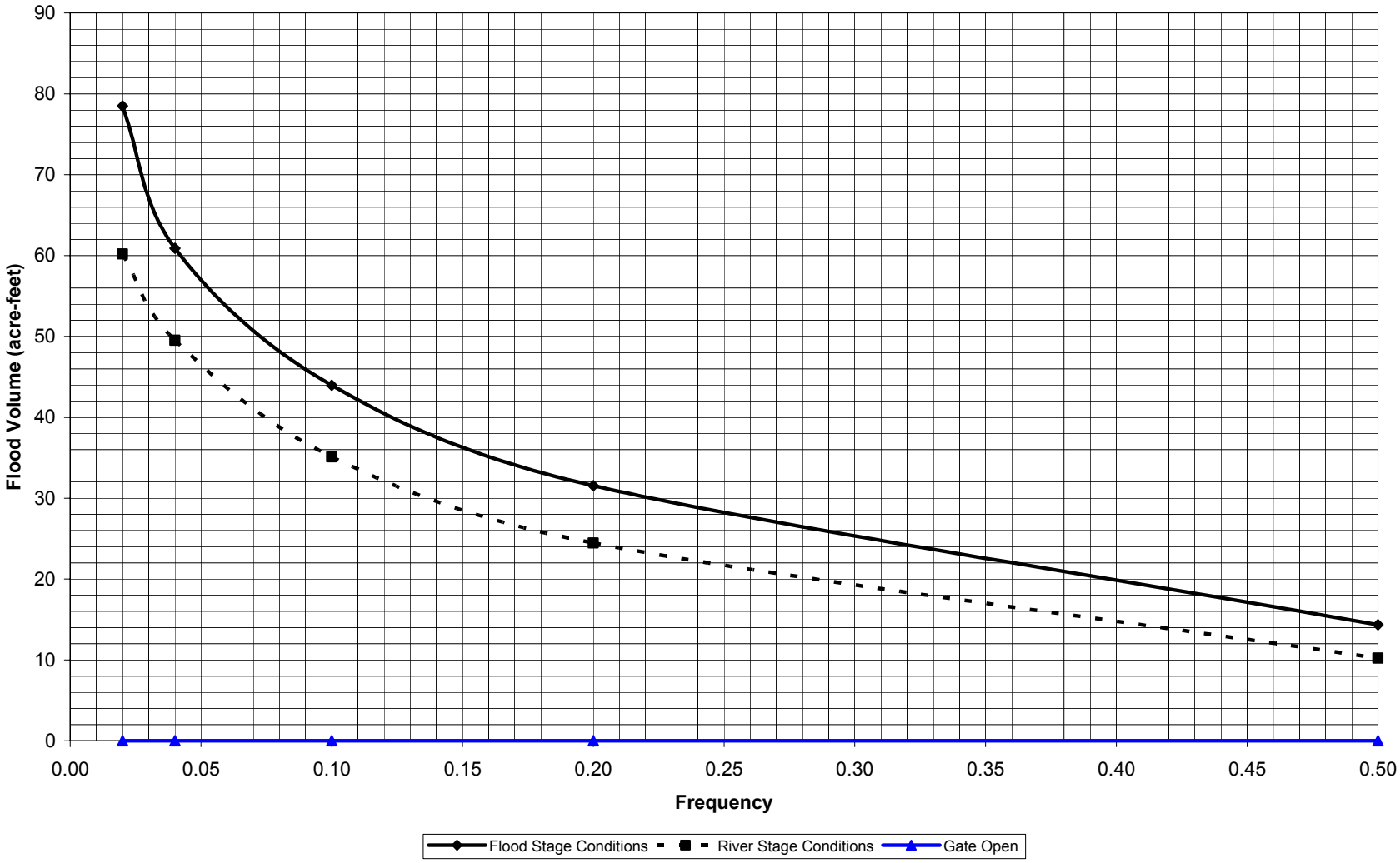
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.53
Armourdale Levee Unit Interior Stormwater Flood Volumes – 12th Street Sewer System 129+30



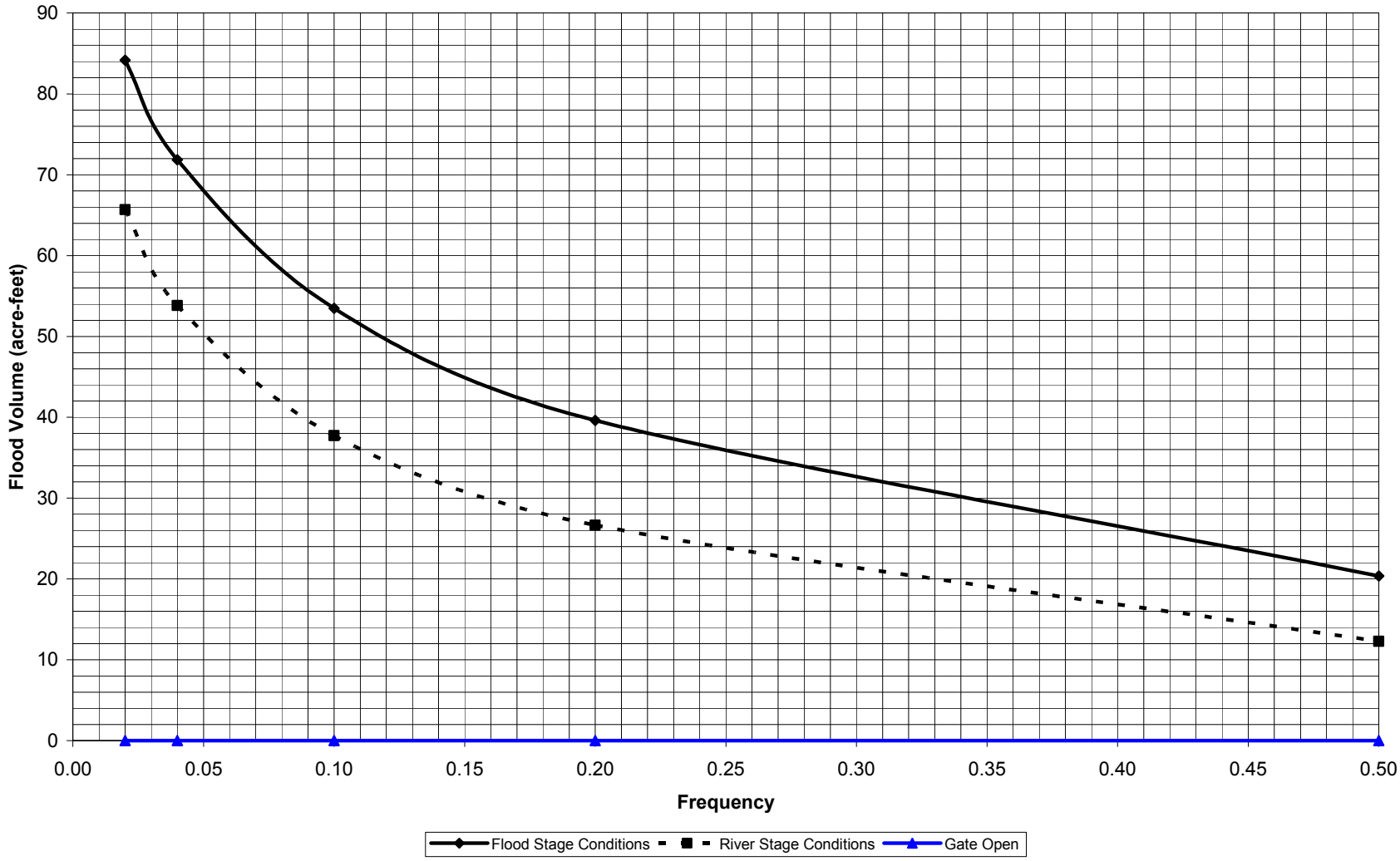
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.54
Armourdale Levee Unit Interior Stormwater Flood Volumes – Mill Street Pumping Plant 156+75



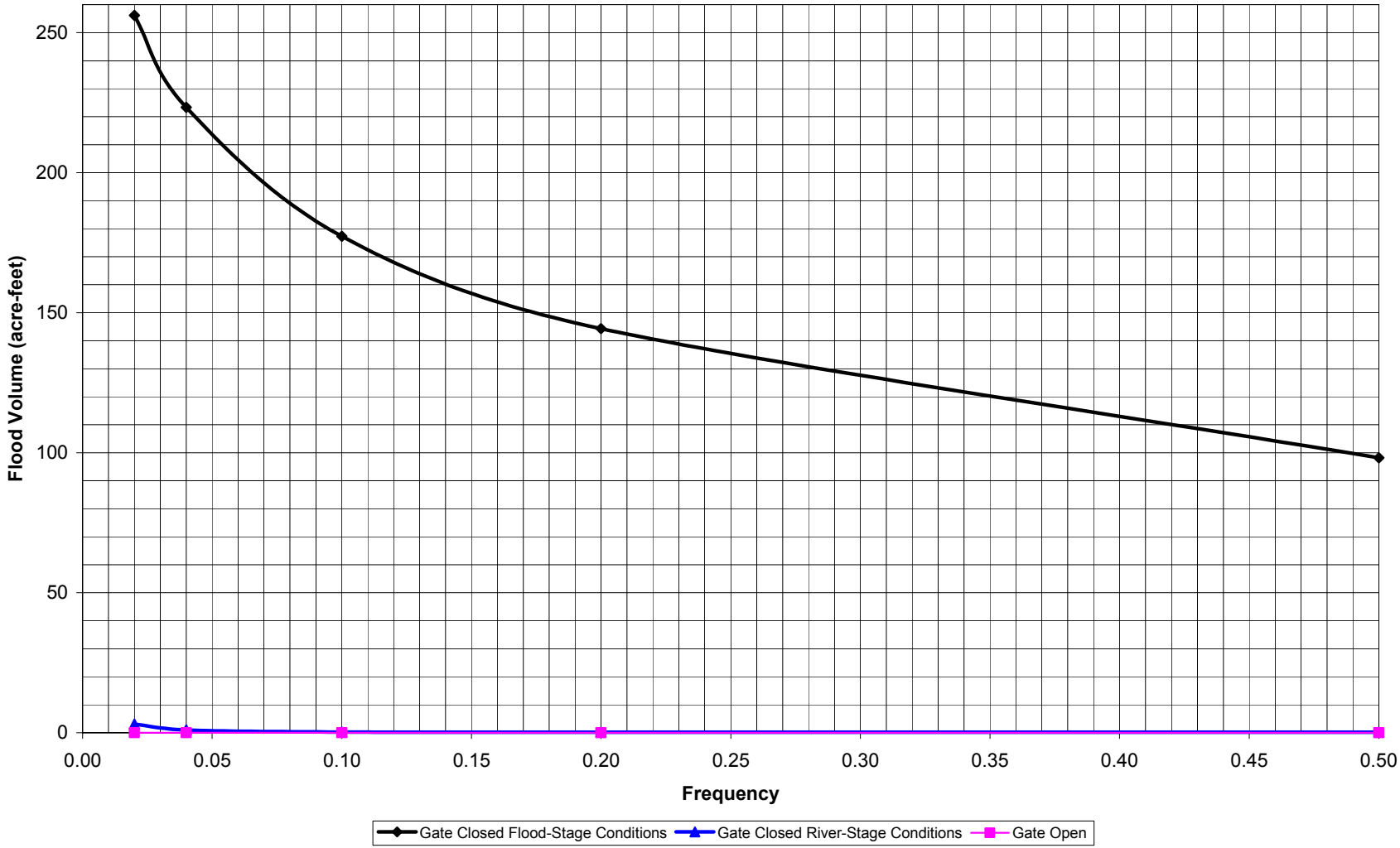
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.55
Armourdale Levee Unit Interior Stormwater Flood Volumes – Shawnee Avenue Pumping Plant 230+77



Designed By: RAN
Checked By: GRL
8/19/2004

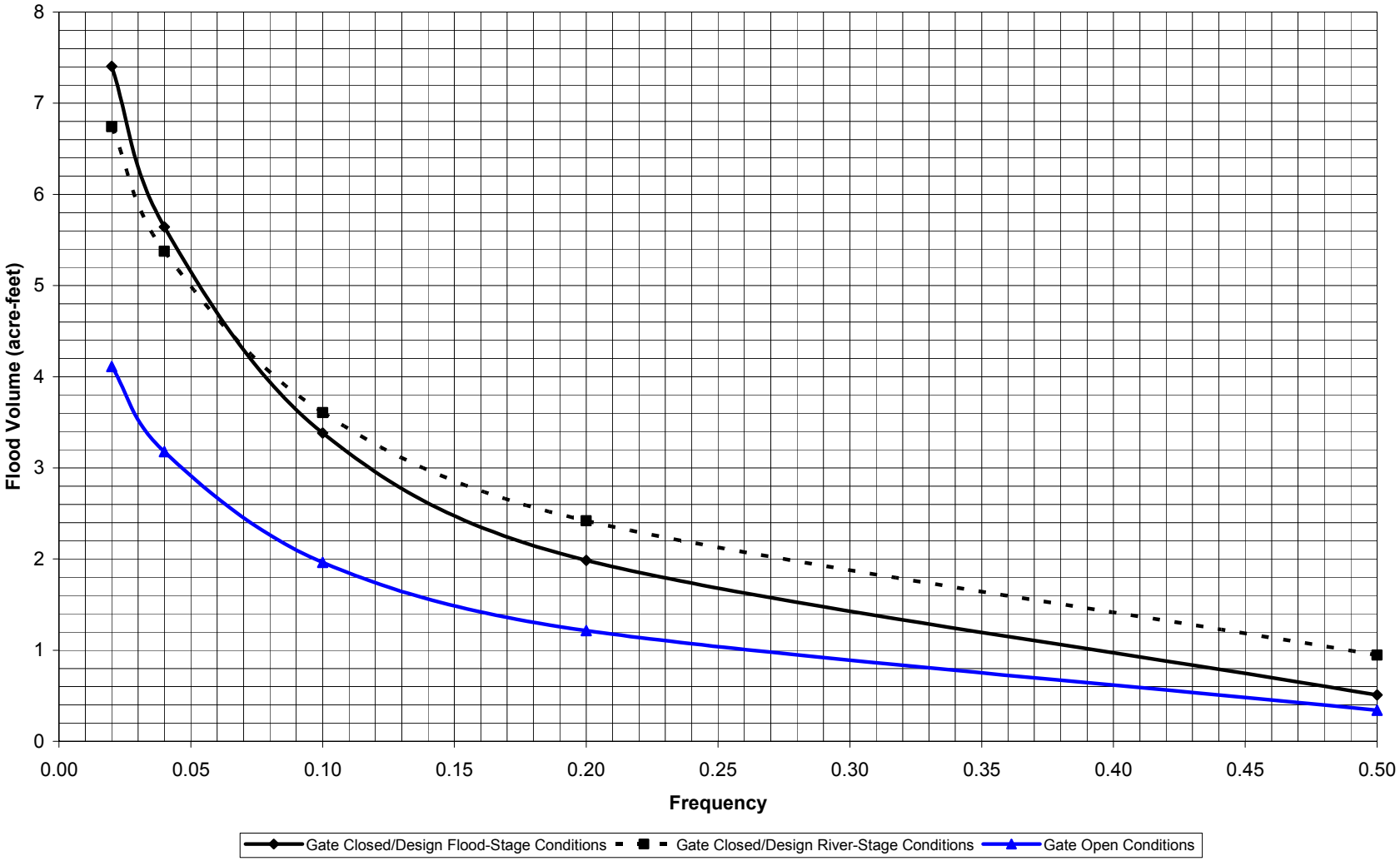
EXHIBIT A-2.56
Armourdale Levee Unit Interior Stormwater Flood Volumes – Splitlog Outfall 311+10



Designed By: RAN
Checked By: GRL
8/19/2004

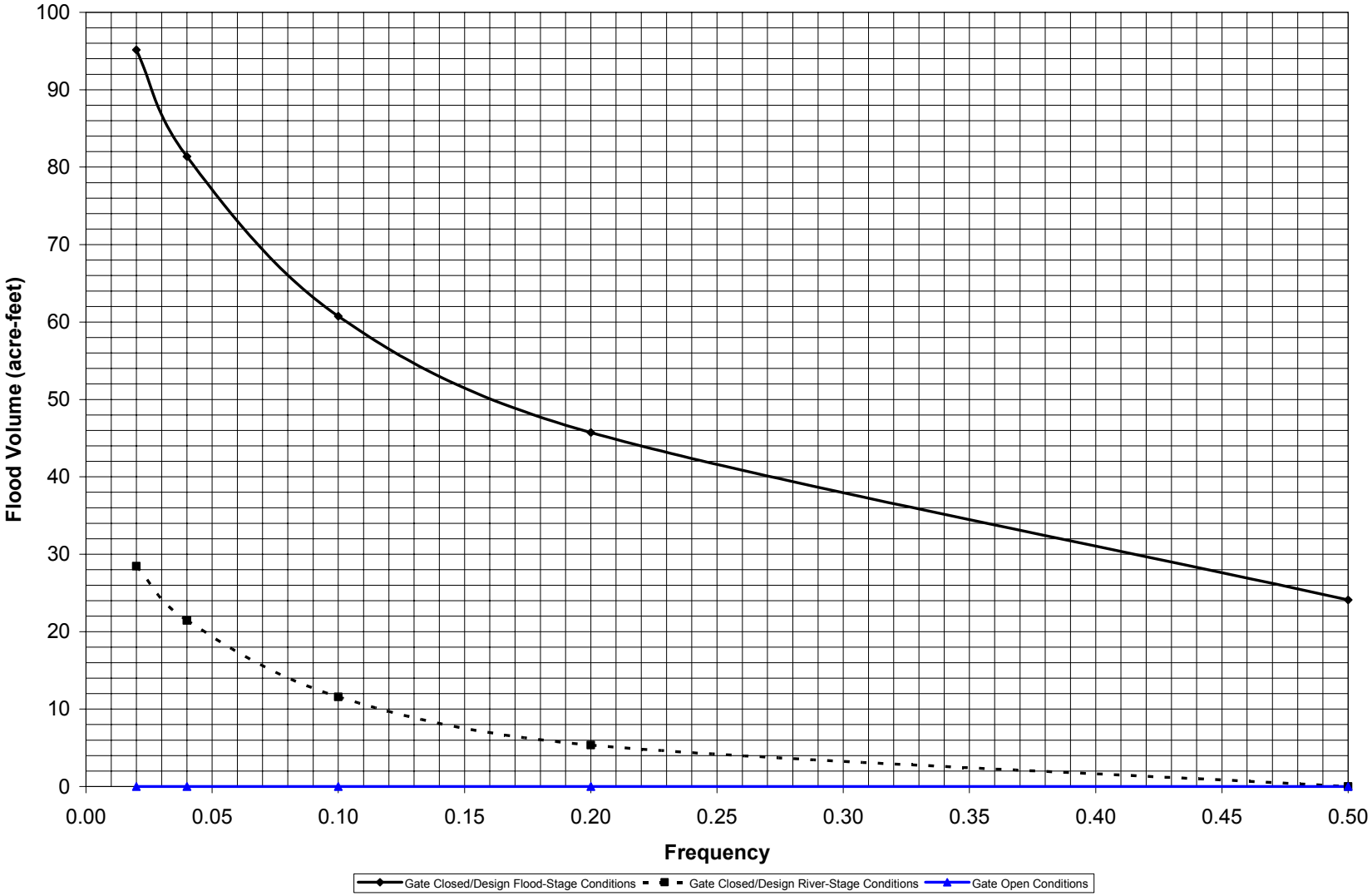
EXHIBIT A-2.57

Central Industrial District (Kansas) Levee Unit Interior Stormwater Flood Volumes – Ohio Avenue Pump Plant -5+85



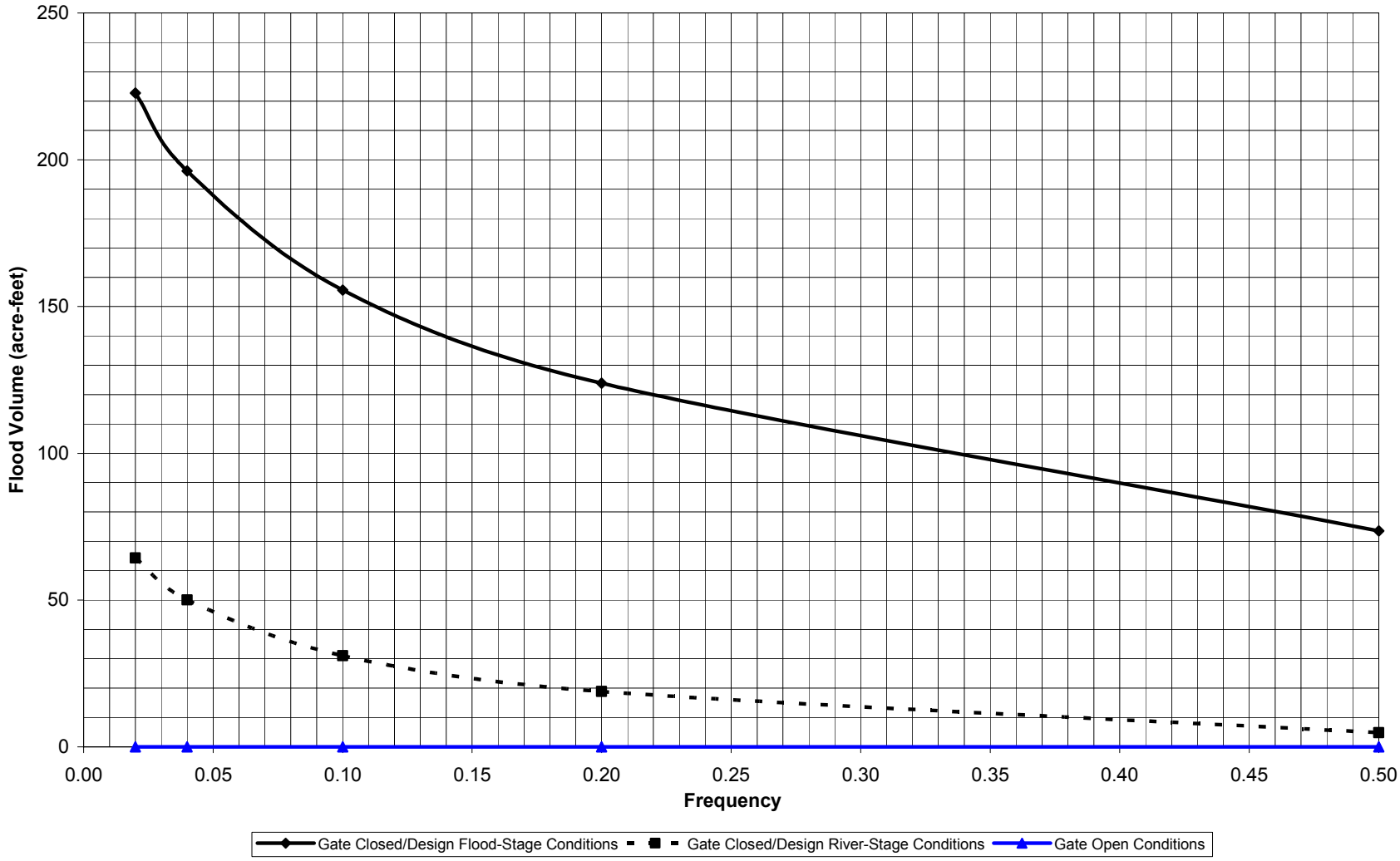
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.58
East Bottoms Levee Unit Interior Stormwater Flood Volumes – Prospect Avenue Pump Station 93+36



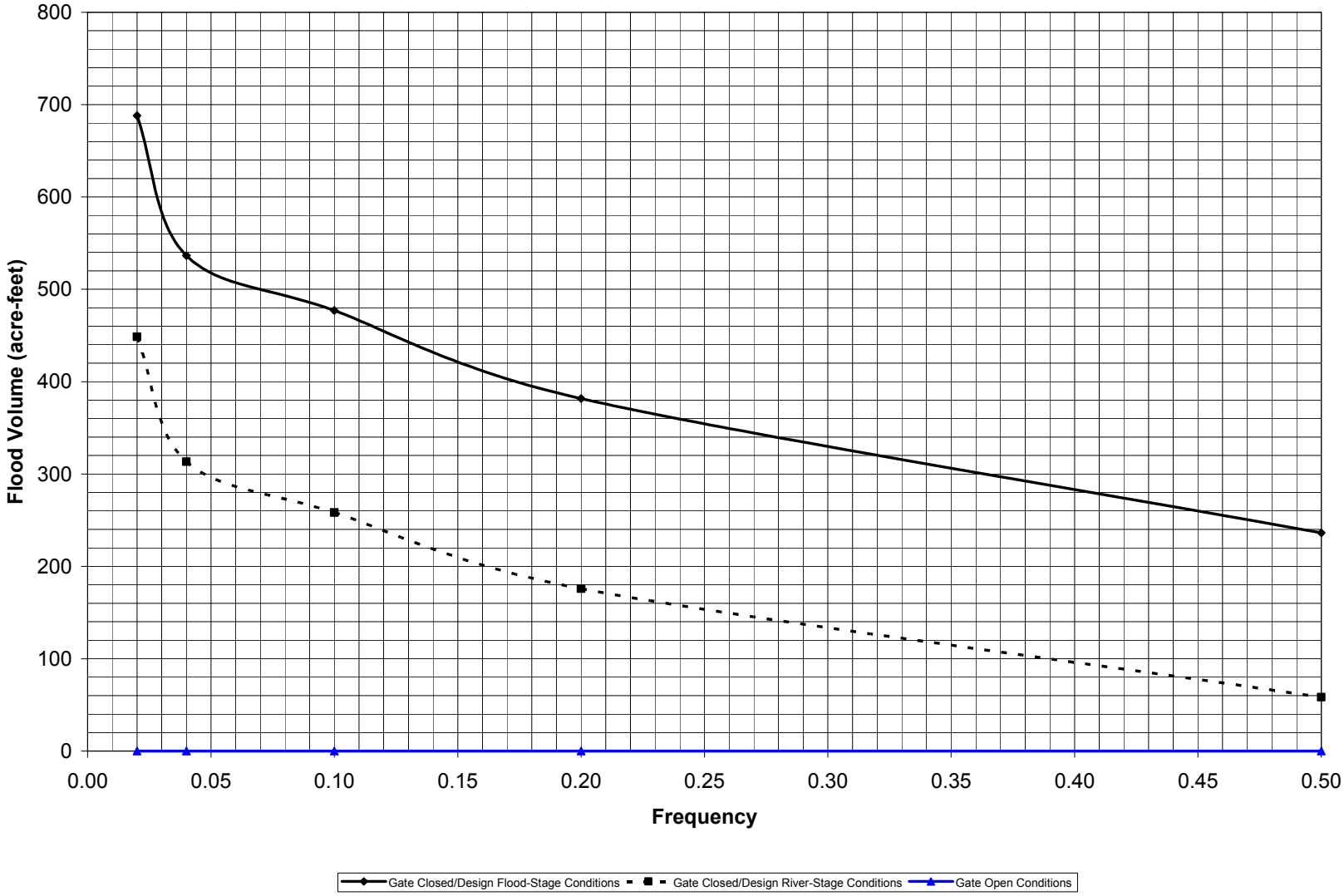
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.59
East Bottoms Levee Unit Interior Stormwater Flood Volumes – Milwaukee Pump Station 172+00



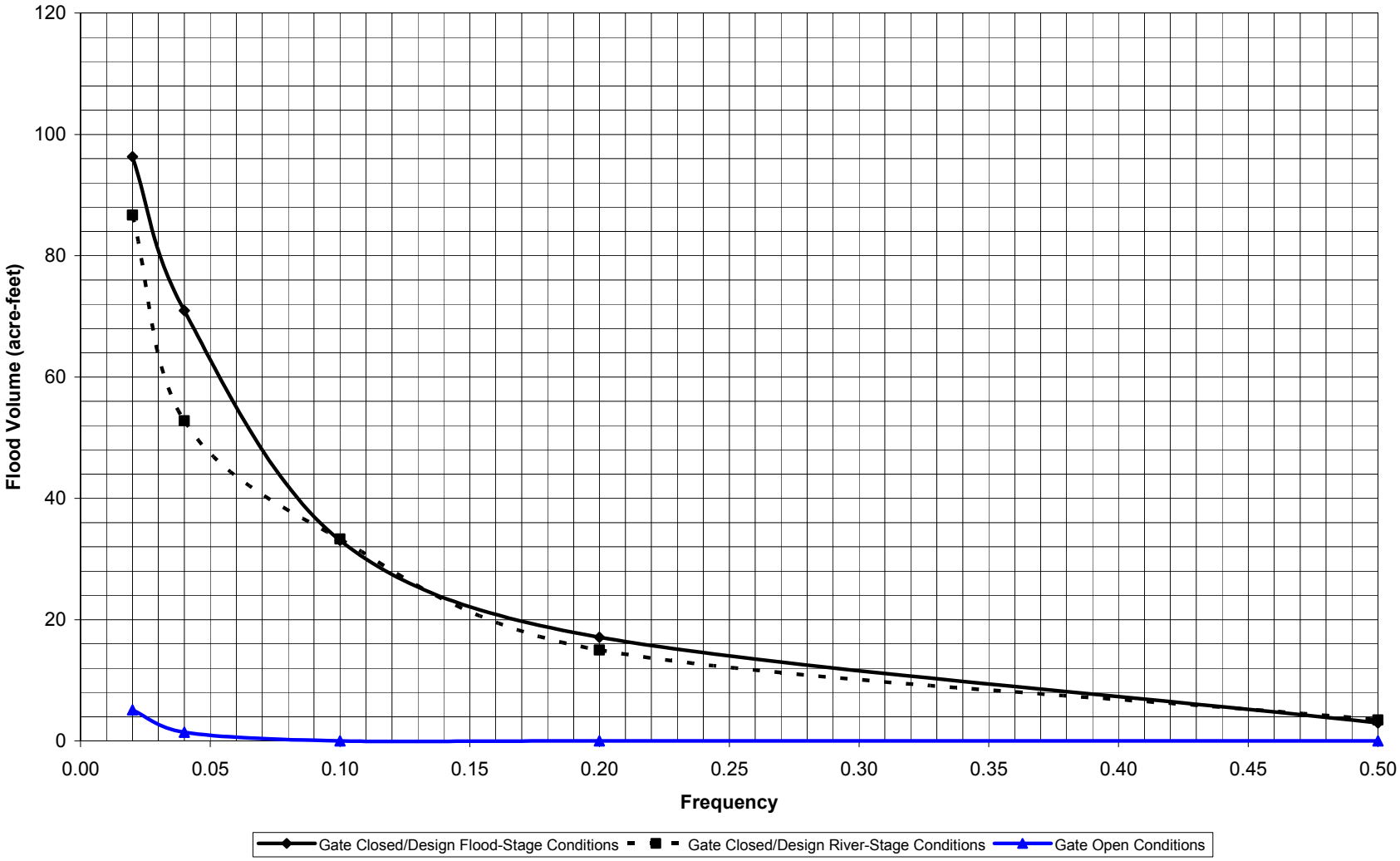
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.60
East Bottoms Levee Unit Interior Stormwater Flood Volumes - Hawthorn Pump Station 401+00



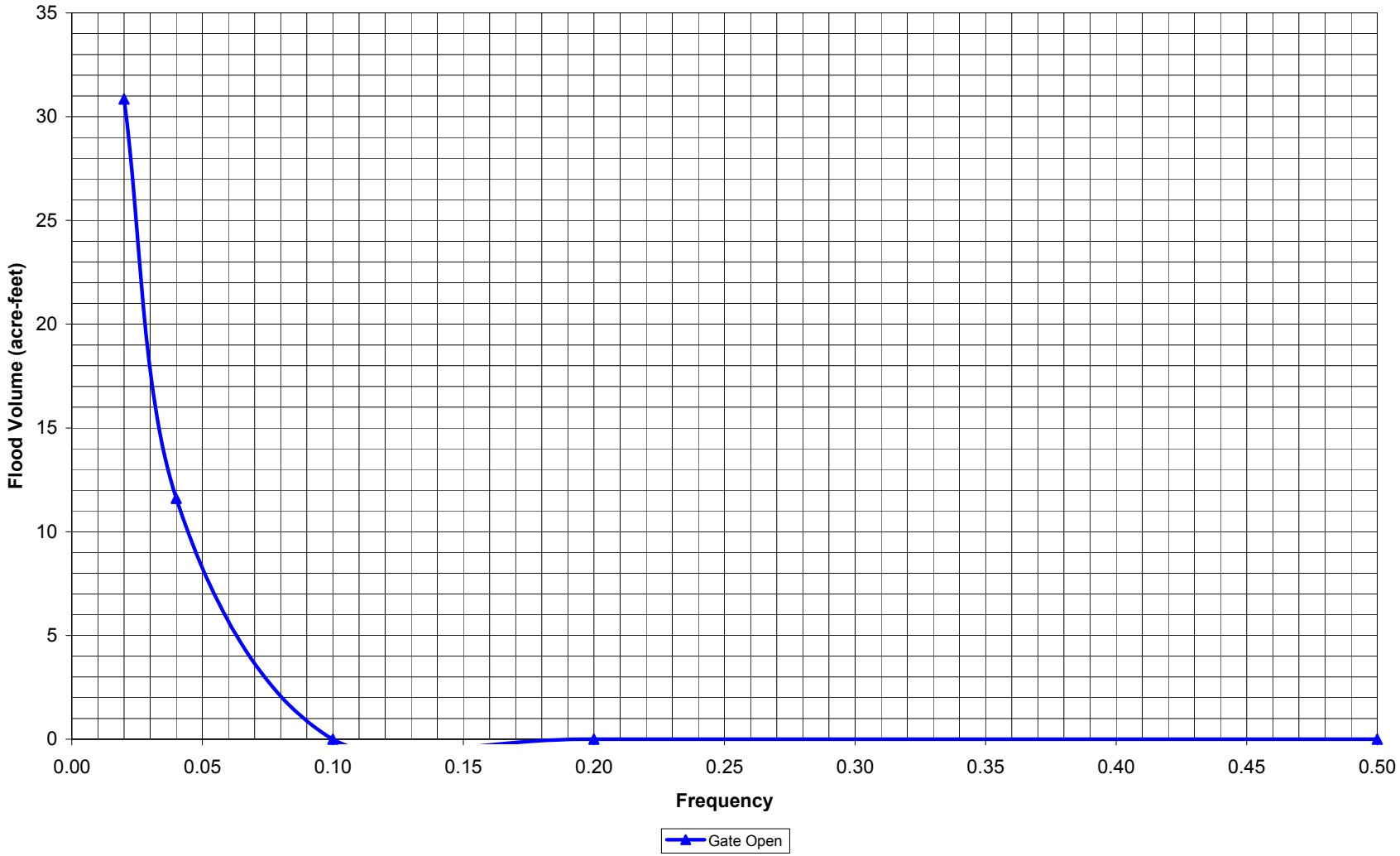
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.61
Birmingham Levee Unit Interior Stormwater Flood Volumes – Birmingham Pump Plant 434+21



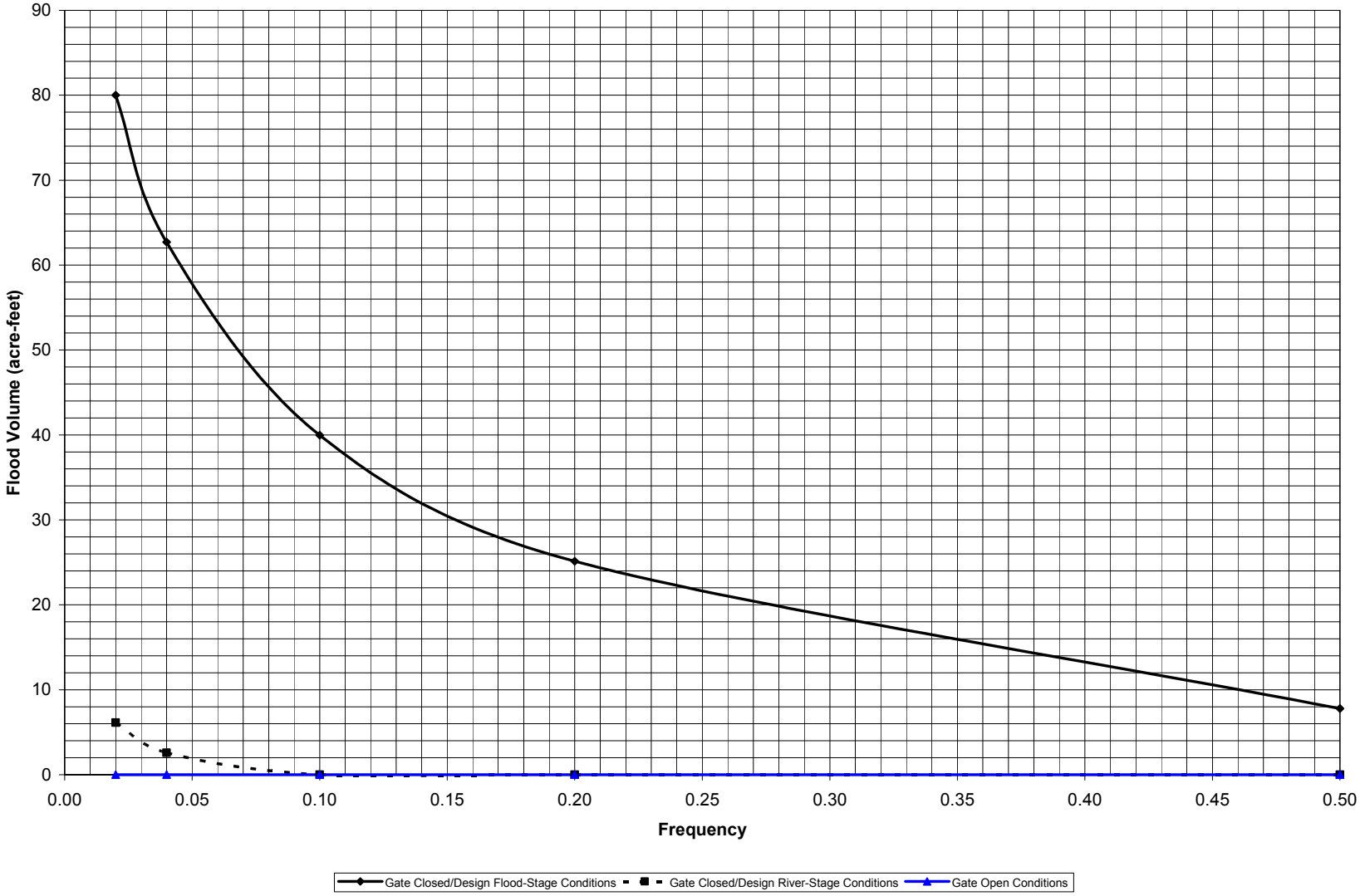
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.62
Birmingham Levee Unit Interior Stormwater Flood Volumes – Southeastern Drainage 288+70



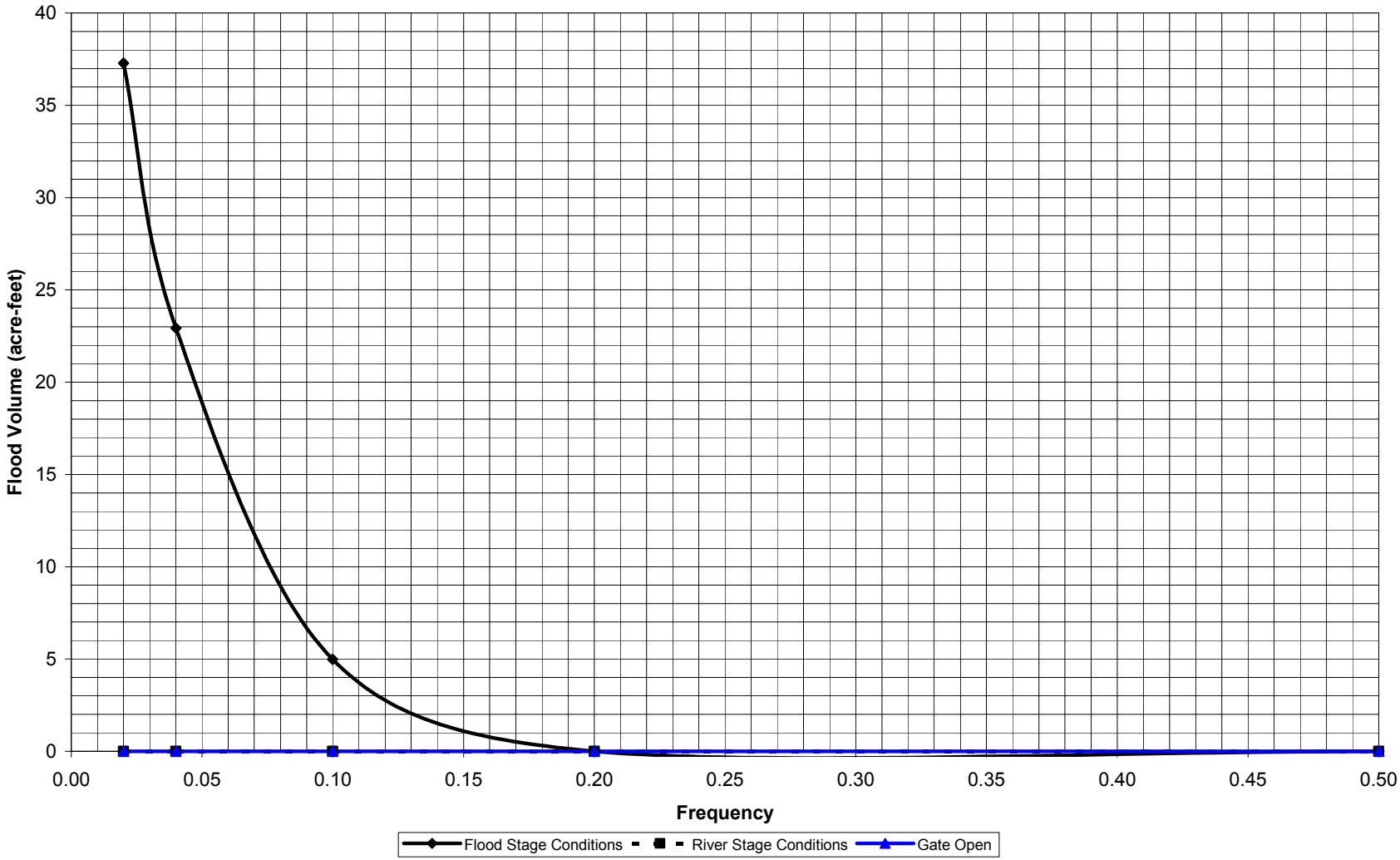
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.63
Central Industrial District (Missouri) Interior Stormwater Flood Volumes – Santa Fe Pump Plant 52+87



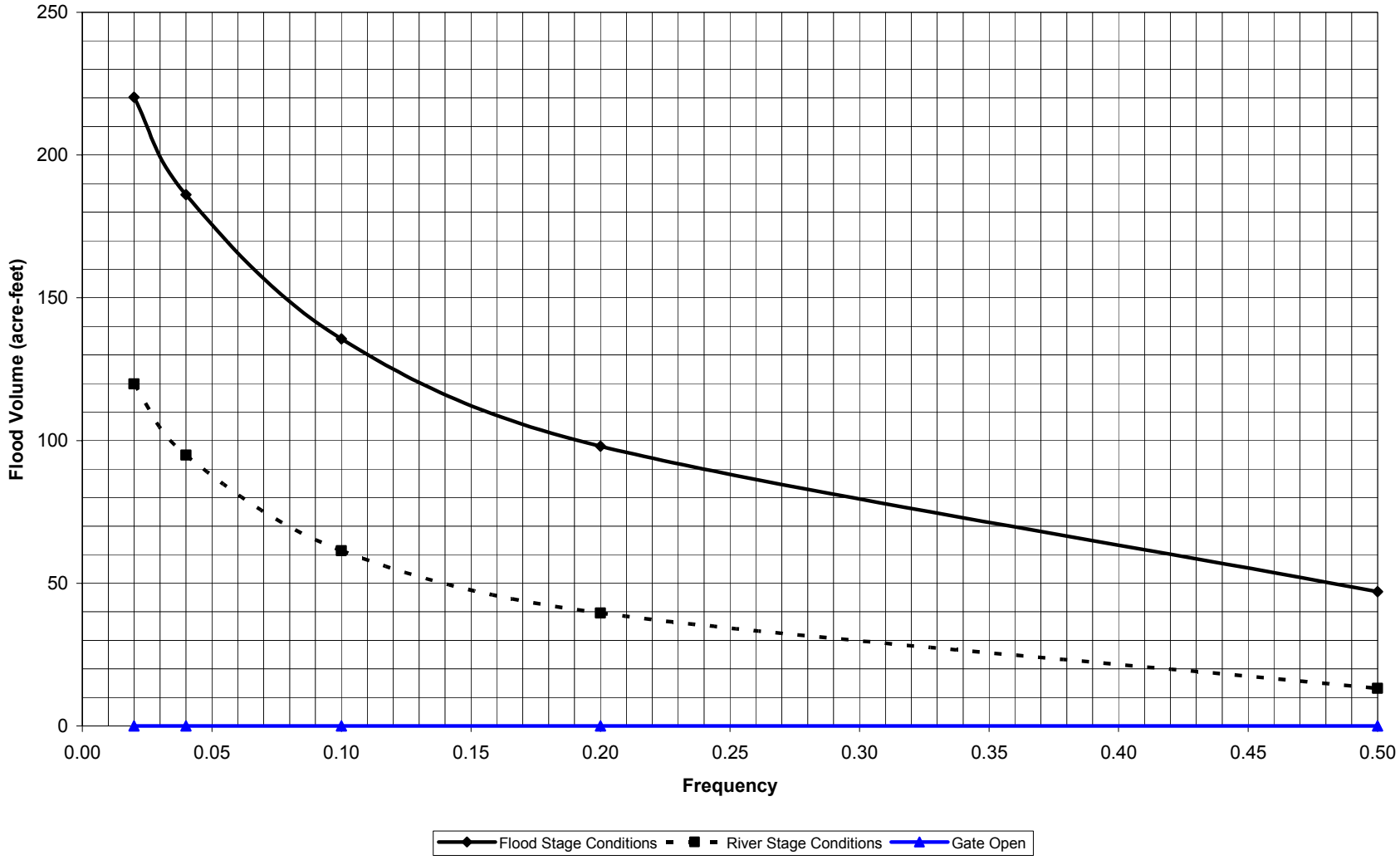
Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.64
Fairfax-Jersey Creek Levee Unit Interior Stormwater Flood Volumes – Pump Plant F-1 267+70



Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.65
North Kansas City Levee Unit Interior Stormwater Flood Volumes – Rock Creek Pump Plant 388+96



Designed By: RAN
Checked By: GRL
8/19/2004

EXHIBIT A-2.66
Inundation Map for Turner Station

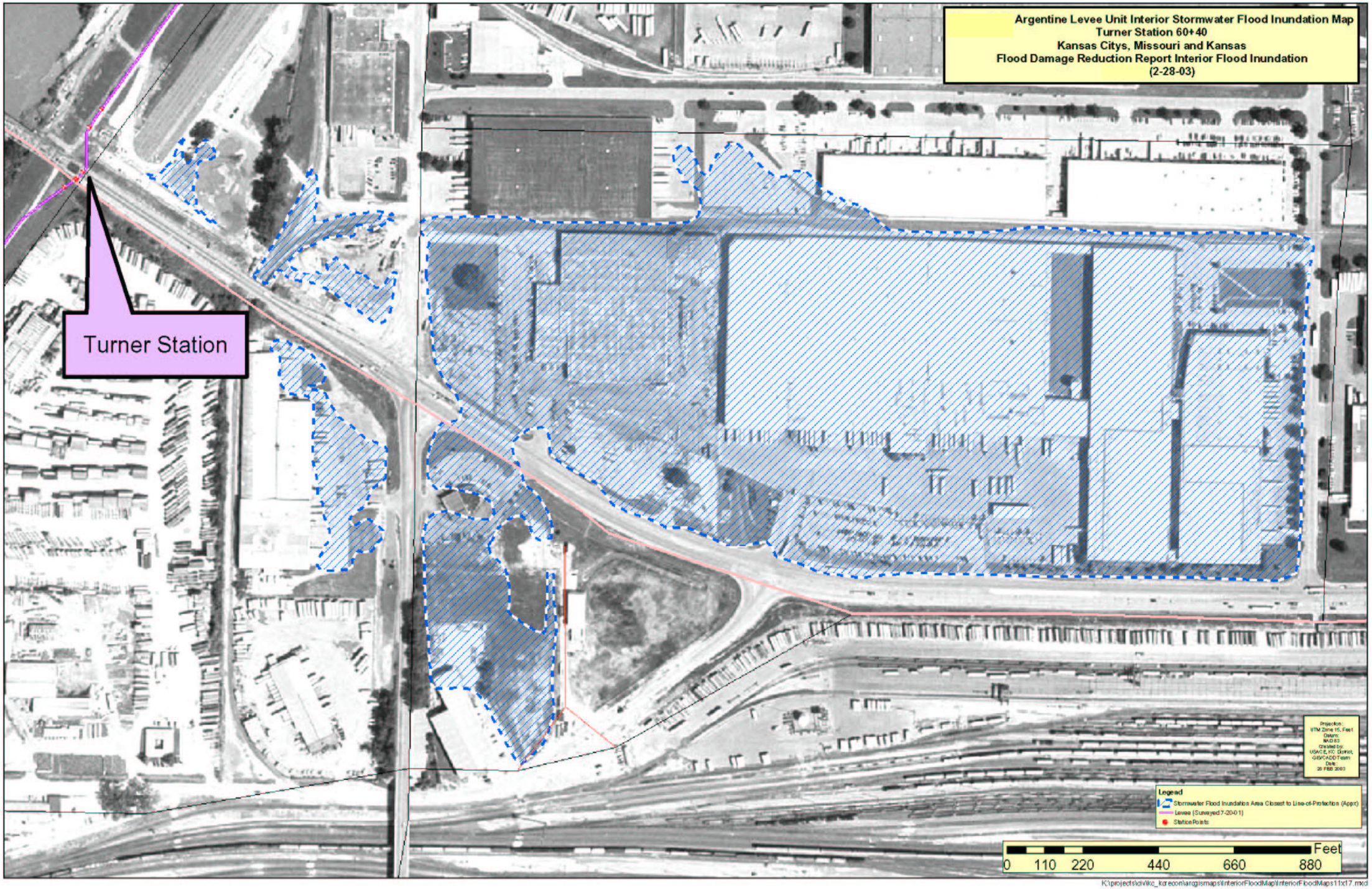


EXHIBIT A-2.67
Inundation Map for Con Agra Pump Plant

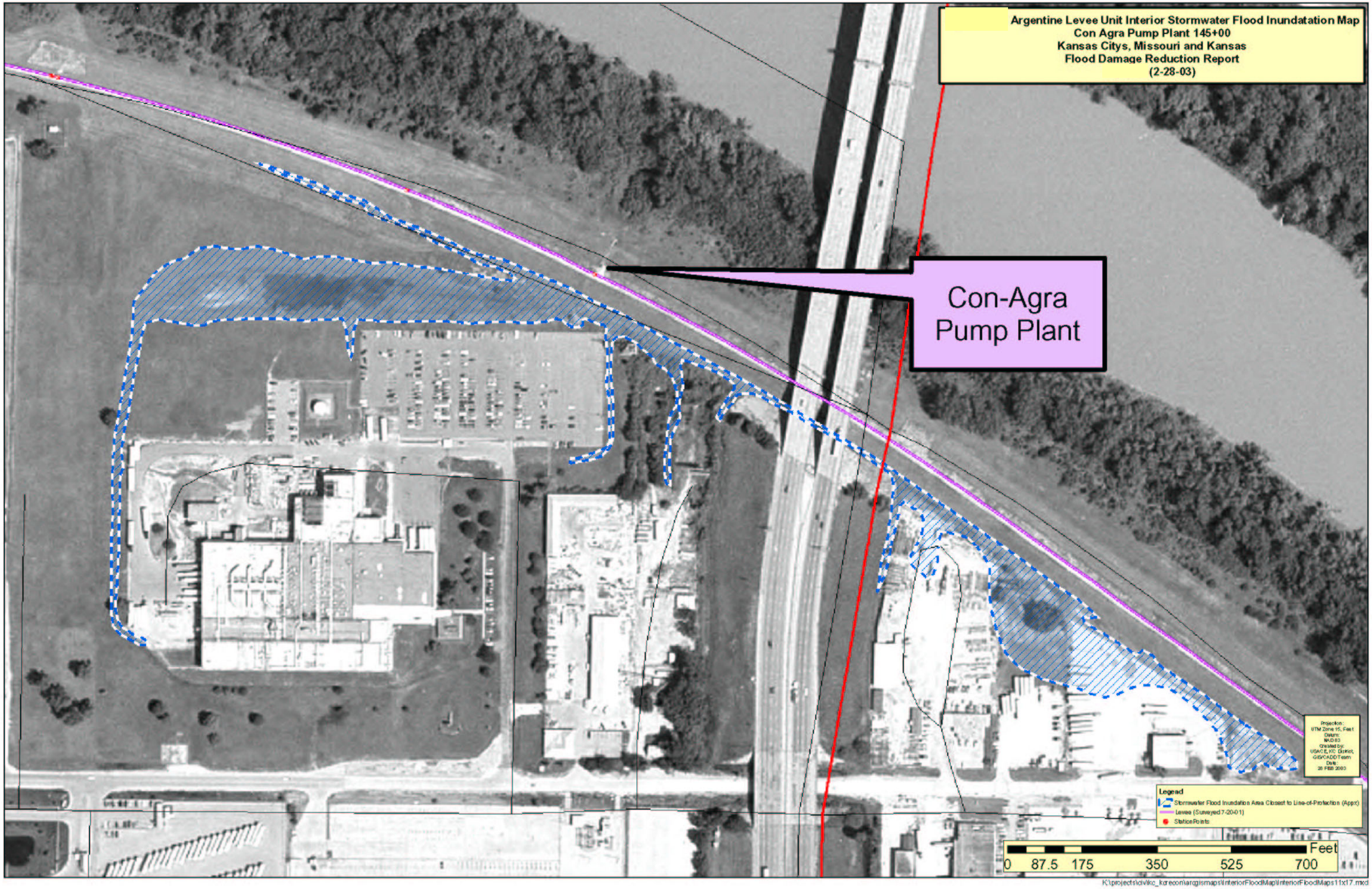


EXHIBIT A-2.68
Inundation Map for Santa Fe Drainage Ditch

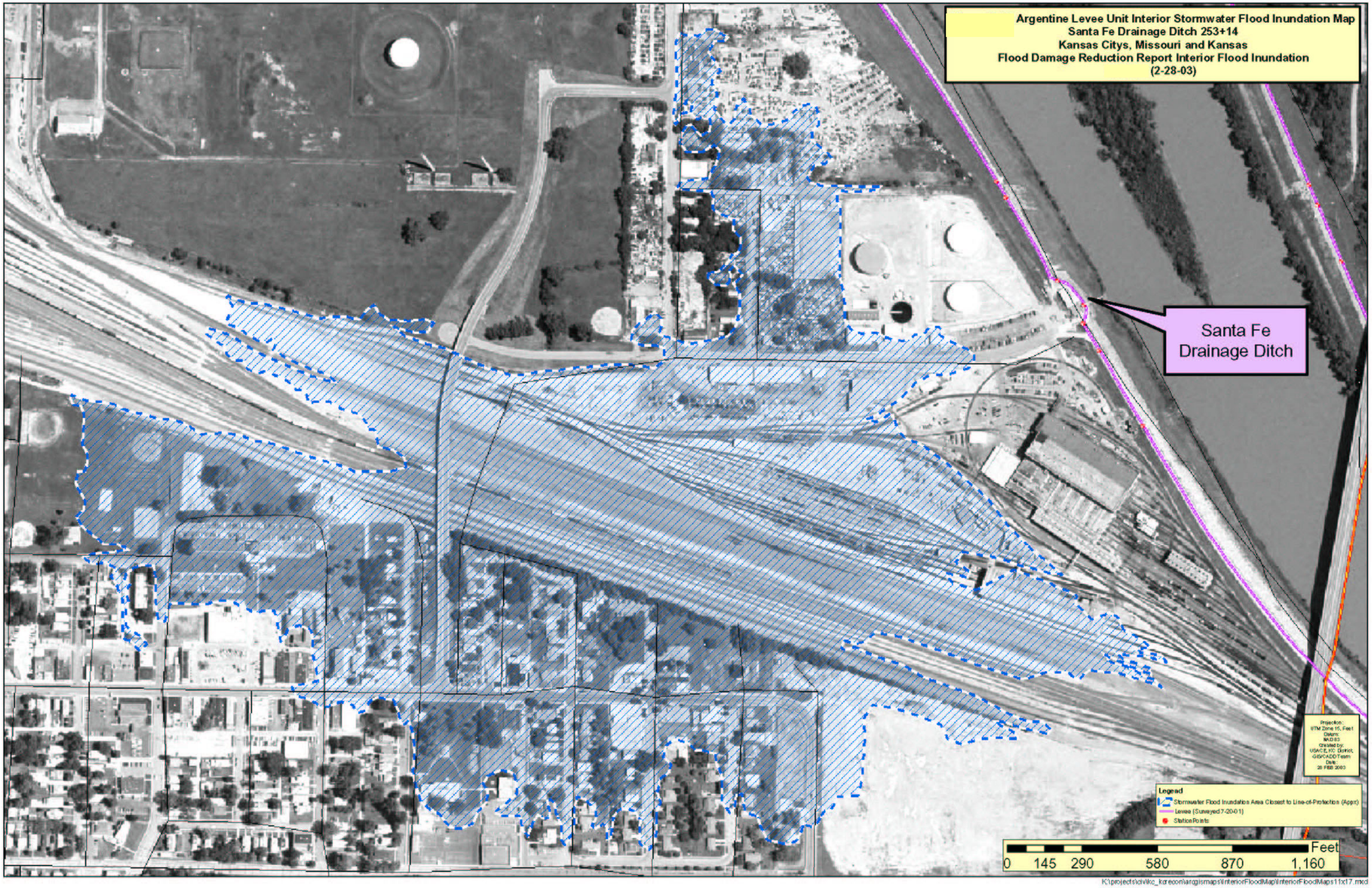


EXHIBIT A-2.69
Inundation Map for Mill Street Pump Plant

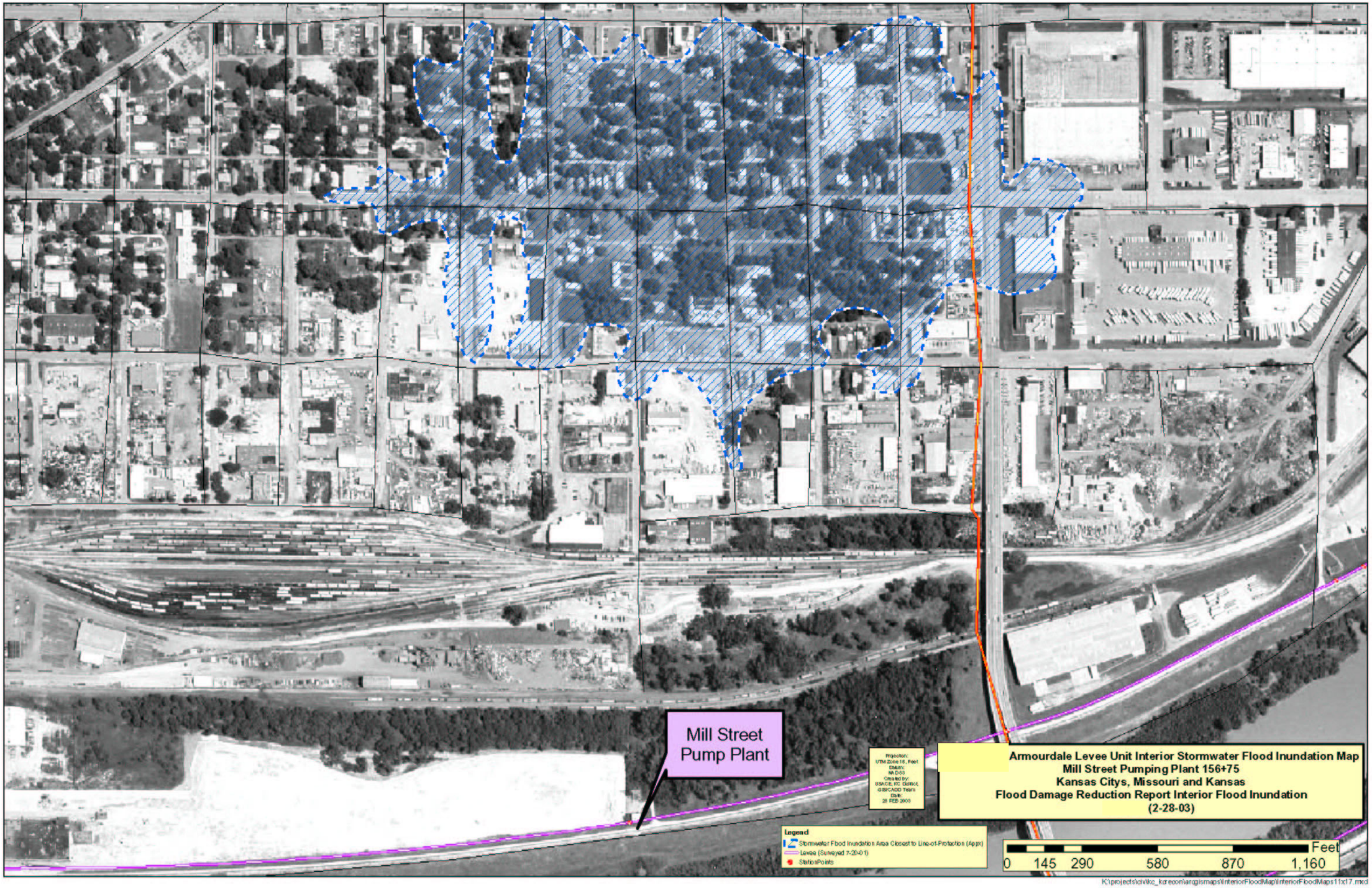


EXHIBIT A-2.70
Inundation Map for Shawnee Avenue Pump Plant

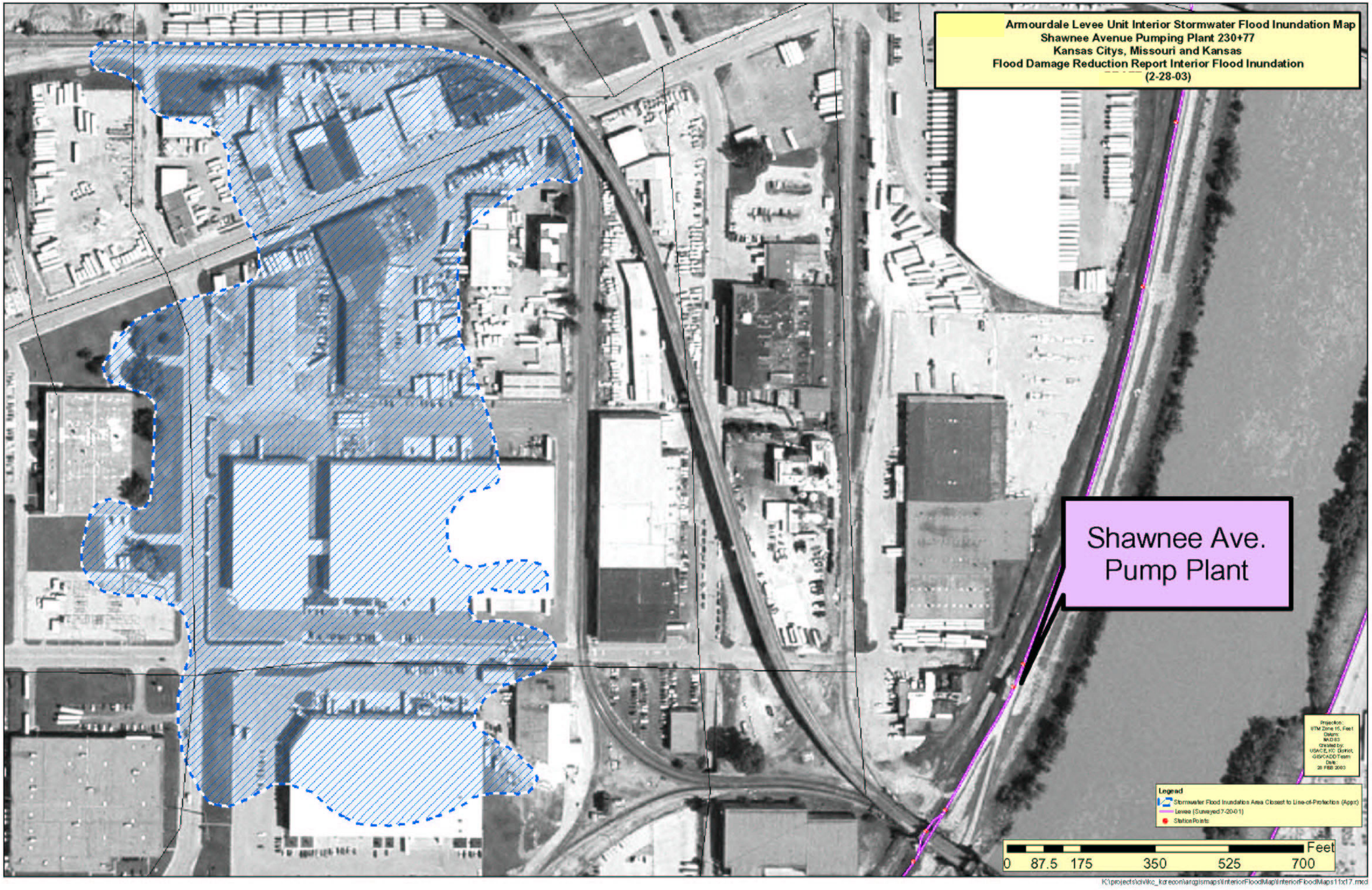


EXHIBIT A-2.71
Inundation Map for Splitlog Outfall

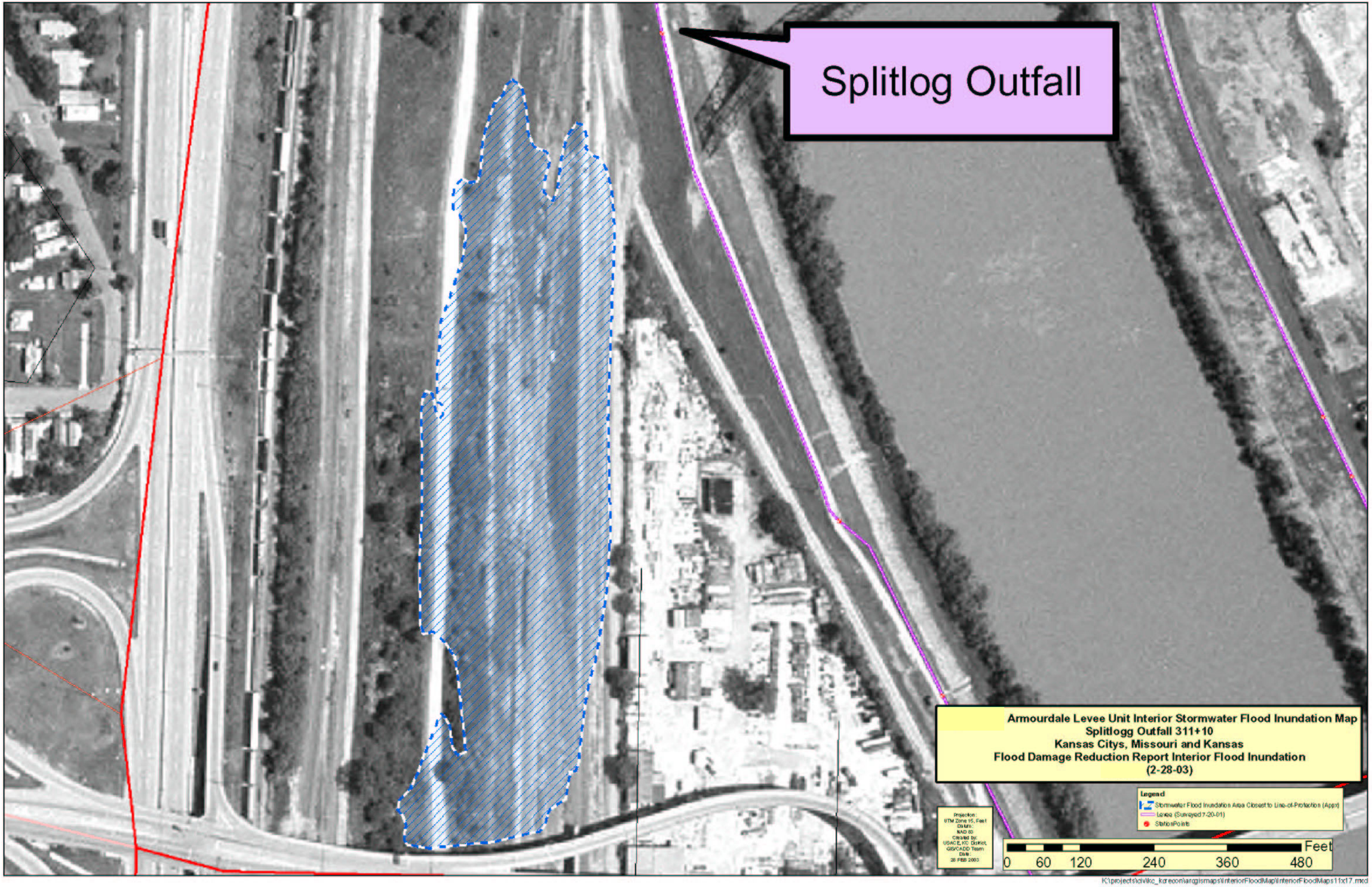


EXHIBIT A-2.72
Inundation Map for Ohio Avenue Pump Plant

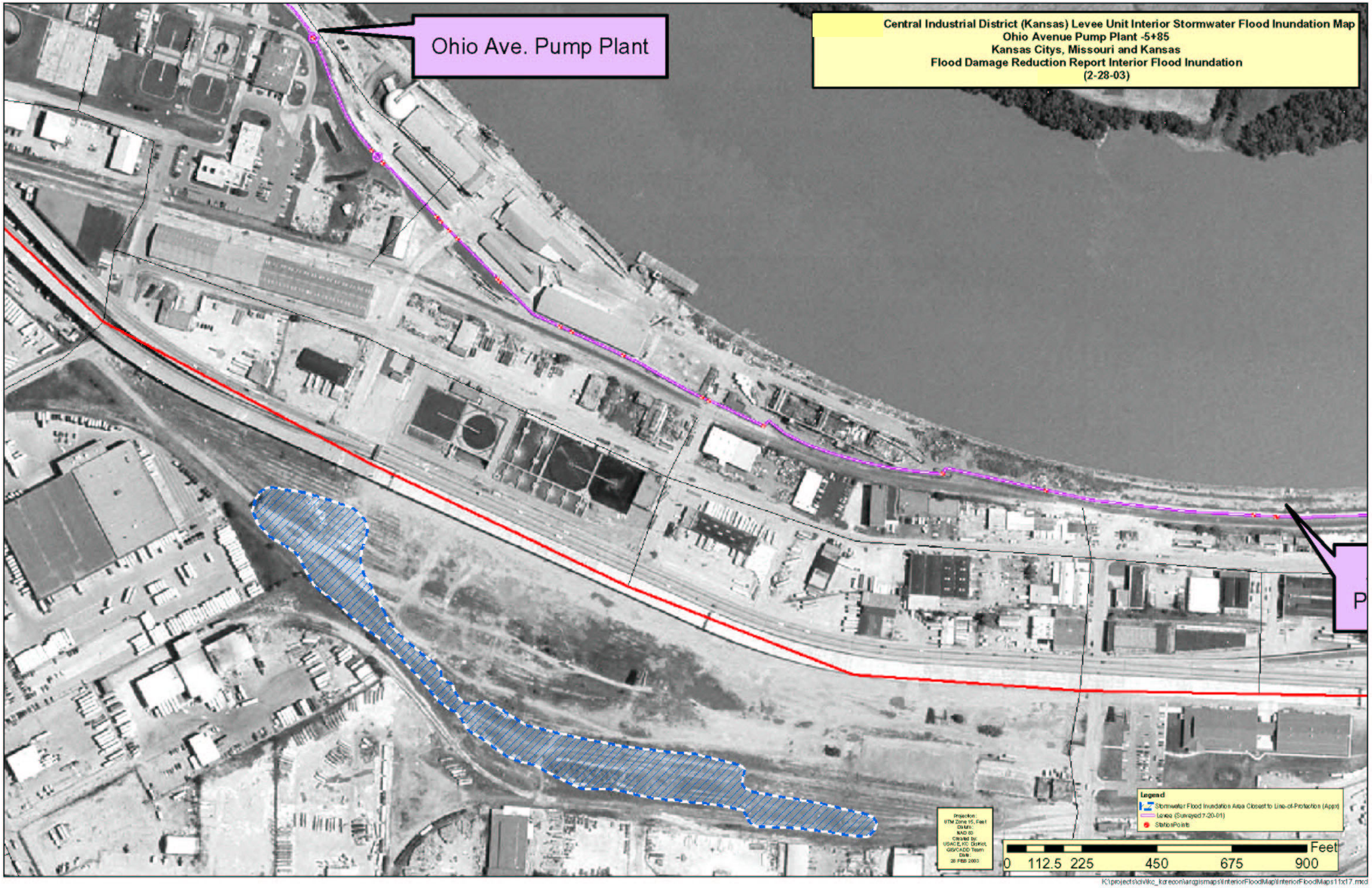


EXHIBIT A-2.73
Inundation Map for Milwaukee Pump Plant

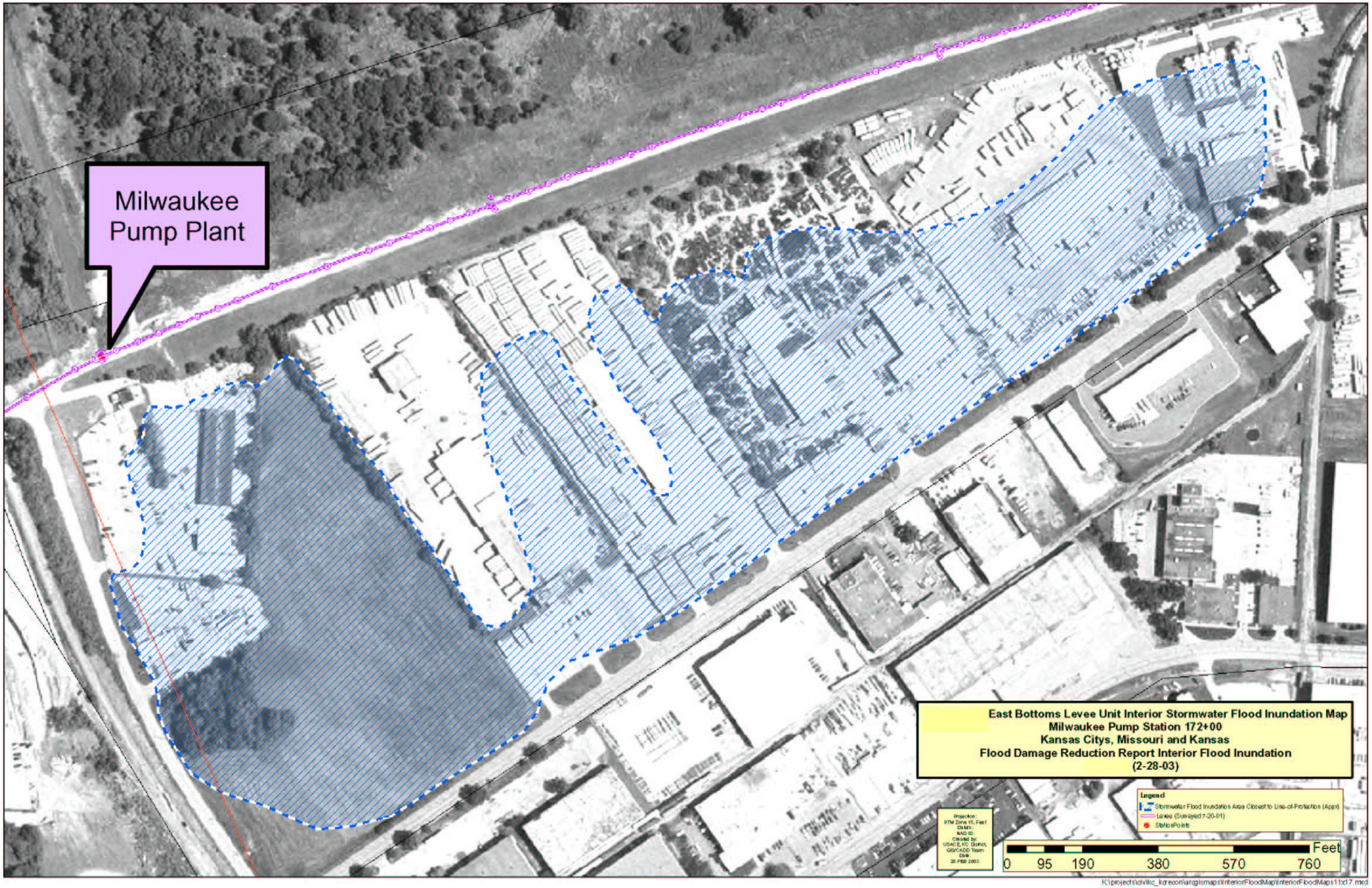


EXHIBIT A-2.74
Inundation Map for Hawthorne Pump Plant

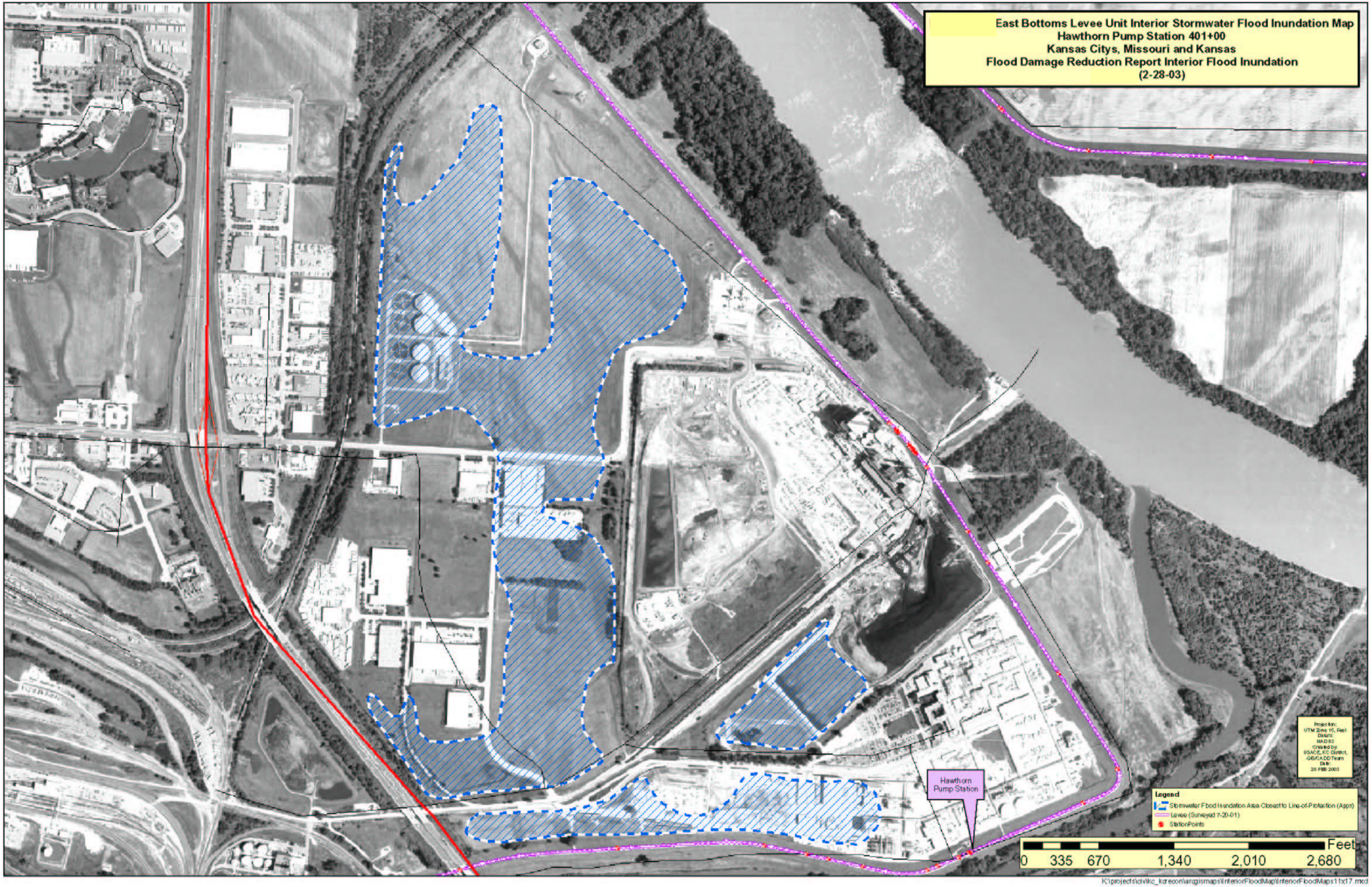


EXHIBIT A-2.75
Inundation Map for Prospect Avenue Pump Plant

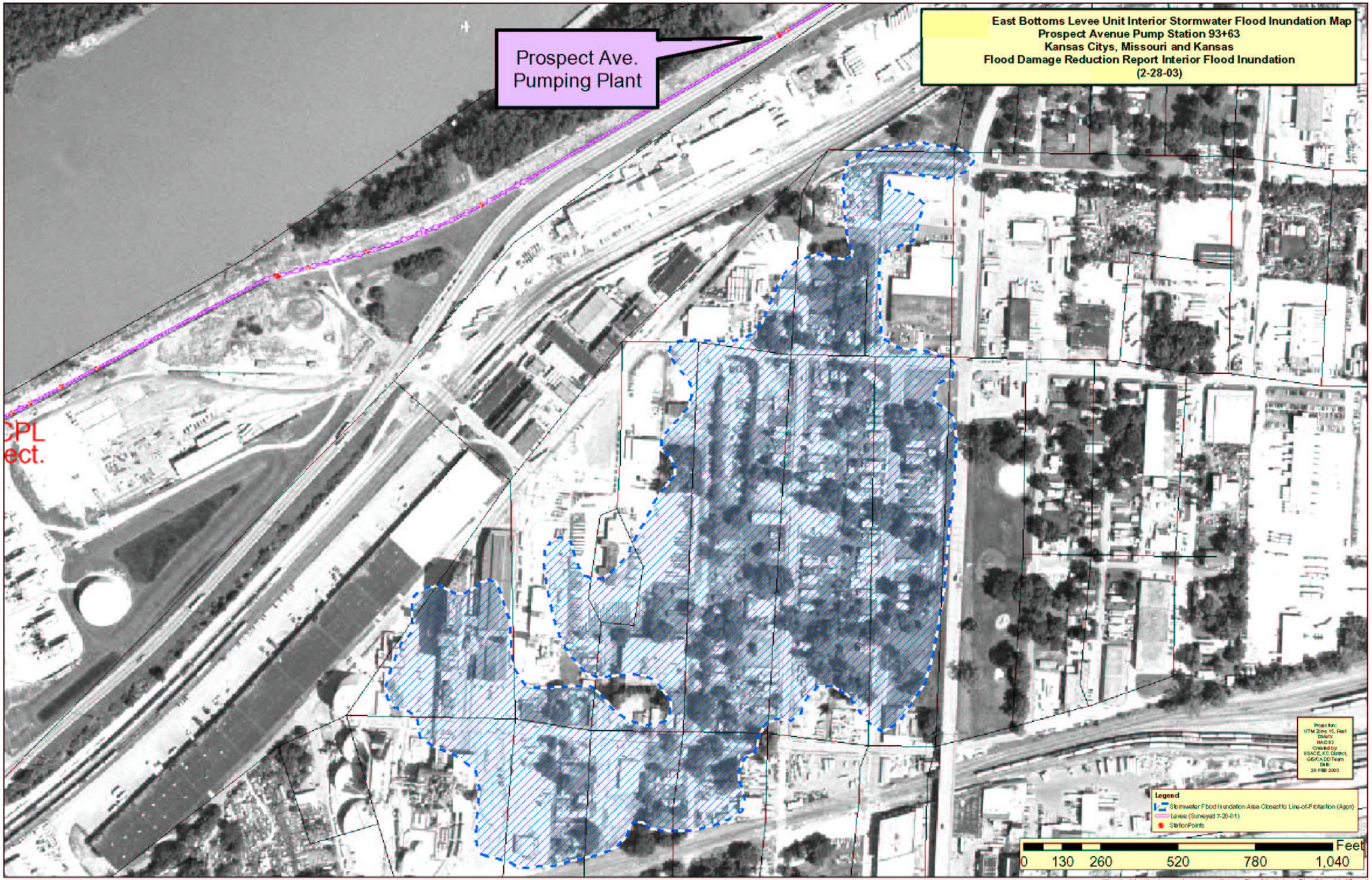


EXHIBIT A-2.76
Inundation Map for Birmingham Pump Plant

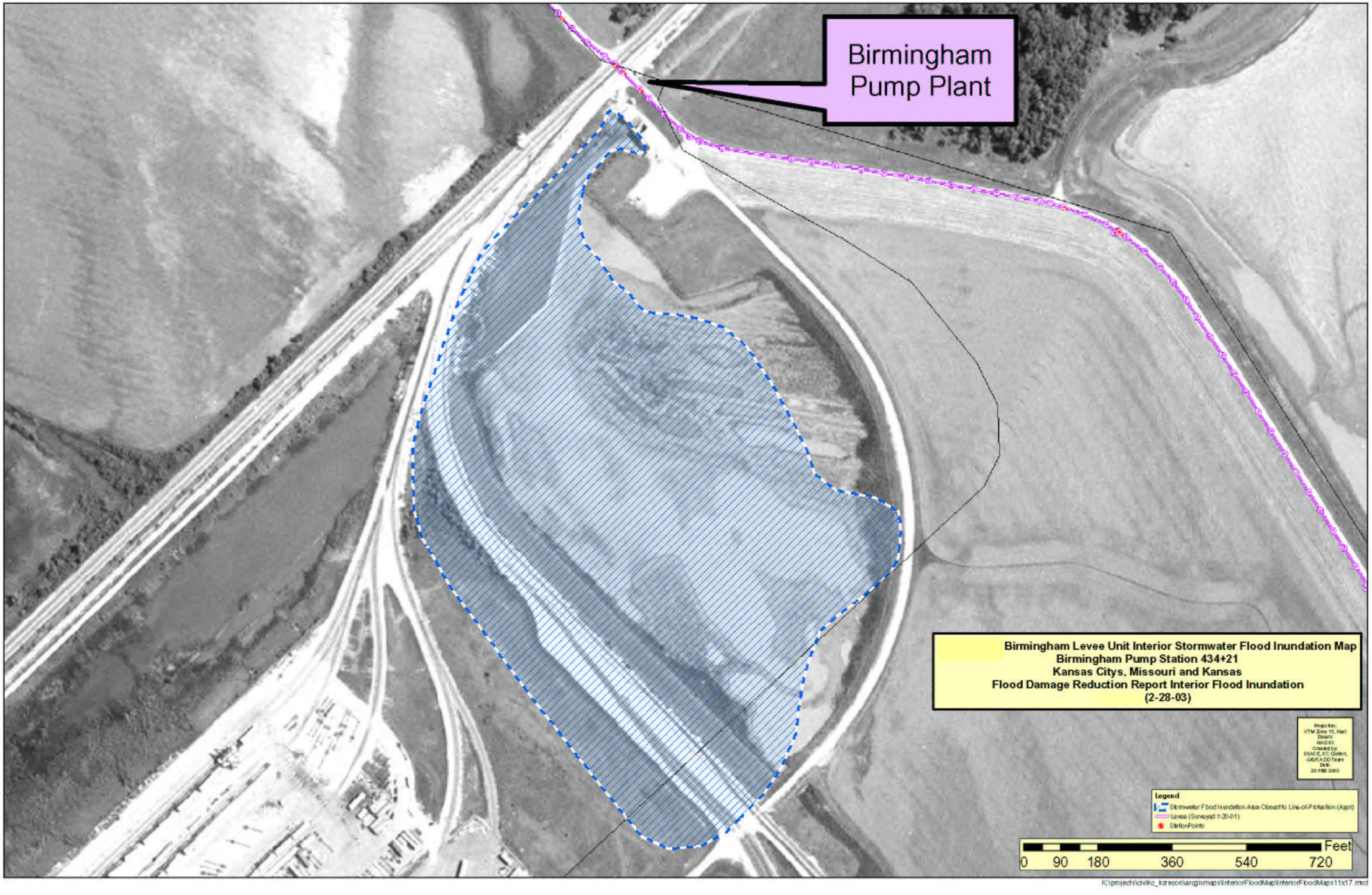


EXHIBIT A-2.77
Inundation Map for Rock Creek Pump Plant

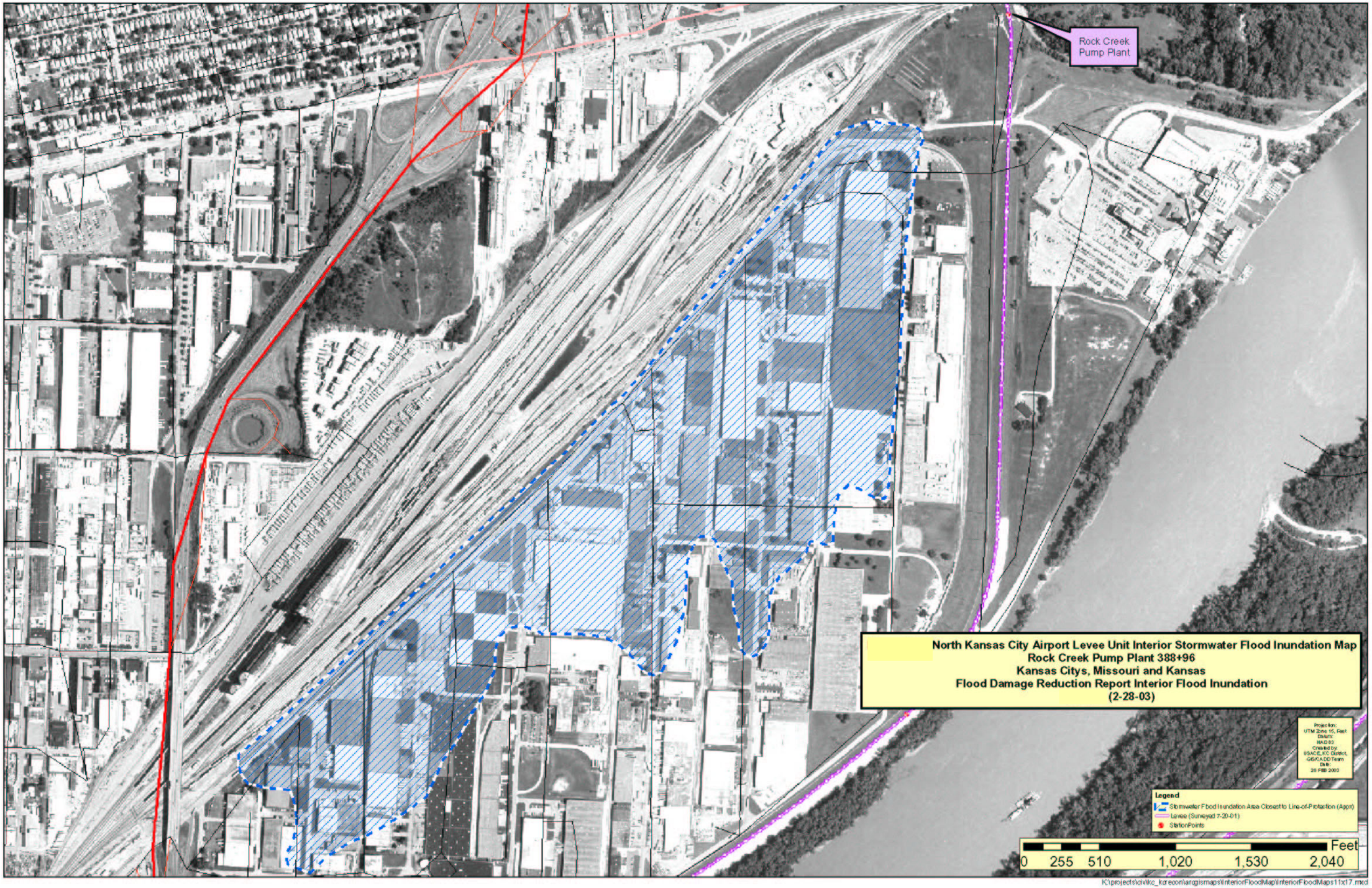


EXHIBIT A-2.78
Bridge Removals

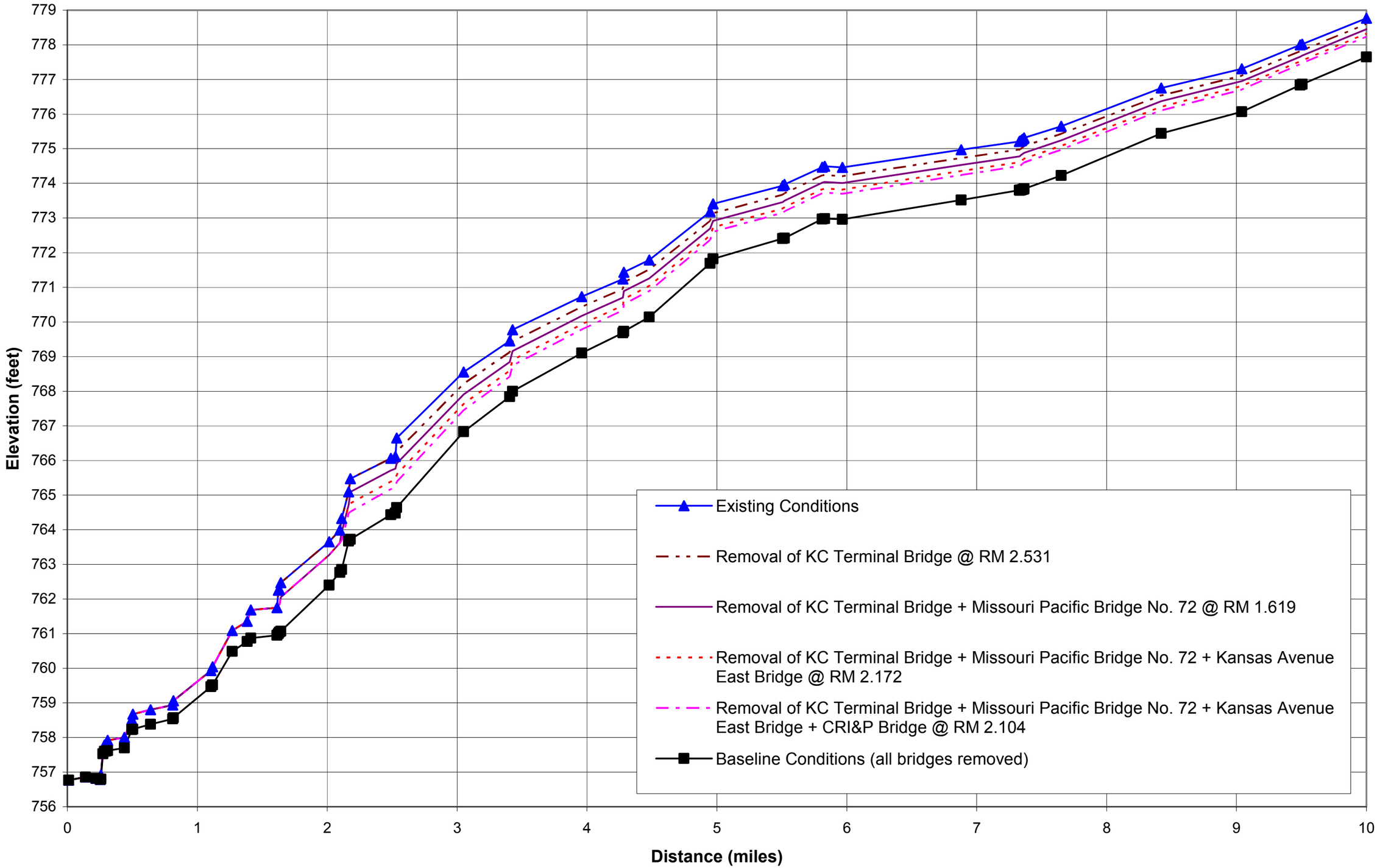


EXHIBIT A-2.79

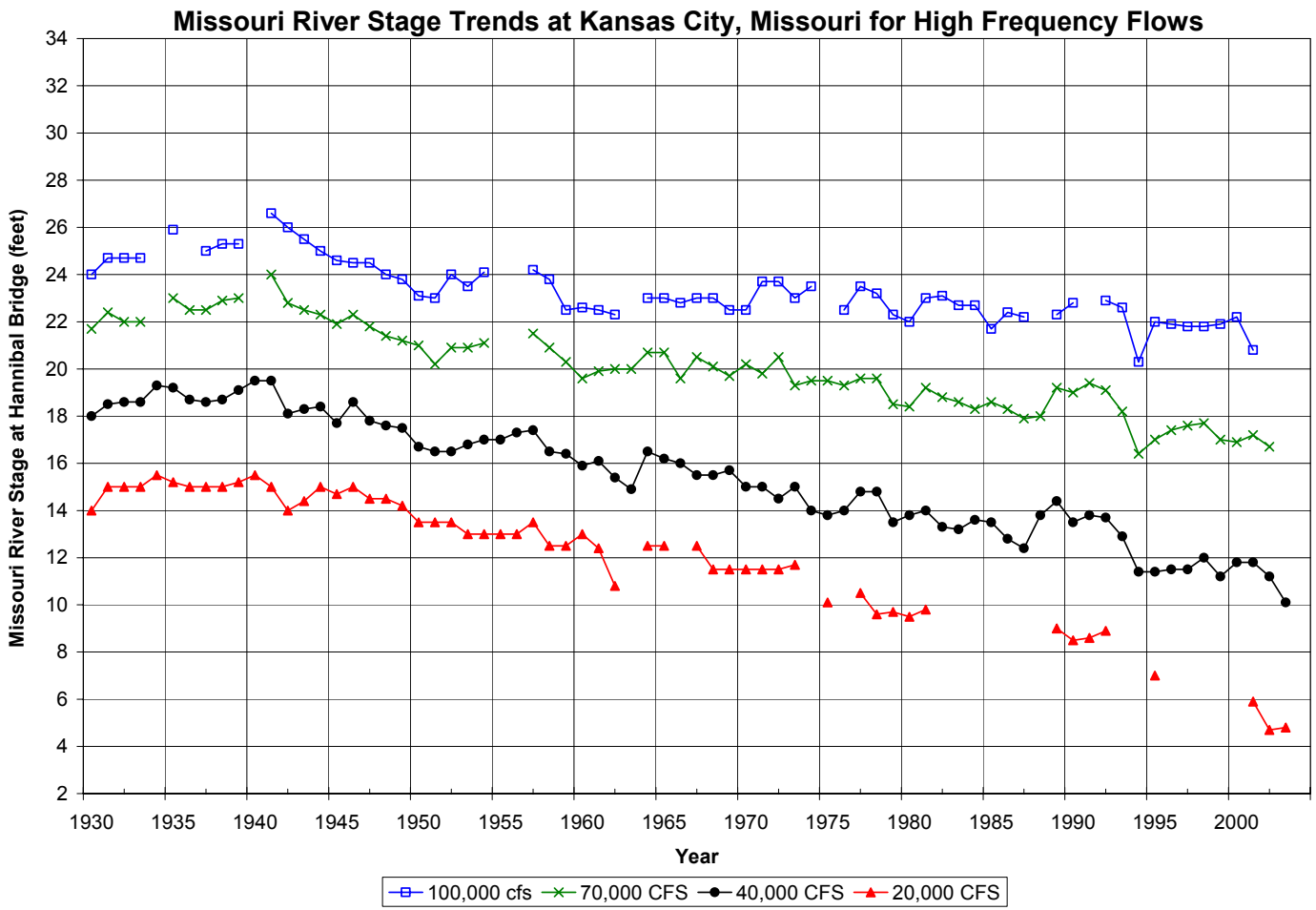


EXHIBIT A-2.80

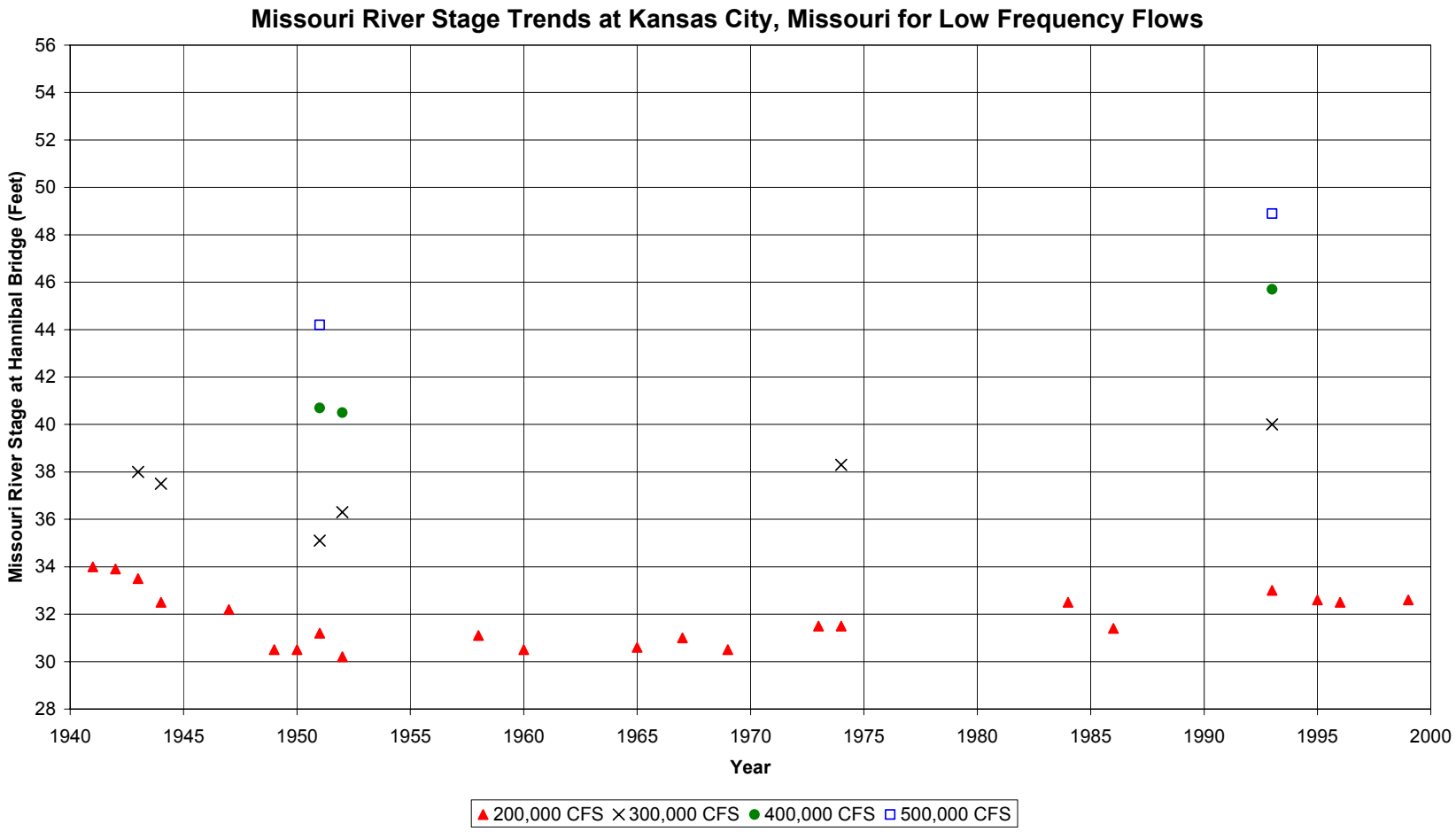


EXHIBIT A-2.81
Missouri River Near the Hannibal Bridge 1951, Kansas City, Missouri and Kansas

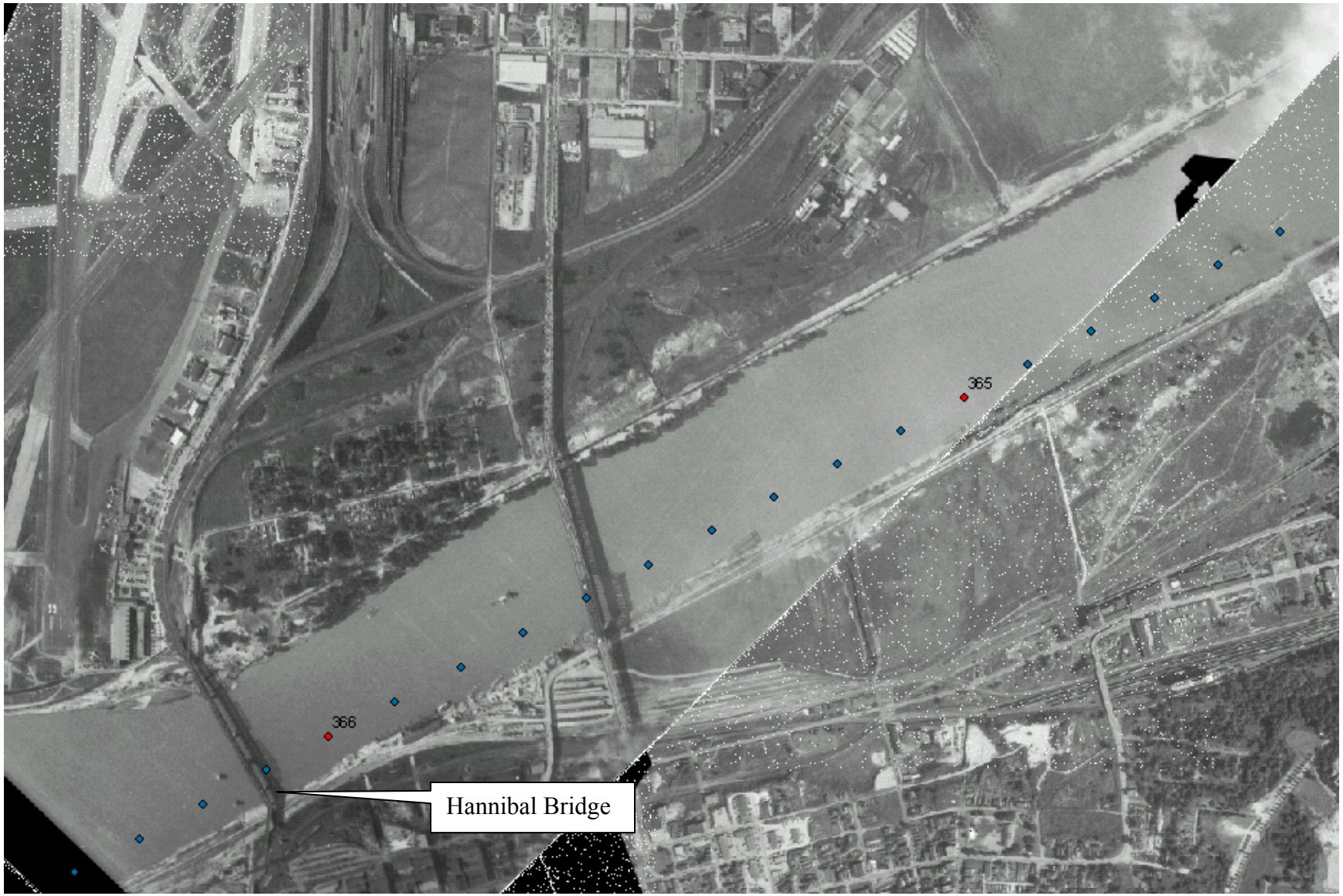


EXHIBIT A-2.82
Missouri River near the Hannibal Bridge 1998, Kansas City, Missouri and Kansas

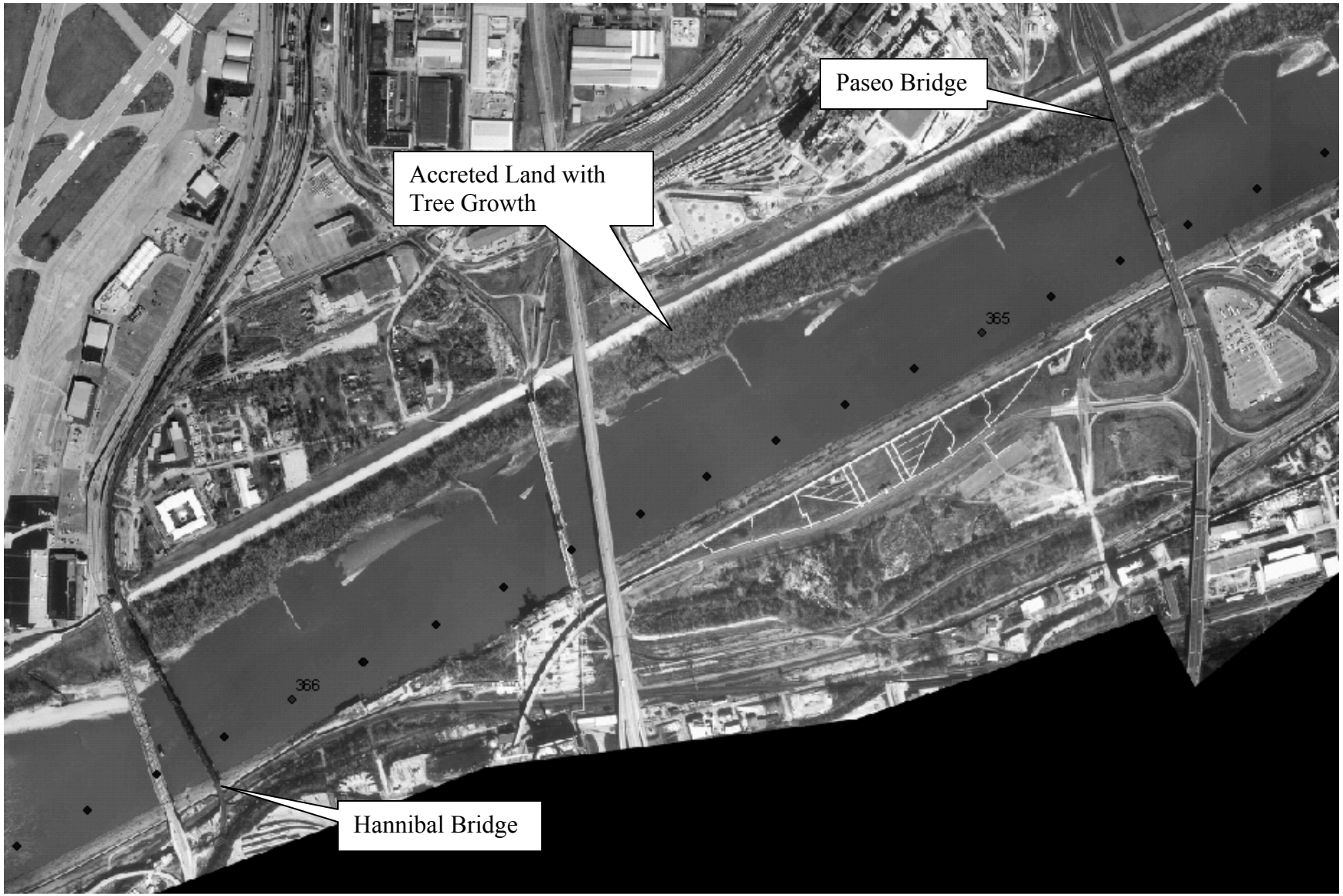
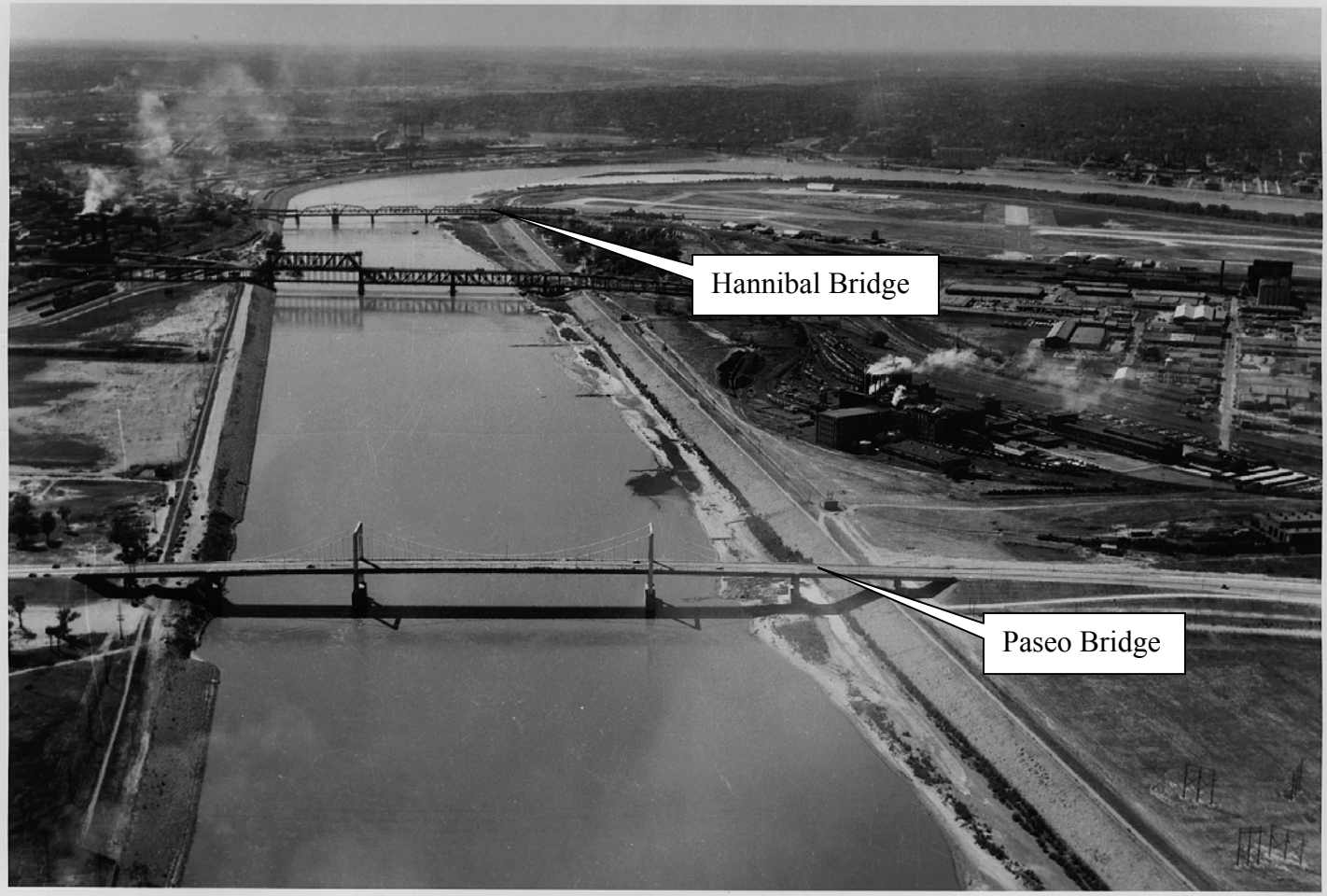


EXHIBIT A-2.83
Missouri River near the Hannibal Bridge 1954, Kansas City, Missouri and Kansas



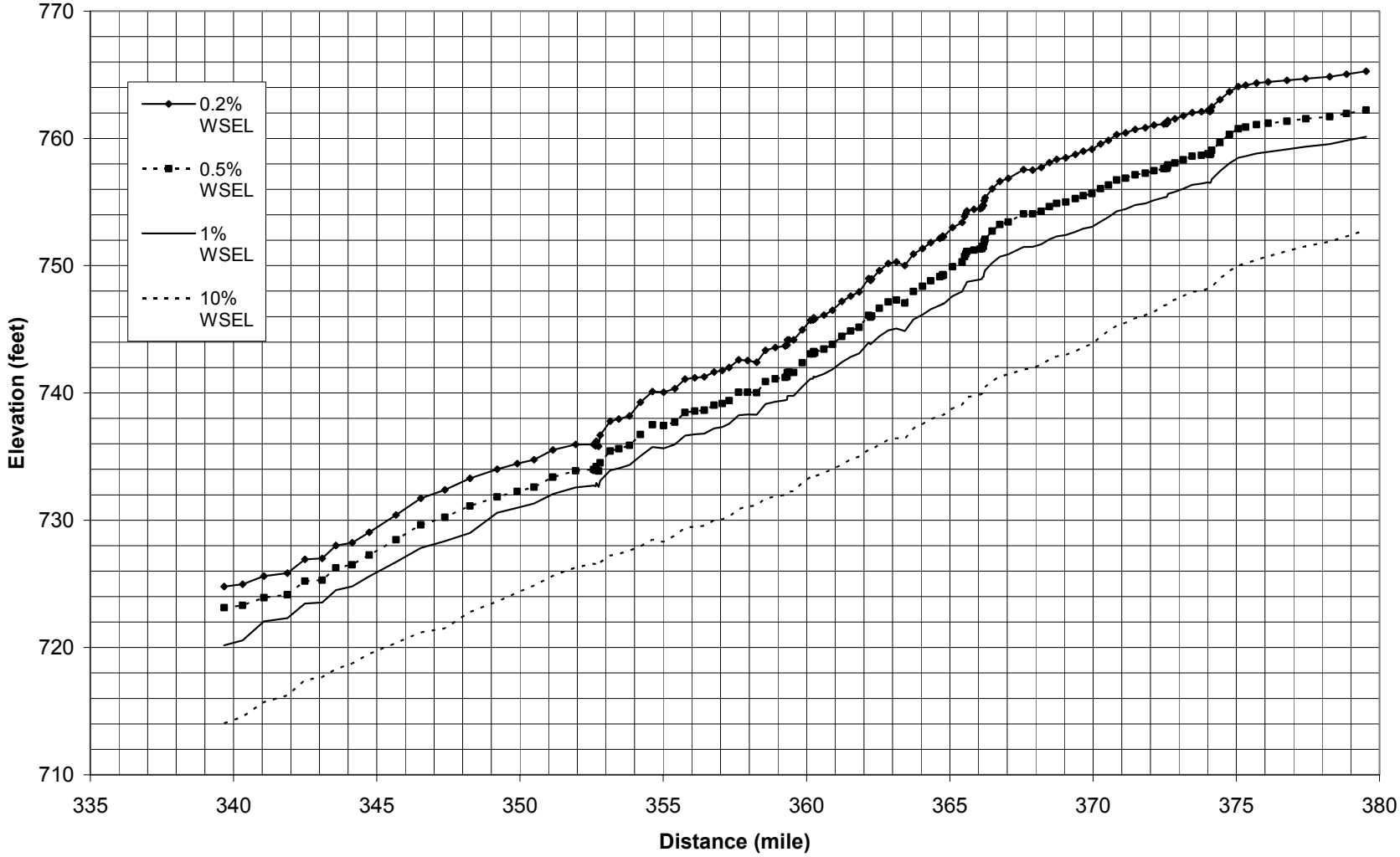
MISSOURI RIVER IMPROVEMENT
KANSAS CITY DISTRICT CHANNEL STABILIZATION AND NAVIGATION PROJECT KANSAS CITY, MISSOURI
AERIAL VIEW WEST (UPSTREAM) FROM APPROXIMATE RIVER MILE 376, SHOWING PORTION OF RIVER FROM KANSAS CITY REACH TO KANSAS RIVER BEND. LEVEE AND BANK PROTECTION ALONG LEFT BANK IN NORTH KANSAS CITY UNIT, LEVEE AND BANK PROTECTION ON RIGHT BANK IN EAST BOTTOMS UNIT. BRIDGES FROM BOTTOM UP ARE: NEW PASEO BRIDGE; (A.S.B.) HIGHWAY & RAILWAY BRIDGE AND C.B. & Q. R.R. (HANNIBAL) RAILWAY AND HIGHWAY BRIDGE. CONFLUENCE OF KANSAS AND MISSOURI RIVERS IN CENTER BACKGROUND.
23 SEPTEMBER 1954 NEG. NO. 61775

EXHIBIT A-2.84
Kansas River 1955, Kansas City, Missouri and Kansas

EXHIBIT A-2.85
Kansas River 1955, Kansas City, Missouri and Kansas

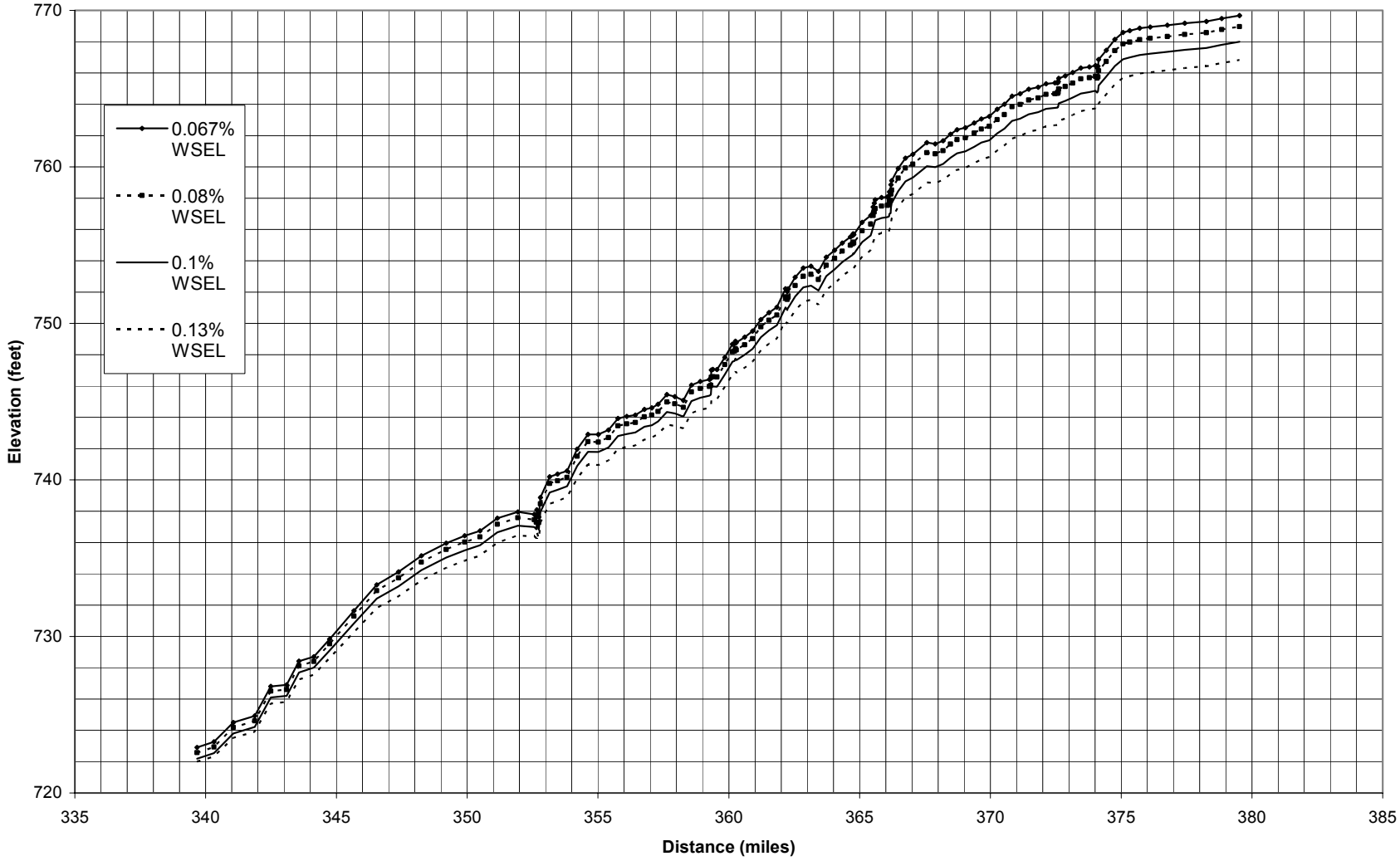
EXHIBIT A-2.86
Kansas River 1998, Kansas City, Missouri and Kansas

EXHIBIT A-2.87
Missouri River Future Conditions without Project Higher Probability Water Surface Profiles



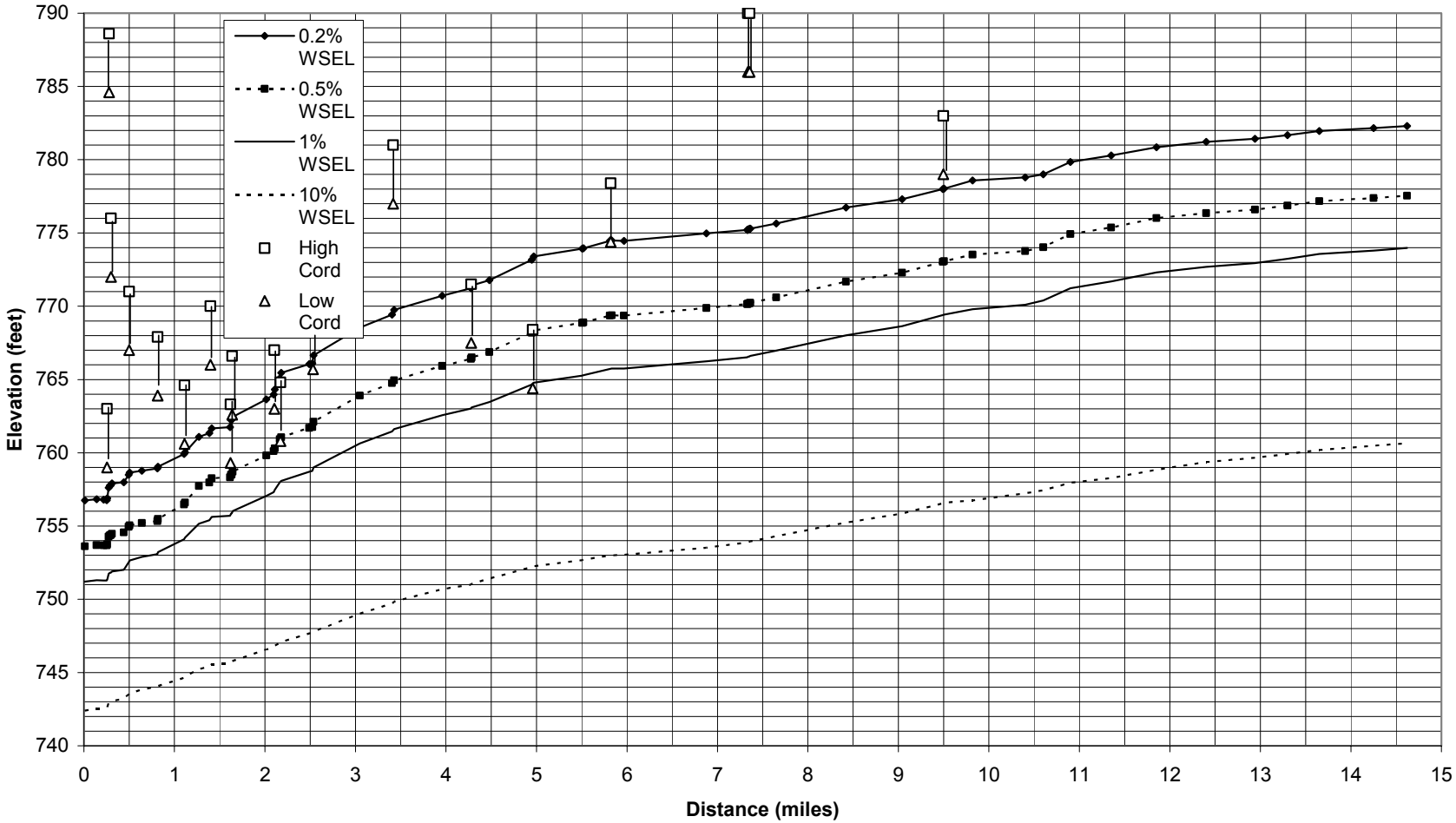
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.88
Missouri River Future Conditions without Project Lower Probability Water Surface Profiles



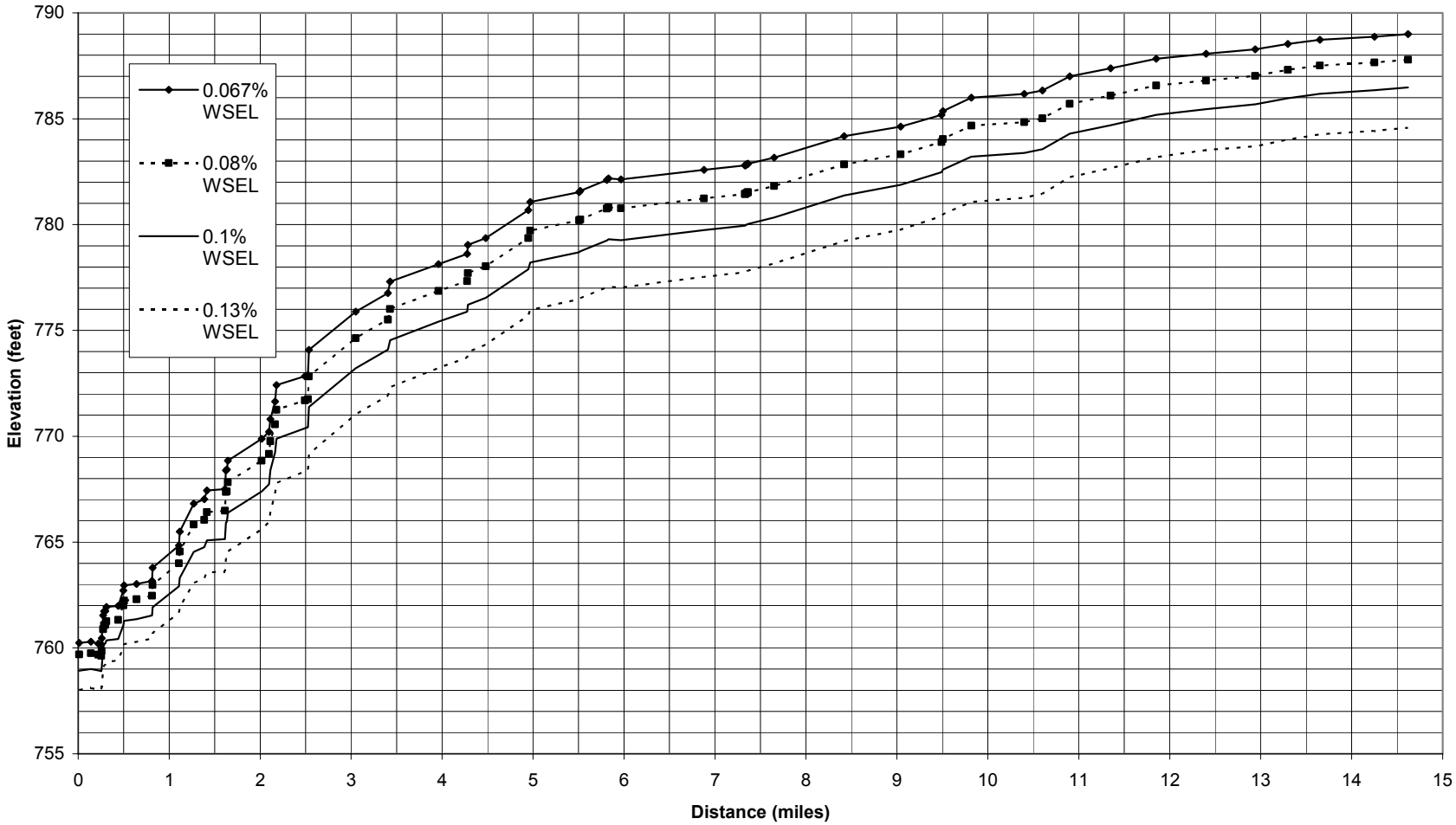
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.89
Kansas River Future Conditions without Project Higher Probability Water Surface Profiles



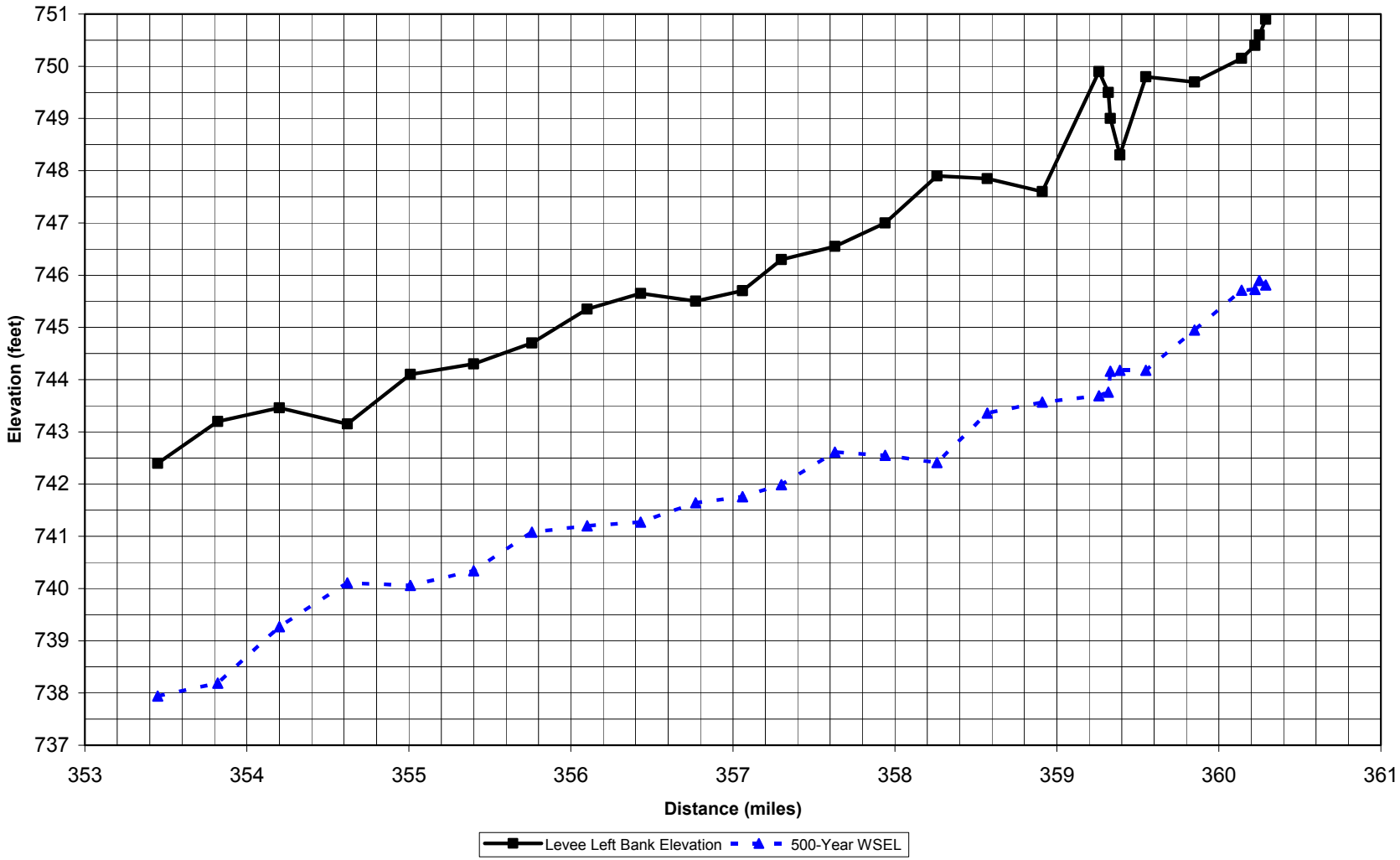
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.90
Kansas River Future Conditions without Project Lower Probability Water Surface Profiles



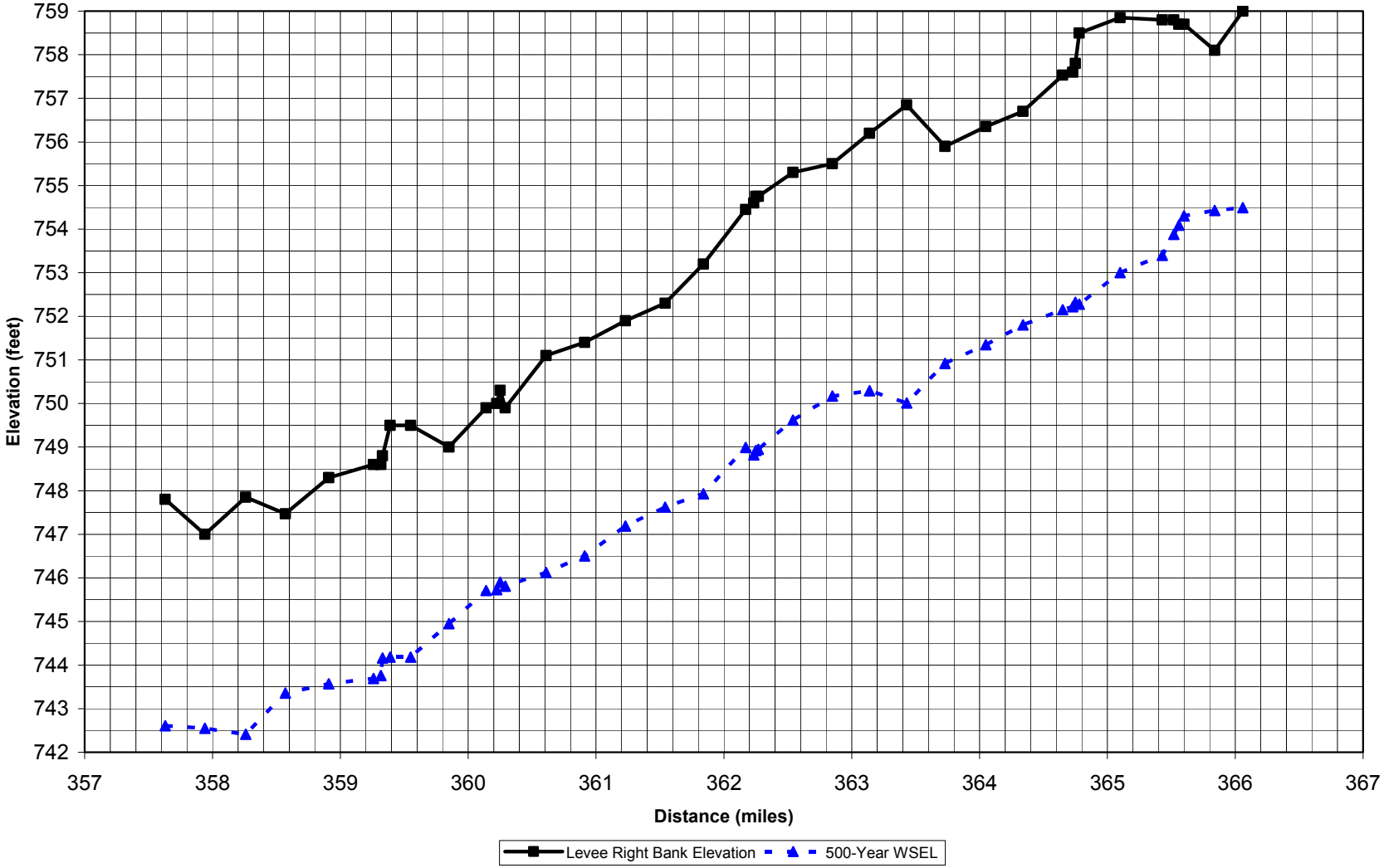
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.91
Birmingham Levee Unit Future Conditions Without Project 0.2% (500-Year)
Chance of Exceedance Water Surface Profile



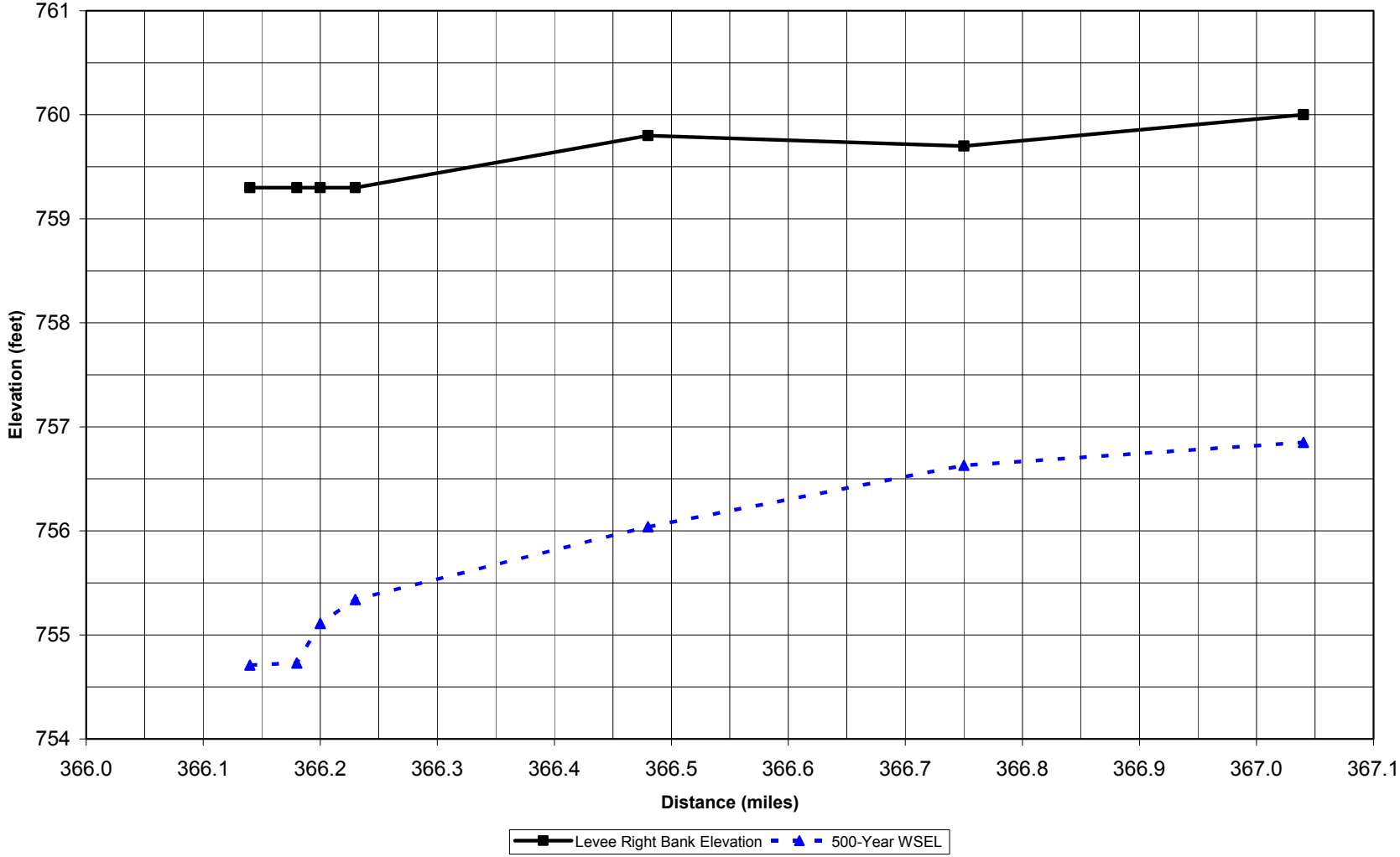
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.92
East Bottoms Levee Unit Future Conditions Without Project 0.2% (500-Year)
Chance of Exceedance Water Surface Profile



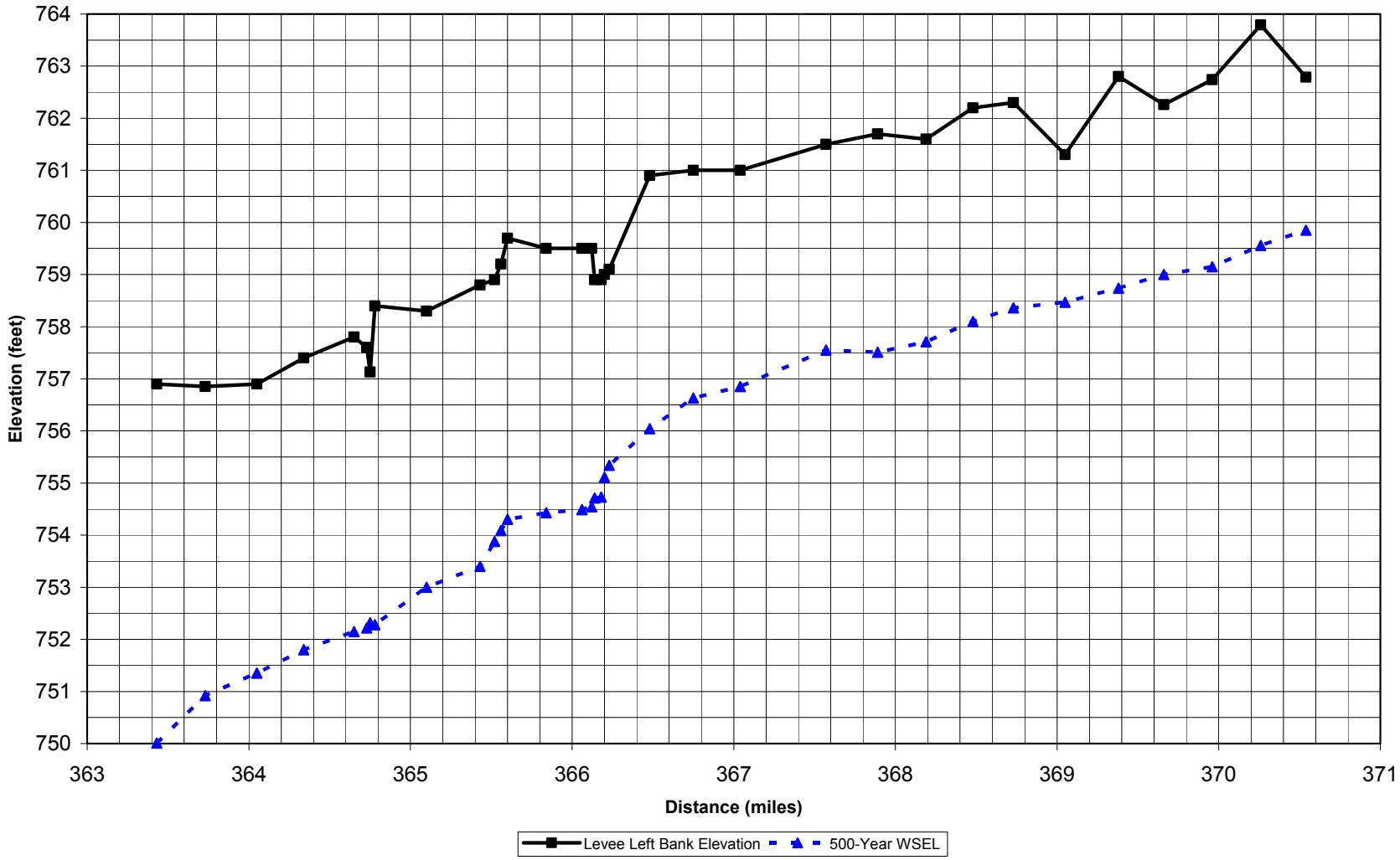
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.93
Central Industrial District (Missouri) Future Conditions Without Project 0.2% (500-Year) Chance of Exceedance Water Surface Profile



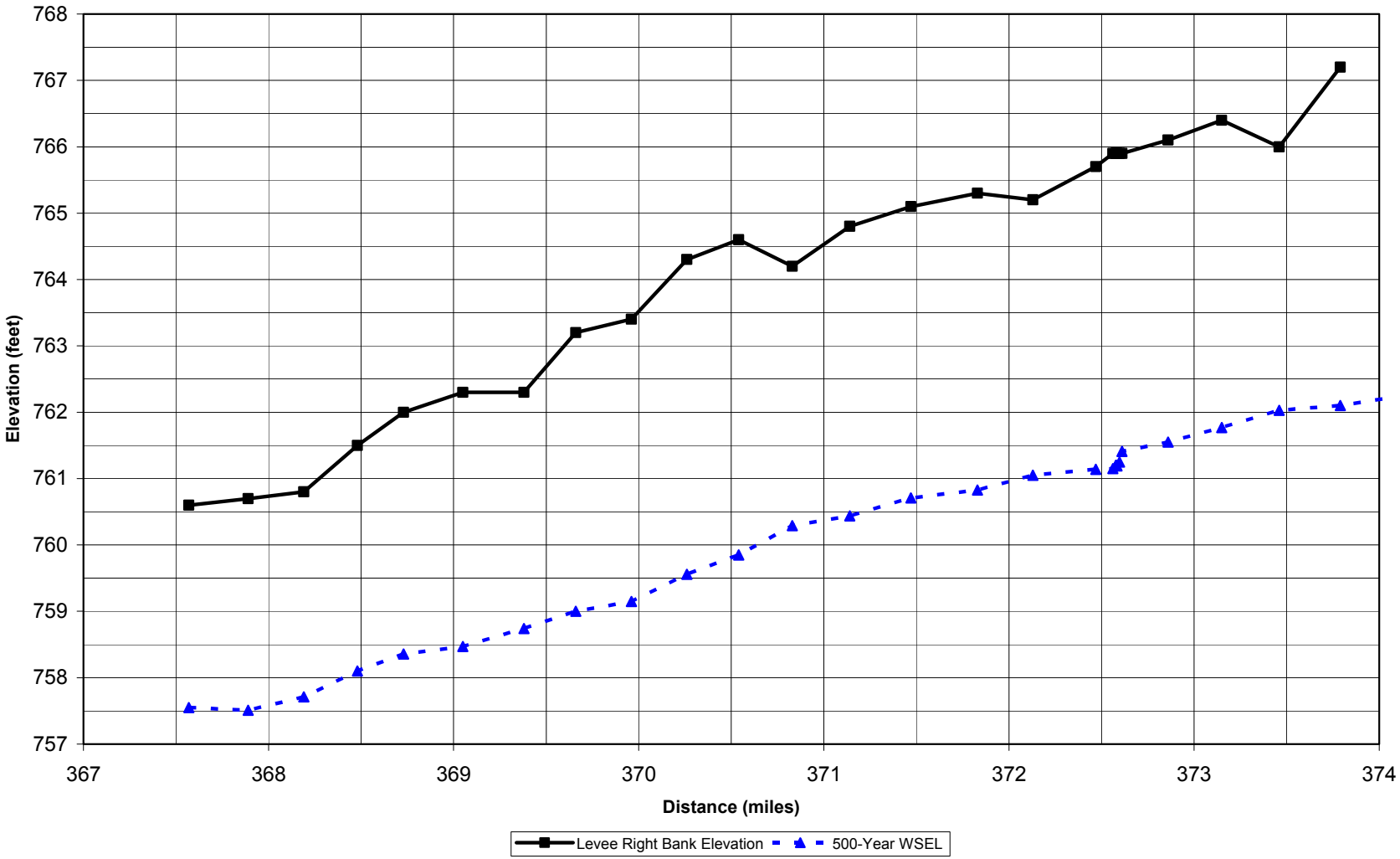
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.94
North Kansas City Airport Levee Unit Future Conditions Without Project 0.2% (500-Year) Chance of Exceedance Water Surface Profile



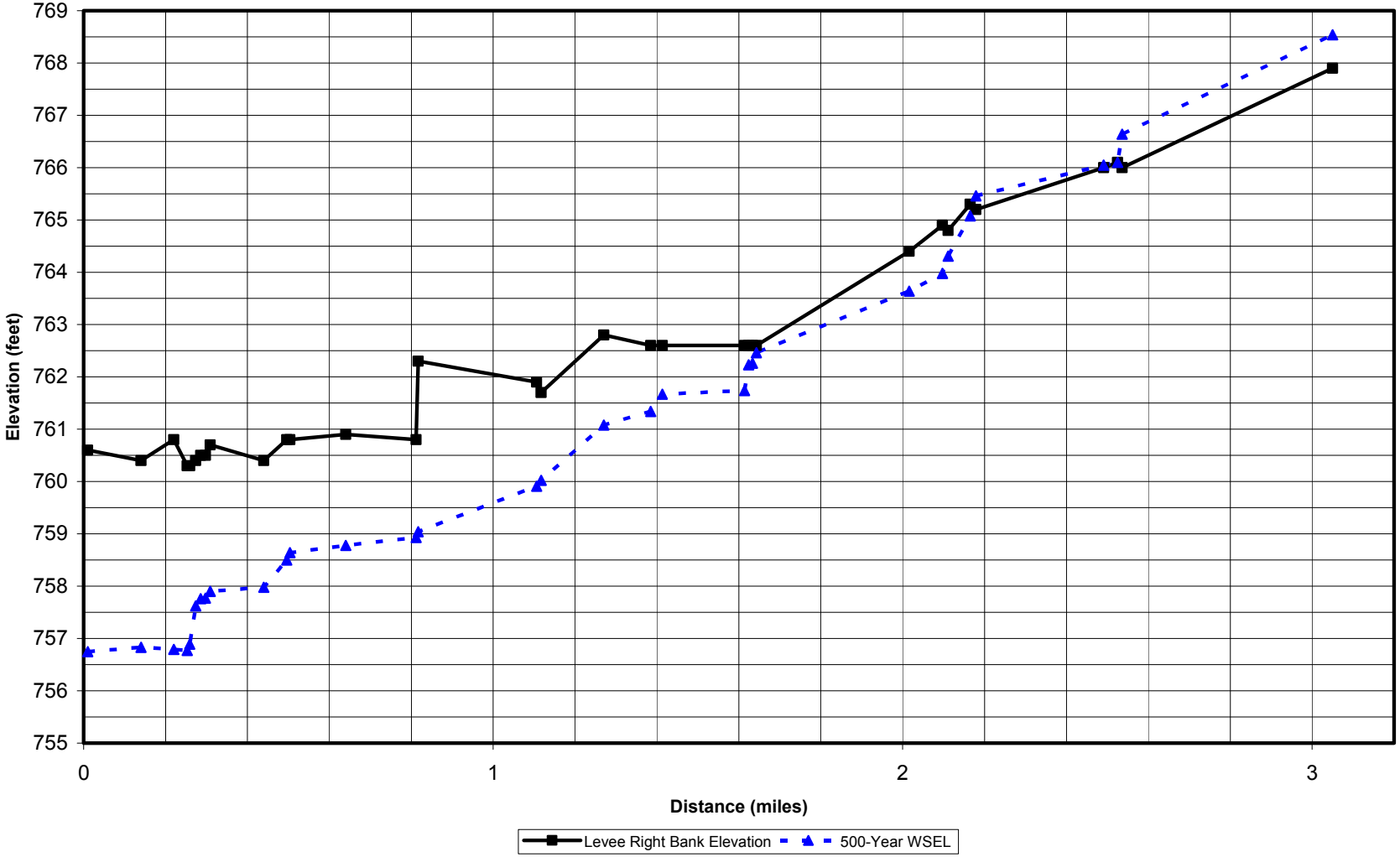
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.95
Fairfax-Jersey Creek Levee Unit Future Conditions Without Project 0.2% (500-Year)
Chance of Exceedance Water Surface Profile



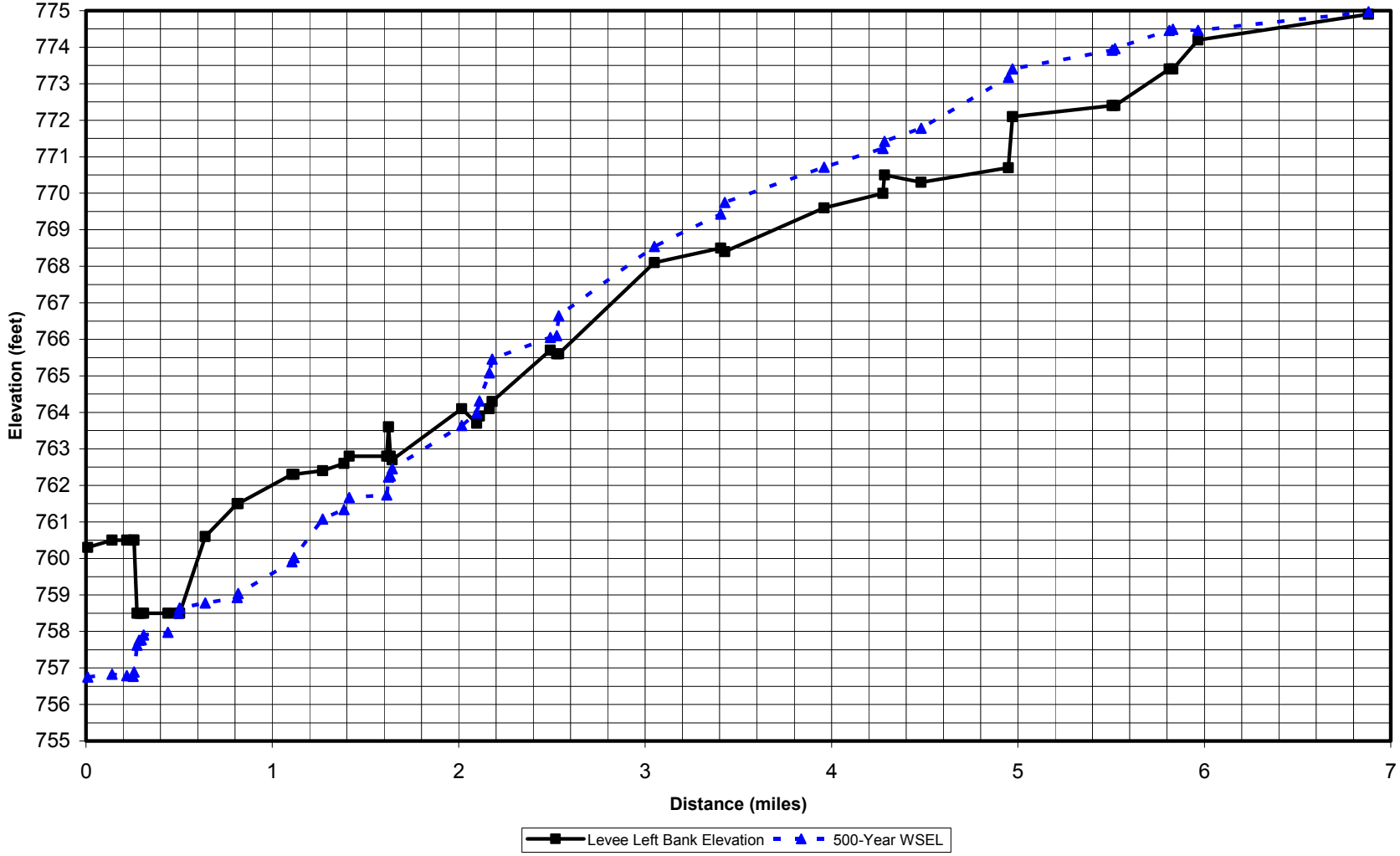
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.96
Central Industrial District (Kansas) Future Conditions Without Project 0.2% (500-Year) Chance of Exceedance Water Surface Profile



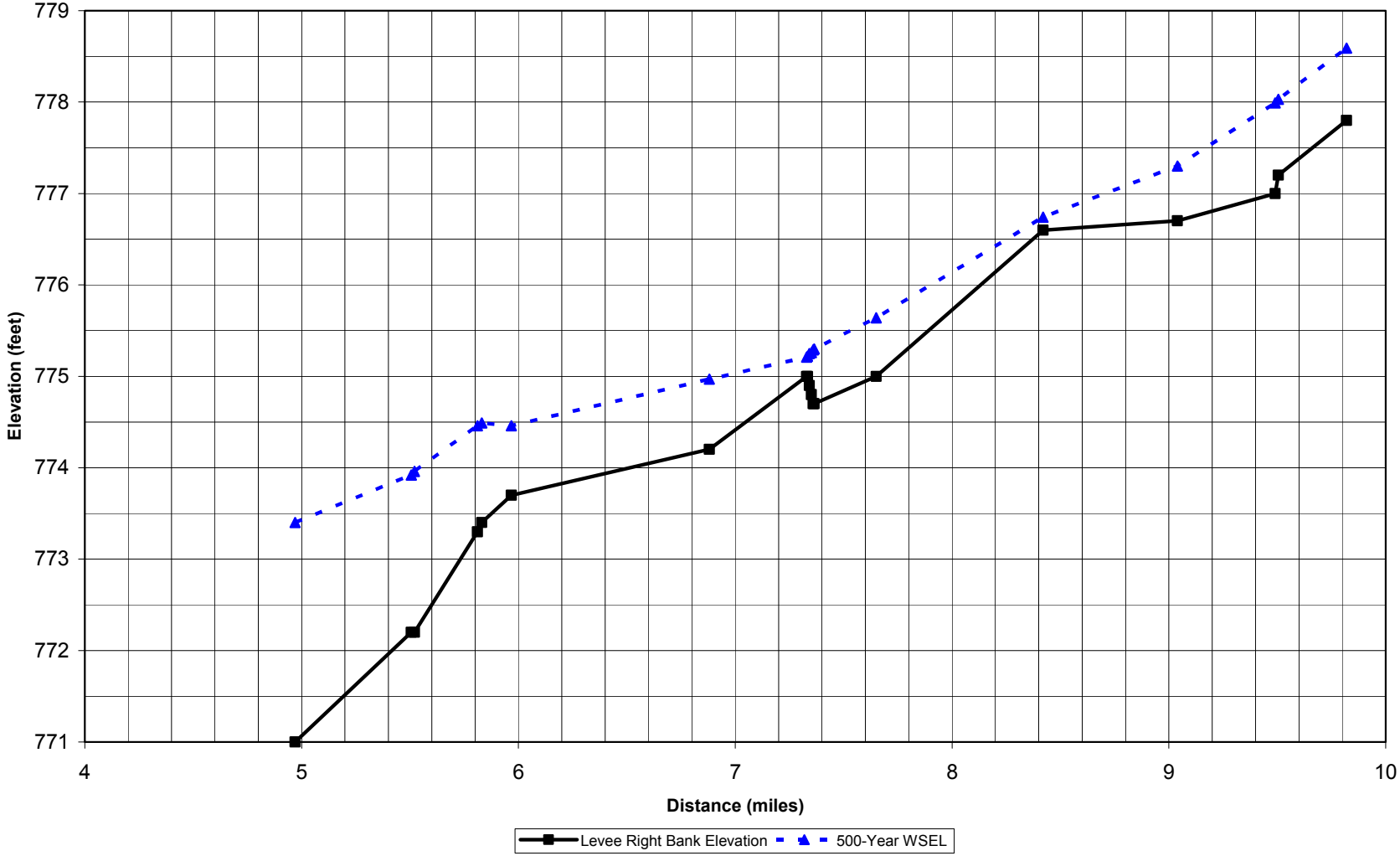
Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.97
Amourdale Levee Unit Future Conditions Without Project 0.2% (500-Year)
Chance of Exceedance Water Surface Profile



Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.98
Argentine Levee Unit Future Conditions Without Project 0.2% (500-Year)
Chance of Exceedance Water Surface Profile



Designed By: EDS
Checked By: GRL
8/19/2004

EXHIBIT A-2.99
Hawthorne Pumping Plant Tributary Area
From 2000 DRG Bayer Site Drainage Study

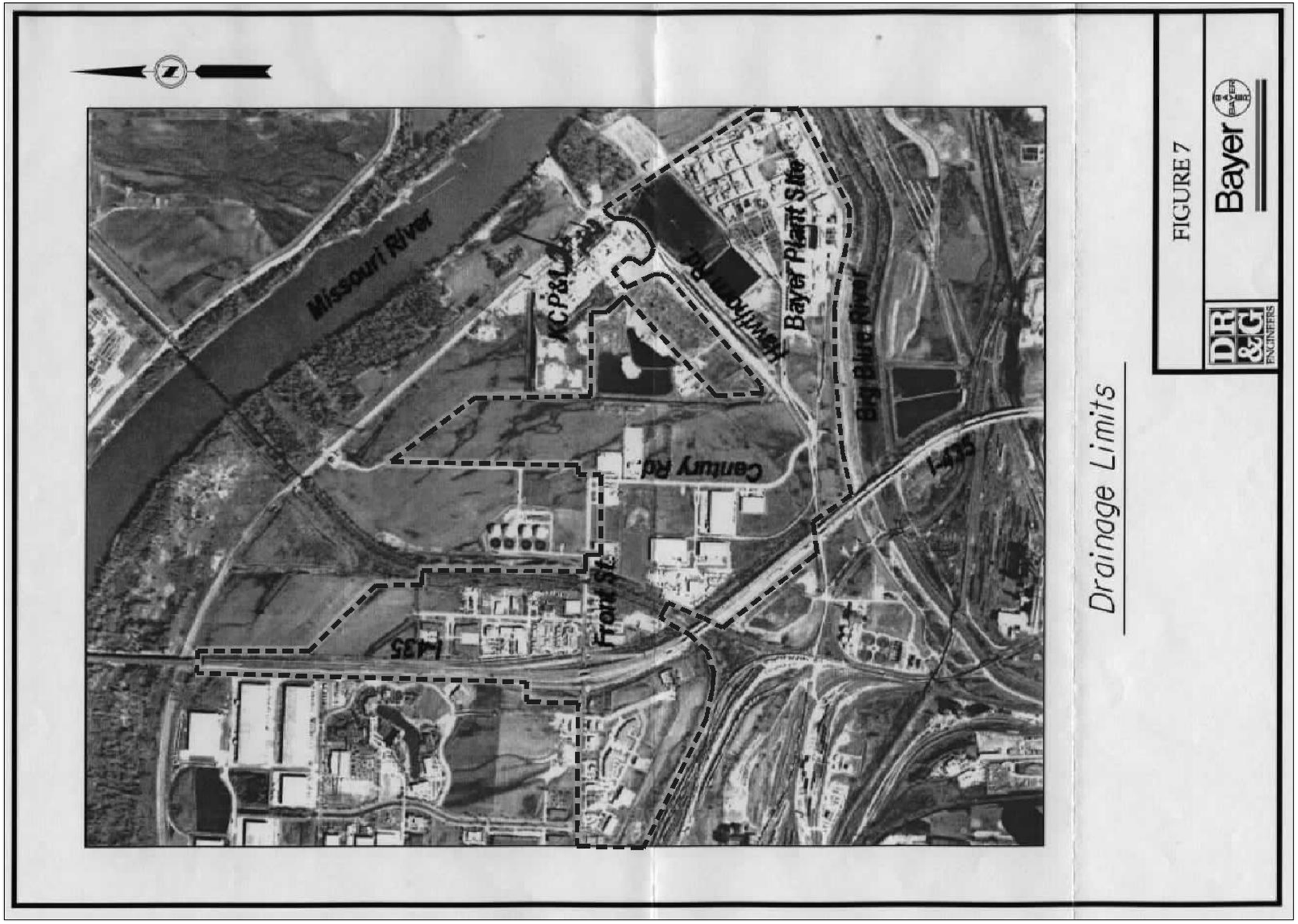


EXHIBIT A-2.100
Hawthorne Pumping Plant Tributary Area
From 1948 East Bottoms Unit Supplement on Interior Drainage

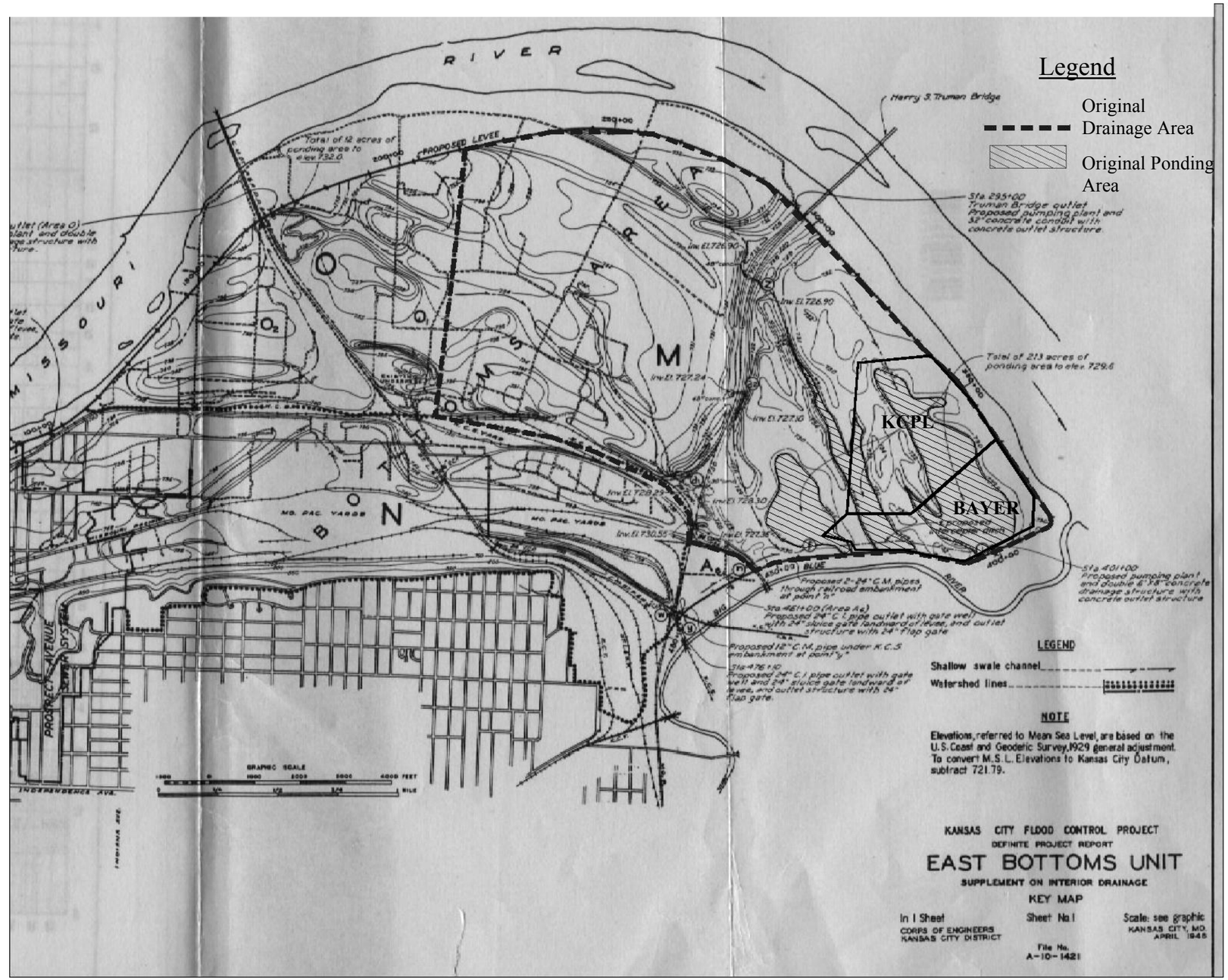


EXHIBIT A-2.101
Kansas River Future Conditions with Tree Removal
0.2% (500-year) Chance of Exceedance Water Surface Profiles

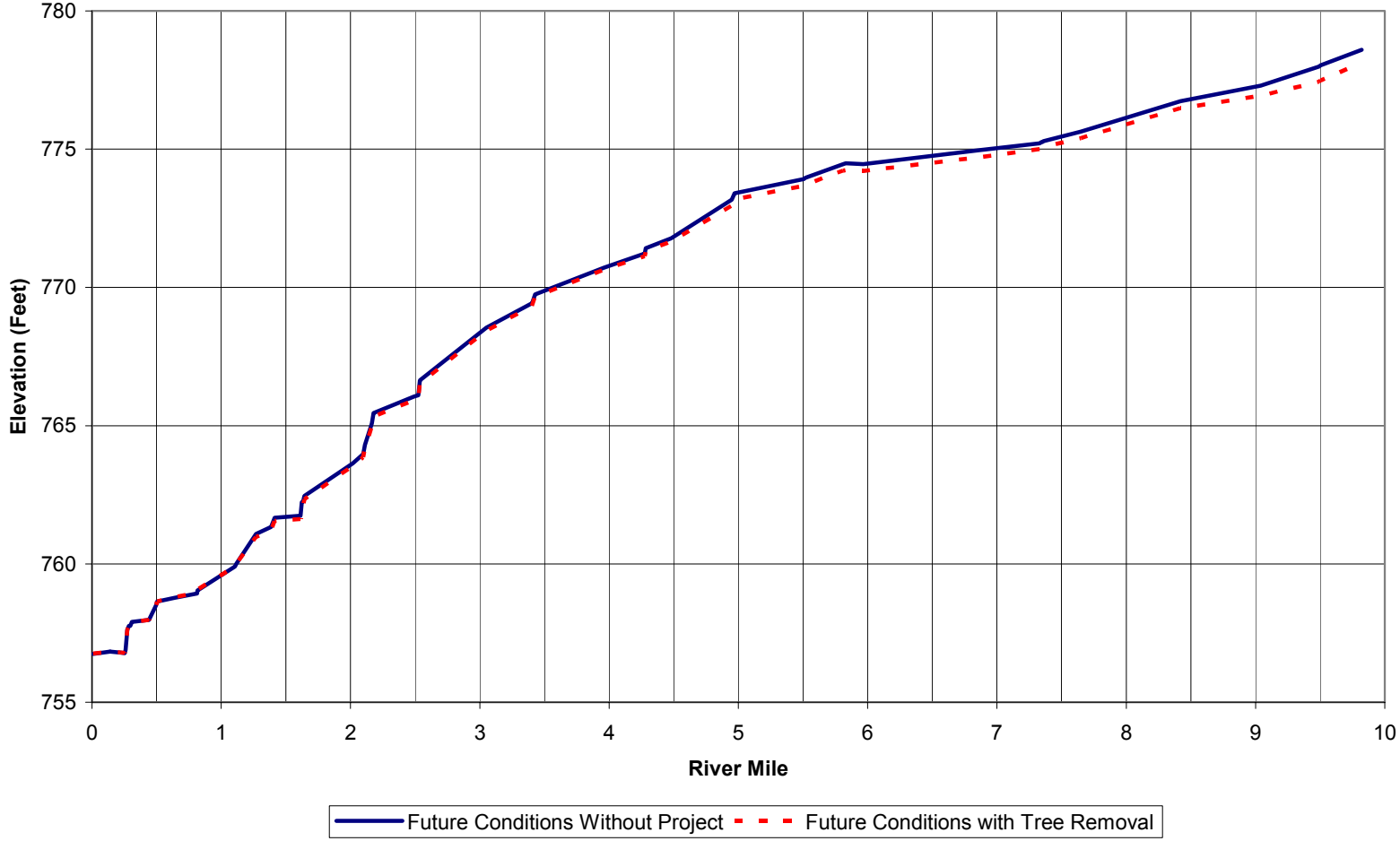


EXHIBIT A-2.102
Kansas River Future Conditions with Tree Removal and Channel Modification
0.2% (500-year) Chance of Exceedance Water Surface Profiles

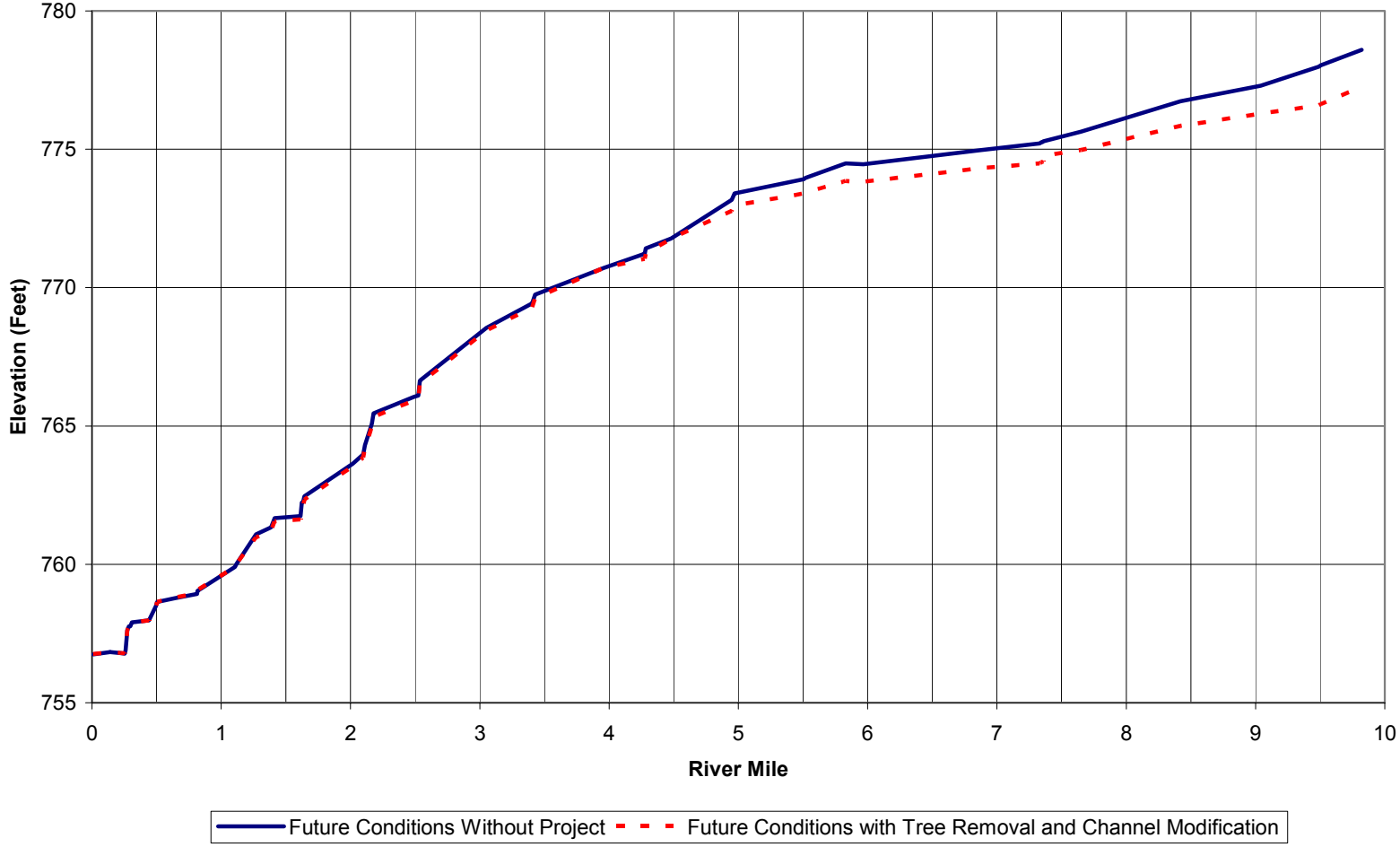


EXHIBIT A-2.103

Summary of Bridges and Sources of Bridge Drawings

River	Bridge	HEC-RAS River Mile	Drawing Source
Kansas	Kansas Avenue West	9.498	State of Kansas DOT
Kansas	I-635 (southbound)	7.355	State of Kansas DOT
Kansas	I-635 (northbound)	7.338	State of Kansas DOT
Kansas	Kansas Avenue	5.821	Kansas City, KS Unified Gov.
Kansas	18th Street	4.960	State of Kansas DOT
Kansas	12th Street	4.280	Kansas City, KS Unified Gov.
Kansas	7th Street	3.416	Kansas City, KS Unified Gov.
Kansas	KC Terminal	2.531	TranSystems Corp. Files
Kansas	Kansas Avenue East	2.172	Kansas City, KS Unified Gov.
Kansas	CRI&P	2.104	Not Available
Kansas	Union Pacific No. 3	1.638	Union Pacific Railroad
Kansas	Missouri Pacific No. 72	1.619	Union Pacific Railroad
Kansas	I-670	1.399	State of Kansas DOT
Kansas	Central Avenue	1.112	Kansas City, KS Unified Gov.
Kansas	KC Southern	0.815	KC Southern Railroad
Kansas	James Street	0.500	Kansas City, KS Unified Gov.
Kansas	I-70 (eastbound)	0.309	State of Kansas DOT
Kansas	I-70 (westbound)	0.280	State of Kansas DOT
Kansas	Missouri Pacific No. 1	0.256	Union Pacific Railroad
Missouri	I-635	374.087	State of Missouri DOT
Missouri	Fairfax (southbound)	372.585	Platte County, Missouri
Missouri	Fairfax (northbound)	372.567	Platte County, Missouri
Missouri	Broadway	366.183	State of Missouri DOT
Missouri	Hannibal	366.124	HNTB Corporation Files
Missouri	ASB Bridge	365.570	HNTB Corporation Files
Missouri	Heart of America	365.530	State of Missouri DOT
Missouri	Paseo	364.734	State of Missouri DOT
Missouri	Old & New Chouteau	362.240	Harrington & Cortelyou, Inc. Files
Missouri	I-435	360.229	State of Missouri DOT
Missouri	Truman Lift Bridge	359.324	HNTB Corporation Files
Missouri	Liberty Bend	352.647	State of Missouri DOT

Note:
The bridge characteristics for the CRI&P bridge were obtained by field survey

EXHIBIT A-2.104

Summary of Surveyed Top-of-Levee Elevations

Summary of Surveyed Top-of-Levee Elevations

River - Reach	HEC-RAS River Mile	Levee Name Left Bank	Top of Levee Elevation (feet) Left Bank	Levee Name Right Bank	Top of Levee Elevation (feet) Right Bank
Missouri - Lower	353.15	Birmingham	740.05		
Missouri - Lower	353.45	Birmingham	742.4		
Missouri - Lower	353.82	Birmingham	743.2		
Missouri - Lower	354.2	Birmingham	743.46		
Missouri - Lower	354.62	Birmingham	743.15		
Missouri - Lower	355.01	Birmingham	744.1		
Missouri - Lower	355.4	Birmingham	744.3		
Missouri - Lower	355.76	Birmingham	744.7		
Missouri - Lower	356.1	Birmingham	745.35		
Missouri - Lower	356.43	Birmingham	745.65		
Missouri - Lower	356.77	Birmingham	745.5		
Missouri - Lower	357.06	Birmingham	745.7		
Missouri - Lower	357.3	Birmingham	746.3		
Missouri - Lower	357.63	Birmingham	746.55	East Bottoms	747.8
Missouri - Lower	357.94	Birmingham	747	East Bottoms	747
Missouri - Lower	358.26	Birmingham	747.9	East Bottoms	747.85
Missouri - Lower	358.57	Birmingham	747.85	East Bottoms	747.47
Missouri - Lower	358.91	Birmingham	747.6	East Bottoms	748.3
Missouri - Lower	359.26	Birmingham	749.9	East Bottoms	748.6
Missouri - Lower	359.318*	Birmingham	749.5	East Bottoms	749.75
Missouri - Lower	359.324	Birmingham	Truman Lift Bridge	East Bottoms	Truman Lift Bridge
Missouri - Lower	359.33	Birmingham	749	East Bottoms	748.8
Missouri - Lower	359.39	Birmingham	747	East Bottoms	749.5
Missouri - Lower	359.55	Birmingham	749.8	East Bottoms	749.5
Missouri - Lower	359.85	Birmingham	749.7	East Bottoms	749
Missouri - Lower	360.14	Birmingham	750.15	East Bottoms	749.9
Missouri - Lower	360.223*	Birmingham	750.4	East Bottoms	750.97
Missouri - Lower	360.229	Birmingham	I-435 Bridge	East Bottoms	I-435 Bridge
Missouri - Lower	360.25	Birmingham	750.6	East Bottoms	750.3
Missouri - Lower	360.29	Birmingham	750.9	East Bottoms	749.9
Missouri - Lower	360.61			East Bottoms	751.1
Missouri - Lower	360.91			East Bottoms	751.4
Missouri - Lower	361.23			East Bottoms	751.9
Missouri - Lower	361.54			East Bottoms	752.3
Missouri - Lower	361.84			East Bottoms	753.2
Missouri - Lower	362.17			East Bottoms	754.45
Missouri - Lower	362.234*			East Bottoms	754.98
Missouri - Lower	362.24		Old Chouteau Bridge	East Bottoms	Old Chouteau Bridge
Missouri - Lower	362.25			East Bottoms	754.75
Missouri - Lower	362.27			East Bottoms	754.75
Missouri - Lower	362.54			East Bottoms	755.3
Missouri - Lower	362.85			East Bottoms	755.5
Missouri - Lower	363.14			East Bottoms	756.2
Missouri - Lower	363.43	North Kansas City	756.9	East Bottoms	756.85
Missouri - Lower	363.73	North Kansas City	756.85	East Bottoms	755.9
Missouri - Lower	364.05	North Kansas City	756.9	East Bottoms	756.35
Missouri - Lower	364.34	North Kansas City	757.4	East Bottoms	756.7
Missouri - Lower	364.65	North Kansas City	757.8	East Bottoms	757.53
Missouri - Lower	364.730*	North Kansas City	757.03	East Bottoms	757.12
Missouri - Lower	364.734	North Kansas City	Paseo Bridge	East Bottoms	Paseo Bridge
Missouri - Lower	364.75	North Kansas City	757.13	East Bottoms	757.8
Missouri - Lower	364.78	North Kansas City	758.4	East Bottoms	758.5
Missouri - Lower	365.1	North Kansas City	758.3	East Bottoms	758.85
Missouri - Lower	365.43	North Kansas City	758.8	East Bottoms	758.8
Missouri - Lower	365.521*	North Kansas City	758.9	East Bottoms	757.7
Missouri - Lower	365.53	North Kansas City	Heart of America Bridge	East Bottoms	Heart of America Bridge
Missouri - Lower	365.56	North Kansas City	759.2	East Bottoms	758.7
Missouri - Lower	365.57	North Kansas City	ASB Bridge	East Bottoms	ASB Bridge
Missouri - Lower	365.6	North Kansas City	759.7	East Bottoms	758.7
Missouri - Lower	365.84	North Kansas City	759.5	East Bottoms	758.1
Missouri - Lower	366.06	North Kansas City	759.5	East Bottoms	759
Missouri - Lower	366.121*	North Kansas City	759.31	East Bottoms	760
Missouri - Lower	366.124	North Kansas City	Hannibal Bridge	East Bottoms	Hannibal Bridge
Missouri - Lower	366.14	North Kansas City	758.9	CID-MO	759.3
Missouri - Lower	366.180*	North Kansas City	759.76	CID-MO	760
Missouri - Lower	366.183	North Kansas City	Broadway Bridge	CID-MO	Broadway Bridge
Missouri - Lower	366.2	North Kansas City	759	CID-MO	759.3
Missouri - Lower	366.23	North Kansas City	759.1	CID-MO	759.3

Summary of Surveyed Top-of-Levee Elevations

River - Reach	HEC-RAS River Mile	Levee Name Left Bank	Top of Levee Elevation (feet) Left Bank	Levee Name Right Bank	Top of Levee Elevation (feet) Right Bank
Missouri - Lower	366.48	North Kansas City	760.9	CID-MO	759.8
Missouri - Lower	366.75	North Kansas City	761	CID-MO	759.7
Missouri - Lower	367.04	North Kansas City	761	CID-MO	760
Missouri - Upper	367.57	North Kansas City	761.5	Fairfax-Jersey Creek	760.6
Missouri - Upper	367.89	North Kansas City	761.7	Fairfax-Jersey Creek	760.7
Missouri - Upper	368.19	North Kansas City	761.6	Fairfax-Jersey Creek	760.8
Missouri - Upper	368.48	North Kansas City	762.2	Fairfax-Jersey Creek	761.5
Missouri - Upper	368.73	North Kansas City	762.3	Fairfax-Jersey Creek	762
Missouri - Upper	369.05	North Kansas City	761.3	Fairfax-Jersey Creek	762.3
Missouri - Upper	369.38	North Kansas City	762.8	Fairfax-Jersey Creek	762.3
Missouri - Upper	369.66	North Kansas City	762.26	Fairfax-Jersey Creek	763.2
Missouri - Upper	369.96	North Kansas City	762.74	Fairfax-Jersey Creek	763.4
Missouri - Upper	370.26	North Kansas City	763.79	Fairfax-Jersey Creek	764.3
Missouri - Upper	370.54	North Kansas City	762.79	Fairfax-Jersey Creek	764.6
Missouri - Upper	370.83			Fairfax-Jersey Creek	764.2
Missouri - Upper	371.14			Fairfax-Jersey Creek	764.8
Missouri - Upper	371.47			Fairfax-Jersey Creek	765.1
Missouri - Upper	371.83			Fairfax-Jersey Creek	765.3
Missouri - Upper	372.13			Fairfax-Jersey Creek	765.2
Missouri - Upper	372.47			Fairfax-Jersey Creek	765.7
Missouri - Upper	372.562*			Fairfax-Jersey Creek	765.9
Missouri - Upper	372.567		Fairfax Bridge (northbound)	Fairfax-Jersey Creek	Fairfax Bridge (northbound)
Missouri - Upper	372.577*			Fairfax-Jersey Creek	765.9
Missouri - Upper	372.58			Fairfax-Jersey Creek	765.9
Missouri - Upper	372.584*			Fairfax-Jersey Creek	765.9
Missouri - Upper	372.585		Fairfax Bridge (southbound)	Fairfax-Jersey Creek	Fairfax Bridge (southbound)
Missouri - Upper	372.597*			Fairfax-Jersey Creek	765.9
Missouri - Upper	372.61			Fairfax-Jersey Creek	765.9
Missouri - Upper	372.86			Fairfax-Jersey Creek	766.1
Missouri - Upper	373.15			Fairfax-Jersey Creek	766.4
Missouri - Upper	373.46			Fairfax-Jersey Creek	766
Missouri - Upper	373.79			Fairfax-Jersey Creek	767.2
Kansas	0.010	Fairfax-Jersey Creek	760.3	CID-KS	760.6
Kansas	0.140	Fairfax-Jersey Creek	760.5	CID-KS	760.4
Kansas	0.220	Fairfax-Jersey Creek	760.5	CID-KS	760.8
Kansas	0.253	RR embankment	760 (assumed)	CID-KS	760.3
Kansas	0.256	RR embankment	Missouri Pacific Bridge No. 1	CID-KS	Missouri Pacific No. 1 Bridge
Kansas	0.259	RR embankment	760 (assumed)	CID-KS	760.3
Kansas	0.274	RR embankment	760 (assumed)	CID-KS	760.4
Kansas	0.280	RR embankment	I-70 Bridge (westbound)	CID-KS	I-70 Bridge (westbound)
Kansas	0.286	RR embankment	760 (assumed)	CID-KS	760.5
Kansas	0.297	RR embankment	760 (assumed)	CID-KS	760.5
Kansas	0.303	RR embankment	I-70 Bridge (eastbound)	CID-KS	I-70 Bridge (eastbound)
Kansas	0.309	RR embankment	760 (assumed)	CID-KS	760.7
Kansas	0.440	RR embankment	760 (assumed)	CID-KS	760.4
Kansas	0.496	RR embankment	760 (assumed)	CID-KS	760.8
Kansas	0.500	RR embankment	James Street Bridge	CID-KS	James Street Bridge
Kansas	0.504	RR embankment	760 (assumed)	CID-KS	760.8
Kansas	0.640	Armourdale	760.6	CID-KS	760.9
Kansas	0.812	Armourdale	761.5	CID-KS	760.8
Kansas	0.815	Armourdale	KC Southern Bridge	CID-KS	KC Southern Bridge
Kansas	0.817	Armourdale	761.5	CID-KS	762.3
Kansas	1.106	Armourdale	762.3	CID-KS	761.9
Kansas	1.112	Armourdale	Central Avenue Bridge	CID-KS	Central Avenue Bridge
Kansas	1.117	Armourdale	762.3	CID-KS	761.7
Kansas	1.270	Armourdale	762.4	CID-KS	762.8
Kansas	1.385	Armourdale	762.6	CID-KS	762.6
Kansas	1.399	Armourdale	I-670 Bridge	CID-KS	I-670 Bridge
Kansas	1.413	Armourdale	762.8	CID-KS	762.6
Kansas	1.614	Armourdale	762.8	CID-KS	762.6
Kansas	1.619	Armourdale	Missouri Pacific Bridge No. 72	CID-KS	Bridge
Kansas	1.624	Armourdale	763.6	CID-KS	762.6
Kansas	1.634	Armourdale	762.8	CID-KS	762.6
Kansas	1.638	Armourdale	Union Pacific Bridge No. 3	CID-KS	Union Pacific Bridge No. 3
Kansas	1.643	Armourdale	762.7	CID-KS	762.6
Kansas	2.016	Armourdale	764.1	CID-KS	764.4
Kansas	2.097	Armourdale	763.7	CID-KS	764.9

Summary of Surveyed Top-of-Levee Elevations

River - Reach	HEC-RAS River Mile	Levee Name Left Bank	Top of Levee Elevation (feet) Left Bank	Levee Name Right Bank	Top of Levee Elevation (feet) Right Bank
Kansas	2.104	Armourdale	CRI&P Bridge	CID-KS	CRI&P Bridge
Kansas	2.111	Armourdale	763.9	CID-KS	764.8
Kansas	2.165	Armourdale	764.1	CID-KS	765.3
Kansas	2.172	Armourdale	Kansas Avenue East Bridge	CID-KS	Kansas Avenue East Bridge
Kansas	2.179	Armourdale	764.3	CID-KS	765.2
Kansas	2.491	Armourdale	765.7	CID-KS	766
Kansas	2.525	Armourdale	765.6	CID-KS	766.1
Kansas	2.531	Armourdale	KC Terminal Bridge	CID-KS	KC Terminal Bridge
Kansas	2.536	Armourdale	765.6	CID-KS	766
Kansas	3.050	Armourdale	768.1	CID-KS	767.9
Kansas	3.405	Armourdale	768.5		
Kansas	3.416	Armourdale	7th Street Bridge		7th Street Bridge
Kansas	3.427	Armourdale	768.4		
Kansas	3.960	Armourdale	769.6		
Kansas	4.276	Armourdale	770	Argentine	
Kansas	4.280	Armourdale	12th Street Bridge	Argentine	12th Street Bridge
Kansas	4.284	Armourdale	770.5	Argentine	
Kansas	4.480	Armourdale	770.3	Argentine	
Kansas	4.949	Armourdale	770.7	Argentine	770.7
Kansas	4.960	Armourdale	18th Street Bridge	Argentine	18th Street Bridge
Kansas	4.970	Armourdale	772.1	Argentine	770.5
Kansas	5.506	Armourdale	772.4	Argentine	772.2
Kansas	5.513	Armourdale	Kaw Powerplant Intake Structure	Argentine	Kaw Powerplant Intake Structure
Kansas	5.520	Armourdale	772.4	Argentine	772.2
Kansas	5.811	Armourdale	773.4	Argentine	773.3
Kansas	5.821	Armourdale	Kansas Avenue Bridge	Argentine	Kansas Avenue Bridge
Kansas	5.831	Armourdale	773.4	Argentine	773.4
Kansas	5.967	Armourdale	774.2	Argentine	773.7
Kansas	6.880	Armourdale	774.9	Argentine	774.2
Kansas	7.329			Argentine	775
Kansas	7.333			Argentine	775
Kansas	7.338		I-635 Bridge (northbound)	Argentine	I-635 Bridge (northbound)
Kansas	7.342			Argentine	774.9
Kansas	7.351			Argentine	774.8
Kansas	7.355		I-635 Bridge (southbound)	Argentine	I-635 Bridge (southbound)
Kansas	7.360			Argentine	774.7
Kansas	7.364			Argentine	774.7
Kansas	7.650			Argentine	775
Kansas	8.420			Argentine	776.6
Kansas	9.040			Argentine	776.7
Kansas	9.490			Argentine	777
Kansas	9.498		Kansas Avenue West Bridge	Argentine	Kansas Avenue West Bridge
Kansas	9.505			Argentine	777.2
Kansas	9.820			Argentine	777.8

* denotes interpolated cross-section

EXHIBIT A-2.105

Missouri River Existing Conditions Water Surface Elevations

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	339.67	10%	10	247,000	714.0	714.8	0.00017	7.3	53,832	5,741	0.25
Lower	Lower Missouri	339.67	1.0%	100	405,000	720.2	721.0	0.00017	8.4	89,196	5,806	0.26
Lower	Lower Missouri	339.67	0.5%	200	459,000	723.2	723.5	0.00009	6.3	176,356	21,611	0.18
Lower	Lower Missouri	339.67	0.2%	500	537,000	724.8	725.2	0.00009	6.7	194,539	21,858	0.19
Lower	Lower Missouri	339.67	0.133%	750	573,000	722.0	722.7	0.00016	8.4	163,602	21,179	0.25
Lower	Lower Missouri	339.67	0.100%	1,000	600,000	722.2	722.9	0.00017	8.7	165,663	21,491	0.26
Lower	Lower Missouri	339.67	0.080%	1,250	621,000	722.6	723.3	0.00017	8.8	170,048	21,566	0.26
Lower	Lower Missouri	339.67	0.067%	1,500	637,000	722.9	723.6	0.00017	8.8	173,559	21,591	0.26
Lower	Lower Missouri	340.32	10%	10	247,000	714.5	715.5	0.00022	8.1	38,017	3,998	0.28
Lower	Lower Missouri	340.32	1%	100	405,000	720.6	721.8	0.00024	9.7	65,800	4,890	0.31
Lower	Lower Missouri	340.32	0.5%	200	459,000	723.3	723.9	0.00014	7.7	131,355	18,630	0.23
Lower	Lower Missouri	340.32	0.2%	500	537,000	725.0	725.6	0.00014	8.1	147,061	23,189	0.24
Lower	Lower Missouri	340.32	0.133%	750	573,000	722.3	723.5	0.00025	10.2	122,036	18,067	0.31
Lower	Lower Missouri	340.32	0.100%	1,000	600,000	722.5	723.8	0.00026	10.5	124,002	18,231	0.32
Lower	Lower Missouri	340.32	0.080%	1,250	621,000	722.9	724.2	0.00026	10.6	127,752	18,442	0.32
Lower	Lower Missouri	340.32	0.067%	1,500	637,000	723.3	724.5	0.00026	10.7	130,742	18,614	0.32
Lower	Lower Missouri	341.06	10%	10	247,000	715.7	716.3	0.00018	6.5	45,581	4,528	0.25
Lower	Lower Missouri	341.06	1%	100	405,000	722.1	722.6	0.00013	6.6	114,196	14,594	0.22
Lower	Lower Missouri	341.06	0.5%	200	459,000	723.9	724.5	0.00012	6.7	133,111	15,032	0.22
Lower	Lower Missouri	341.06	0.2%	500	537,000	725.6	726.2	0.00013	7.1	150,151	15,122	0.22
Lower	Lower Missouri	341.06	0.133%	750	573,000	723.5	724.4	0.00020	8.5	128,891	15,002	0.28
Lower	Lower Missouri	341.06	0.100%	1,000	600,000	723.8	724.7	0.00021	8.8	131,730	15,022	0.28
Lower	Lower Missouri	341.06	0.080%	1,250	621,000	724.2	725.1	0.00021	8.9	135,736	15,050	0.29
Lower	Lower Missouri	341.06	0.067%	1,500	637,000	724.5	725.4	0.00021	8.9	138,831	15,065	0.29
Lower	Lower Missouri	341.88	10%	10	247,000	716.2	717.5	0.00028	9.0	37,113	6,251	0.32
Lower	Lower Missouri	341.88	1%	100	405,000	722.3	723.6	0.00026	10.0	79,848	12,656	0.32
Lower	Lower Missouri	341.88	0.5%	200	459,000	724.2	725.4	0.00025	10.1	94,511	13,188	0.31
Lower	Lower Missouri	341.88	0.2%	500	537,000	725.9	727.2	0.00026	10.7	108,409	21,652	0.32
Lower	Lower Missouri	341.88	0.133%	750	573,000	723.9	725.9	0.00040	12.8	92,550	13,162	0.40
Lower	Lower Missouri	341.88	0.100%	1,000	600,000	724.2	726.3	0.00042	13.2	94,940	13,189	0.41
Lower	Lower Missouri	341.88	0.080%	1,250	621,000	724.6	726.7	0.00042	13.3	98,221	13,197	0.41
Lower	Lower Missouri	341.88	0.067%	1,500	637,000	724.9	727.0	0.00042	13.4	100,715	13,205	0.41
Lower	Lower Missouri	342.49	10%	10	247,000	717.4	718.1	0.00012	6.6	50,767	7,916	0.21
Lower	Lower Missouri	342.49	1%	100	405,000	723.4	724.2	0.00013	7.7	102,128	12,781	0.23
Lower	Lower Missouri	342.49	0.5%	200	459,000	725.2	726.0	0.00013	7.9	118,366	13,536	0.23
Lower	Lower Missouri	342.49	0.2%	500	537,000	726.9	727.8	0.00014	8.4	134,108	22,644	0.24
Lower	Lower Missouri	342.49	0.133%	750	573,000	725.7	726.8	0.00018	9.6	122,881	13,538	0.28
Lower	Lower Missouri	342.49	0.100%	1,000	600,000	726.1	727.3	0.00019	9.8	126,371	13,539	0.28
Lower	Lower Missouri	342.49	0.080%	1,250	621,000	726.5	727.7	0.00019	9.9	130,017	22,623	0.28
Lower	Lower Missouri	342.49	0.067%	1,500	637,000	726.8	728.0	0.00020	10.0	132,776	22,636	0.28
Lower	Lower Missouri	343.09	10%	10	247,000	717.7	718.6	0.00018	8.0	37,939	3,601	0.26
Lower	Lower Missouri	343.09	1%	100	405,000	723.5	724.9	0.00022	10.0	69,765	10,167	0.30
Lower	Lower Missouri	343.09	0.5%	200	459,000	725.3	726.7	0.00022	10.3	83,401	12,010	0.30
Lower	Lower Missouri	343.09	0.2%	500	537,000	727.0	728.5	0.00024	10.9	96,855	12,179	0.31
Lower	Lower Missouri	343.09	0.133%	750	573,000	725.8	727.8	0.00032	12.4	87,489	12,077	0.36
Lower	Lower Missouri	343.09	0.100%	1,000	600,000	726.2	728.3	0.00033	12.8	90,497	12,111	0.37
Lower	Lower Missouri	343.09	0.080%	1,250	621,000	726.6	728.7	0.00033	12.9	93,626	12,145	0.37
Lower	Lower Missouri	343.09	0.067%	1,500	637,000	726.9	729.1	0.00034	13.0	95,991	12,170	0.37
Lower	Lower Missouri	343.57	10%	10	247,000	718.3	719.1	0.00018	7.4	44,056	7,821	0.25
Lower	Lower Missouri	343.57	1%	100	405,000	724.5	725.5	0.00018	8.5	83,278	9,399	0.26
Lower	Lower Missouri	343.57	0.5%	200	459,000	726.3	727.2	0.00018	8.8	94,503	9,635	0.26
Lower	Lower Missouri	343.57	0.2%	500	537,000	728.0	729.1	0.00019	9.4	105,930	9,789	0.28
Lower	Lower Missouri	343.57	0.133%	750	573,000	727.3	728.6	0.00024	10.4	101,028	9,755	0.31
Lower	Lower Missouri	343.57	0.100%	1,000	600,000	727.7	729.1	0.00025	10.7	103,839	9,775	0.32
Lower	Lower Missouri	343.57	0.080%	1,250	621,000	728.1	729.5	0.00025	10.8	106,480	9,793	0.32
Lower	Lower Missouri	343.57	0.067%	1,500	637,000	728.4	729.9	0.00025	10.9	108,462	9,806	0.32

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	344.14	10%	10	247,000	718.7	719.8	0.00021	8.2	37,614	3,535	0.28
Lower	Lower Missouri	344.14	1%	100	405,000	724.8	726.2	0.00025	10.0	63,353	5,164	0.31
Lower	Lower Missouri	344.14	0.5%	200	459,000	726.5	728.0	0.00026	10.5	71,190	5,436	0.32
Lower	Lower Missouri	344.14	0.2%	500	537,000	728.3	730.0	0.00028	11.4	79,304	5,474	0.34
Lower	Lower Missouri	344.14	0.133%	750	573,000	727.6	729.7	0.00035	12.5	76,164	5,467	0.37
Lower	Lower Missouri	344.14	0.100%	1,000	600,000	728.0	730.2	0.00037	12.9	78,164	5,472	0.38
Lower	Lower Missouri	344.14	0.080%	1,250	621,000	728.4	730.7	0.00037	13.1	80,013	5,475	0.39
Lower	Lower Missouri	344.14	0.067%	1,500	637,000	728.7	731.0	0.00038	13.3	81,400	5,477	0.39
Lower	Lower Missouri	344.74	10%	10	247,000	719.5	720.4	0.00018	7.6	37,679	3,478	0.25
Lower	Lower Missouri	344.74	1%	100	405,000	725.6	726.9	0.00021	9.6	61,033	4,044	0.29
Lower	Lower Missouri	344.74	0.5%	200	459,000	727.3	728.7	0.00023	10.2	67,590	4,065	0.30
Lower	Lower Missouri	344.74	0.2%	500	537,000	729.1	730.8	0.00025	11.1	74,610	4,087	0.32
Lower	Lower Missouri	344.74	0.133%	750	573,000	728.6	730.6	0.00030	12.0	72,896	4,081	0.35
Lower	Lower Missouri	344.74	0.100%	1,000	600,000	729.1	731.2	0.00031	12.4	74,757	4,087	0.35
Lower	Lower Missouri	344.74	0.080%	1,250	621,000	729.5	731.7	0.00032	12.6	76,367	4,092	0.36
Lower	Lower Missouri	344.74	0.067%	1,500	637,000	729.8	732.1	0.00033	12.8	77,572	4,101	0.36
Lower	Lower Missouri	345.67	10%	10	247,000	720.3	721.2	0.00017	7.5	36,280	3,010	0.25
Lower	Lower Missouri	345.67	1%	100	405,000	726.7	727.9	0.00019	9.2	68,548	5,245	0.28
Lower	Lower Missouri	345.67	0.5%	200	459,000	728.5	729.8	0.00020	9.7	76,791	5,285	0.28
Lower	Lower Missouri	345.67	0.2%	500	537,000	730.4	731.9	0.00022	10.5	86,026	5,315	0.30
Lower	Lower Missouri	345.67	0.133%	750	573,000	730.3	732.0	0.00025	11.2	85,324	5,313	0.32
Lower	Lower Missouri	345.67	0.100%	1,000	600,000	730.8	732.6	0.00026	11.5	87,934	5,322	0.33
Lower	Lower Missouri	345.67	0.080%	1,250	621,000	731.3	733.1	0.00026	11.7	90,109	5,361	0.33
Lower	Lower Missouri	345.67	0.067%	1,500	637,000	731.6	733.5	0.00027	11.8	91,741	5,378	0.33
Lower	Lower Missouri	346.54	10%	10	247,000	721.2	721.8	0.00010	6.5	41,042	2,623	0.20
Lower	Lower Missouri	346.54	1%	100	405,000	727.8	728.6	0.00011	7.6	89,429	8,155	0.22
Lower	Lower Missouri	346.54	0.5%	200	459,000	729.7	730.5	0.00011	8.0	99,661	8,180	0.22
Lower	Lower Missouri	346.54	0.2%	500	537,000	731.7	732.7	0.00012	8.6	111,473	8,218	0.23
Lower	Lower Missouri	346.54	0.133%	750	573,000	731.8	732.9	0.00014	9.2	111,857	8,254	0.25
Lower	Lower Missouri	346.54	0.100%	1,000	600,000	732.4	733.5	0.00014	9.4	115,301	8,258	0.25
Lower	Lower Missouri	346.54	0.080%	1,250	621,000	732.9	734.1	0.00014	9.5	118,110	8,260	0.25
Lower	Lower Missouri	346.54	0.067%	1,500	637,000	733.3	734.5	0.00015	9.6	120,217	8,262	0.26
Lower	Lower Missouri	347.38	10%	10	247,000	721.5	722.7	0.00028	8.8	32,250	2,444	0.32
Lower	Lower Missouri	347.38	1%	100	405,000	728.4	729.3	0.00021	8.8	90,220	8,600	0.28
Lower	Lower Missouri	347.38	0.5%	200	459,000	730.2	731.2	0.00019	8.9	103,695	8,622	0.28
Lower	Lower Missouri	347.38	0.2%	500	537,000	732.4	733.4	0.00019	9.3	119,280	8,674	0.28
Lower	Lower Missouri	347.38	0.133%	750	573,000	732.6	733.6	0.00021	9.8	120,452	8,676	0.30
Lower	Lower Missouri	347.38	0.100%	1,000	600,000	733.2	734.3	0.00021	9.9	125,147	8,685	0.30
Lower	Lower Missouri	347.38	0.080%	1,250	621,000	733.7	734.8	0.00021	10.0	128,946	8,692	0.30
Lower	Lower Missouri	347.38	0.067%	1,500	637,000	734.1	735.2	0.00021	10.1	131,794	8,697	0.30
Lower	Lower Missouri	348.25	10%	10	247,000	722.8	723.7	0.00017	7.8	35,722	2,851	0.26
Lower	Lower Missouri	348.25	1%	100	405,000	729.0	730.4	0.00021	9.9	54,744	3,131	0.30
Lower	Lower Missouri	348.25	0.5%	200	459,000	731.1	731.9	0.00014	8.2	119,223	8,705	0.24
Lower	Lower Missouri	348.25	0.2%	500	537,000	733.3	734.1	0.00014	8.6	137,072	8,735	0.24
Lower	Lower Missouri	348.25	0.133%	750	573,000	733.6	734.5	0.00015	9.0	139,315	8,739	0.26
Lower	Lower Missouri	348.25	0.100%	1,000	600,000	734.2	735.1	0.00015	9.1	144,719	8,751	0.26
Lower	Lower Missouri	348.25	0.080%	1,250	621,000	734.8	735.7	0.00015	9.2	149,057	17,958	0.26
Lower	Lower Missouri	348.25	0.067%	1,500	637,000	735.2	736.1	0.00015	9.3	152,312	17,960	0.26
Lower	Lower Missouri	349.2	10%	10	247,000	723.6	724.6	0.00018	8.1	35,340	2,338	0.27
Lower	Lower Missouri	349.2	1%	100	405,000	730.6	731.3	0.00013	7.9	115,483	11,061	0.23
Lower	Lower Missouri	349.2	0.5%	200	459,000	731.8	732.6	0.00014	8.3	126,419	11,195	0.24
Lower	Lower Missouri	349.2	0.2%	500	537,000	734.0	734.8	0.00014	8.6	145,408	11,255	0.24
Lower	Lower Missouri	349.2	0.133%	750	573,000	734.4	735.2	0.00015	9.1	148,451	11,292	0.25
Lower	Lower Missouri	349.2	0.100%	1,000	600,000	735.0	735.9	0.00015	9.2	154,211	15,200	0.25
Lower	Lower Missouri	349.2	0.080%	1,250	621,000	735.6	736.4	0.00015	9.2	158,810	15,283	0.25
Lower	Lower Missouri	349.2	0.067%	1,500	637,000	736.0	736.8	0.00015	9.3	162,258	15,335	0.25

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	349.9	10%	10	247,000	724.3	725.3	0.00018	8.0	33,739	1,722	0.26
Lower	Lower Missouri	349.9	1%	100	405,000	731.0	731.8	0.00015	8.3	105,131	13,741	0.25
Lower	Lower Missouri	349.9	0.5%	200	459,000	732.3	733.2	0.00015	8.7	116,966	13,767	0.25
Lower	Lower Missouri	349.9	0.2%	500	537,000	734.5	735.4	0.00015	9.0	137,114	13,815	0.26
Lower	Lower Missouri	349.9	0.133%	750	573,000	734.8	735.8	0.00016	9.4	140,700	13,839	0.27
Lower	Lower Missouri	349.9	0.100%	1,000	600,000	735.5	736.5	0.00016	9.5	146,832	14,305	0.27
Lower	Lower Missouri	349.9	0.080%	1,250	621,000	736.0	737.0	0.00016	9.6	151,705	14,306	0.27
Lower	Lower Missouri	349.9	0.067%	1,500	637,000	736.4	737.4	0.00016	9.6	155,358	14,307	0.27
Lower	Lower Missouri	350.49	10%	10	247,000	724.9	725.9	0.00019	8.1	31,353	1,365	0.27
Lower	Lower Missouri	350.49	1%	100	405,000	731.3	732.4	0.00018	9.1	84,477	13,829	0.28
Lower	Lower Missouri	350.49	0.5%	200	459,000	732.6	733.8	0.00019	9.6	95,155	13,858	0.29
Lower	Lower Missouri	350.49	0.2%	500	537,000	734.8	736.0	0.00019	9.9	113,085	13,925	0.29
Lower	Lower Missouri	350.49	0.133%	750	573,000	735.2	736.5	0.00020	10.4	116,500	13,958	0.30
Lower	Lower Missouri	350.49	0.100%	1,000	600,000	735.8	737.1	0.00020	10.5	121,964	13,978	0.30
Lower	Lower Missouri	350.49	0.080%	1,250	621,000	736.4	737.7	0.00020	10.5	126,298	13,982	0.30
Lower	Lower Missouri	350.49	0.067%	1,500	637,000	736.8	738.1	0.00020	10.6	129,550	13,985	0.30
Lower	Lower Missouri	351.15	10%	10	247,000	725.6	726.5	0.00015	7.4	40,414	3,625	0.25
Lower	Lower Missouri	351.15	1%	100	405,000	732.1	733.0	0.00015	8.5	95,031	15,268	0.25
Lower	Lower Missouri	351.15	0.5%	200	459,000	733.4	734.4	0.00016	8.9	106,419	15,904	0.26
Lower	Lower Missouri	351.15	0.2%	500	537,000	735.5	736.6	0.00016	9.3	124,857	16,093	0.27
Lower	Lower Missouri	351.15	0.133%	750	573,000	736.0	737.1	0.00017	9.7	128,920	16,112	0.28
Lower	Lower Missouri	351.15	0.100%	1,000	600,000	736.7	737.8	0.00017	9.8	134,547	16,118	0.28
Lower	Lower Missouri	351.15	0.080%	1,250	621,000	737.2	738.3	0.00017	9.9	138,988	16,120	0.28
Lower	Lower Missouri	351.15	0.067%	1,500	637,000	737.6	738.7	0.00017	10.0	142,321	16,121	0.28
Lower	Lower Missouri	351.94	10%	10	247,000	726.3	727.0	0.00013	7.1	42,785	11,020	0.23
Lower	Lower Missouri	351.94	1%	100	405,000	732.6	733.7	0.00015	8.8	69,441	12,793	0.26
Lower	Lower Missouri	351.94	0.5%	200	459,000	733.9	735.1	0.00017	9.5	75,163	13,115	0.27
Lower	Lower Missouri	351.94	0.2%	500	537,000	736.0	737.4	0.00018	10.2	84,226	13,324	0.29
Lower	Lower Missouri	351.94	0.133%	750	573,000	736.5	738.0	0.00020	10.7	86,351	13,337	0.30
Lower	Lower Missouri	351.94	0.100%	1,000	600,000	737.1	738.7	0.00020	10.9	89,114	17,183	0.30
Lower	Lower Missouri	351.94	0.080%	1,250	621,000	737.6	739.2	0.00021	11.1	91,289	17,227	0.31
Lower	Lower Missouri	351.94	0.067%	1,500	637,000	738.0	739.6	0.00021	11.2	92,919	17,238	0.31
Lower	Lower Missouri	352.57	10%	10	247,000	726.6	727.5	0.00013	7.7	33,091	4,426	0.23
Lower	Lower Missouri	352.57	1%	100	405,000	732.7	734.4	0.00019	10.5	44,894	11,277	0.30
Lower	Lower Missouri	352.57	0.5%	200	459,000	734.0	736.0	0.00022	11.4	47,604	11,655	0.32
Lower	Lower Missouri	352.57	0.2%	500	537,000	736.0	738.4	0.00025	12.7	51,848	12,719	0.34
Lower	Lower Missouri	352.57	0.133%	750	573,000	736.4	739.1	0.00027	13.3	52,833	12,814	0.36
Lower	Lower Missouri	352.57	0.100%	1,000	600,000	737.0	739.8	0.00029	13.8	54,109	16,645	0.37
Lower	Lower Missouri	352.57	0.080%	1,250	621,000	737.5	740.4	0.00029	14.1	55,111	16,744	0.37
Lower	Lower Missouri	352.57	0.067%	1,500	637,000	737.8	740.9	0.00030	14.3	55,858	16,831	0.38
Lower	Lower Missouri	352.641*	10%	10	247,000	726.6	727.6	0.00015	8.2	30,631	1,700	0.26
Lower	Lower Missouri	352.641*	1%	100	405,000	732.7	734.6	0.00022	11.1	40,336	2,450	0.32
Lower	Lower Missouri	352.641*	0.5%	200	459,000	733.9	736.2	0.00025	12.1	42,487	4,484	0.34
Lower	Lower Missouri	352.641*	0.2%	500	537,000	735.9	738.6	0.00029	13.4	45,848	8,179	0.37
Lower	Lower Missouri	352.641*	0.133%	750	573,000	736.3	739.3	0.00032	14.1	46,609	8,513	0.39
Lower	Lower Missouri	352.641*	0.100%	1,000	600,000	736.9	740.1	0.00033	14.5	47,611	8,790	0.40
Lower	Lower Missouri	352.641*	0.080%	1,250	621,000	737.3	740.7	0.00034	14.9	48,397	8,971	0.41
Lower	Lower Missouri	352.641*	0.067%	1,500	637,000	737.6	741.1	0.00035	15.1	48,995	9,083	0.41
Lower		352.647	Liberty Bend Bridge									
Lower	Lower Missouri	352.66	10%	10	247,000	726.7	727.7	0.00011	7.7	32,249	1,819	0.24
Lower	Lower Missouri	352.66	1%	100	405,000	732.9	734.7	0.00016	10.6	42,175	2,422	0.30
Lower	Lower Missouri	352.66	0.5%	200	459,000	734.2	736.3	0.00018	11.5	44,383	2,825	0.32
Lower	Lower Missouri	352.66	0.2%	500	537,000	736.2	738.7	0.00021	12.8	47,800	5,534	0.35
Lower	Lower Missouri	352.66	0.133%	750	573,000	736.7	739.5	0.00023	13.5	48,636	6,443	0.36

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	352.66	0.100%	1,000	600,000	737.3	740.2	0.00024	13.9	49,657	7,438	0.37
Lower	Lower Missouri	352.66	0.080%	1,250	621,000	737.7	740.8	0.00025	14.2	50,455	7,972	0.38
Lower	Lower Missouri	352.66	0.067%	1,500	637,000	738.1	741.3	0.00025	14.5	51,071	10,673	0.39
Lower	Lower Missouri	352.74	10%	10	247,000	726.5	727.8	0.00016	9.1	27,579	8,933	0.29
Lower	Lower Missouri	352.74	1%	100	405,000	732.6	734.9	0.00023	12.2	37,840	11,300	0.36
Lower	Lower Missouri	352.74	0.5%	200	459,000	733.9	736.6	0.00026	13.3	40,413	11,480	0.38
Lower	Lower Missouri	352.74	0.2%	500	537,000	735.8	739.0	0.00029	14.6	44,773	11,742	0.41
Lower	Lower Missouri	352.74	0.133%	750	573,000	736.3	739.8	0.00032	15.4	45,826	11,788	0.43
Lower	Lower Missouri	352.74	0.100%	1,000	600,000	736.8	740.6	0.00033	15.8	47,200	11,850	0.44
Lower	Lower Missouri	352.74	0.080%	1,250	621,000	737.3	741.2	0.00034	16.2	48,293	11,930	0.45
Lower	Lower Missouri	352.74	0.067%	1,500	637,000	737.6	741.6	0.00035	16.4	49,134	11,958	0.45
Lower	Lower Missouri	352.8	10%	10	247,000	726.7	727.9	0.00015	8.8	29,893	10,484	0.28
Lower	Lower Missouri	352.8	1%	100	405,000	733.1	735.0	0.00020	11.3	47,448	11,839	0.33
Lower	Lower Missouri	352.8	0.5%	200	459,000	734.5	736.7	0.00022	12.2	51,633	11,887	0.35
Lower	Lower Missouri	352.8	0.2%	500	537,000	736.7	739.2	0.00024	13.2	58,191	12,040	0.37
Lower	Lower Missouri	352.8	0.133%	750	573,000	737.3	740.0	0.00025	13.8	59,911	12,053	0.38
Lower	Lower Missouri	352.8	0.100%	1,000	600,000	738.0	740.8	0.00026	14.1	61,928	12,061	0.39
Lower	Lower Missouri	352.8	0.080%	1,250	621,000	738.5	741.4	0.00026	14.4	63,514	12,068	0.39
Lower	Lower Missouri	352.8	0.067%	1,500	637,000	738.9	741.9	0.00027	14.5	64,724	12,073	0.39
Lower	Lower Missouri	353.15	10%	10	247,000	727.2	728.1	0.00011	7.7	34,878	3,000	0.24
Lower	Lower Missouri	353.15	1%	100	405,000	733.9	735.4	0.00014	9.9	57,560	5,438	0.28
Lower	Lower Missouri	353.15	0.5%	200	459,000	735.5	737.1	0.00015	10.6	63,286	5,490	0.29
Lower	Lower Missouri	353.15	0.2%	500	537,000	737.8	739.6	0.00016	11.4	72,075	5,573	0.31
Lower	Lower Missouri	353.15	0.133%	750	573,000	738.5	740.5	0.00017	11.9	74,649	5,587	0.32
Lower	Lower Missouri	353.15	0.100%	1,000	600,000	739.2	741.2	0.00017	12.1	77,347	5,601	0.32
Lower	Lower Missouri	353.15	0.080%	1,250	621,000	739.8	741.9	0.00018	12.3	79,512	5,613	0.32
Lower	Lower Missouri	353.15	0.067%	1,500	637,000	740.2	742.3	0.00018	12.4	81,159	15,454	0.33
Lower	Lower Missouri	353.45	10%	10	247,000	727.4	728.4	0.00013	8.0	33,909	2,132	0.26
Lower	Lower Missouri	353.45	1%	100	405,000	734.1	735.6	0.00017	10.2	52,517	3,202	0.30
Lower	Lower Missouri	353.45	0.5%	200	459,000	735.6	737.4	0.00018	10.9	57,455	3,221	0.32
Lower	Lower Missouri	353.45	0.2%	500	537,000	738.0	740.0	0.00020	11.8	65,004	3,238	0.33
Lower	Lower Missouri	353.45	0.133%	750	573,000	738.7	740.8	0.00021	12.3	67,240	3,243	0.34
Lower	Lower Missouri	353.45	0.100%	1,000	600,000	739.4	741.6	0.00021	12.6	69,561	4,792	0.35
Lower	Lower Missouri	353.45	0.080%	1,250	621,000	740.0	742.2	0.00021	12.7	71,450	4,808	0.35
Lower	Lower Missouri	353.45	0.067%	1,500	637,000	740.4	742.7	0.00022	12.9	72,856	4,811	0.35
Lower	Lower Missouri	353.82	10%	10	247,000	727.6	728.6	0.00012	8.0	32,493	1,846	0.25
Lower	Lower Missouri	353.82	1%	100	405,000	734.4	736.0	0.00016	10.4	48,280	2,423	0.30
Lower	Lower Missouri	353.82	0.5%	200	459,000	735.9	737.8	0.00017	11.2	52,012	2,432	0.31
Lower	Lower Missouri	353.82	0.2%	500	537,000	738.2	740.4	0.00019	12.2	57,653	2,447	0.33
Lower	Lower Missouri	353.82	0.133%	750	573,000	738.9	741.3	0.00020	12.7	59,345	2,451	0.34
Lower	Lower Missouri	353.82	0.100%	1,000	600,000	739.6	742.1	0.00021	13.1	61,072	2,455	0.35
Lower	Lower Missouri	353.82	0.080%	1,250	621,000	740.2	742.7	0.00021	13.3	62,473	2,459	0.35
Lower	Lower Missouri	353.82	0.067%	1,500	637,000	740.6	743.2	0.00022	13.5	63,516	3,181	0.36
Lower	Lower Missouri	354.2	10%	10	247,000	728.0	728.9	0.00012	7.7	37,102	3,103	0.25
Lower	Lower Missouri	354.2	1%	100	405,000	735.1	736.3	0.00014	9.4	63,498	3,879	0.27
Lower	Lower Missouri	354.2	0.5%	200	459,000	736.8	738.1	0.00014	9.9	70,112	3,915	0.28
Lower	Lower Missouri	354.2	0.2%	500	537,000	739.3	740.8	0.00015	10.6	80,083	3,946	0.29
Lower	Lower Missouri	354.2	0.133%	750	573,000	740.1	741.7	0.00015	10.9	83,311	3,956	0.30
Lower	Lower Missouri	354.2	0.100%	1,000	600,000	740.9	742.5	0.00016	11.1	86,425	3,966	0.30
Lower	Lower Missouri	354.2	0.080%	1,250	621,000	741.5	743.2	0.00016	11.3	88,932	3,974	0.30
Lower	Lower Missouri	354.2	0.067%	1,500	637,000	742.0	743.7	0.00016	11.4	90,804	3,979	0.30
Lower	Lower Missouri	354.62	10%	10	247,000	728.5	729.1	0.00008	6.5	49,464	3,682	0.21
Lower	Lower Missouri	354.62	1%	100	405,000	735.8	736.6	0.00009	7.8	81,306	4,525	0.22
Lower	Lower Missouri	354.62	0.5%	200	459,000	737.5	738.4	0.00009	8.2	89,383	4,603	0.23
Lower	Lower Missouri	354.62	0.2%	500	537,000	740.1	741.1	0.00010	8.7	101,429	4,621	0.24

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	354.62	0.133%	750	573,000	741.0	742.0	0.00010	9.0	105,451	4,623	0.24
Lower	Lower Missouri	354.62	0.100%	1,000	600,000	741.8	742.9	0.00010	9.2	109,189	4,625	0.24
Lower	Lower Missouri	354.62	0.080%	1,250	621,000	742.5	743.5	0.00010	9.3	112,176	4,627	0.25
Lower	Lower Missouri	354.62	0.067%	1,500	637,000	742.9	744.0	0.00010	9.4	114,353	4,628	0.25
Lower	Lower Missouri	355.01	10%	10	247,000	728.3	729.5	0.00020	8.9	33,093	3,629	0.31
Lower	Lower Missouri	355.01	1%	100	405,000	735.7	737.0	0.00018	9.9	62,977	4,332	0.31
Lower	Lower Missouri	355.01	0.5%	200	459,000	737.5	738.8	0.00018	10.3	70,827	4,443	0.31
Lower	Lower Missouri	355.01	0.2%	500	537,000	740.1	741.5	0.00017	10.6	82,707	4,586	0.31
Lower	Lower Missouri	355.01	0.133%	750	573,000	741.0	742.4	0.00018	10.9	86,788	4,700	0.31
Lower	Lower Missouri	355.01	0.100%	1,000	600,000	741.8	743.3	0.00017	11.0	90,640	4,706	0.31
Lower	Lower Missouri	355.01	0.080%	1,250	621,000	742.5	743.9	0.00017	11.1	93,720	4,712	0.31
Lower	Lower Missouri	355.01	0.067%	1,500	637,000	742.9	744.4	0.00017	11.2	95,958	4,722	0.31
Lower	Lower Missouri	355.4	10%	10	247,000	728.8	729.9	0.00014	8.4	32,744	4,409	0.27
Lower	Lower Missouri	355.4	1%	100	405,000	736.0	737.3	0.00015	9.9	63,124	6,396	0.29
Lower	Lower Missouri	355.4	0.5%	200	459,000	737.7	739.2	0.00016	10.4	72,502	6,606	0.30
Lower	Lower Missouri	355.4	0.2%	500	537,000	740.4	741.9	0.00016	10.7	86,758	6,628	0.30
Lower	Lower Missouri	355.4	0.133%	750	573,000	741.3	742.8	0.00016	11.0	91,560	6,638	0.30
Lower	Lower Missouri	355.4	0.100%	1,000	600,000	742.1	743.6	0.00016	11.1	95,987	6,640	0.30
Lower	Lower Missouri	355.4	0.080%	1,250	621,000	742.7	744.3	0.00016	11.2	99,518	6,641	0.30
Lower	Lower Missouri	355.4	0.067%	1,500	637,000	743.2	744.8	0.00015	11.2	102,092	6,642	0.30
Lower	Lower Missouri	355.76	10%	10	247,000	729.4	730.1	0.00010	6.8	39,147	3,824	0.22
Lower	Lower Missouri	355.76	1%	100	405,000	736.7	737.6	0.00011	8.2	72,593	6,655	0.24
Lower	Lower Missouri	355.76	0.5%	200	459,000	738.5	739.5	0.00011	8.6	83,079	6,874	0.25
Lower	Lower Missouri	355.76	0.2%	500	537,000	741.1	742.1	0.00011	8.9	98,650	7,077	0.25
Lower	Lower Missouri	355.76	0.133%	750	573,000	742.0	743.1	0.00011	9.1	104,093	7,087	0.25
Lower	Lower Missouri	355.76	0.100%	1,000	600,000	742.8	743.9	0.00011	9.2	108,989	7,096	0.25
Lower	Lower Missouri	355.76	0.080%	1,250	621,000	743.5	744.6	0.00011	9.3	112,883	7,105	0.25
Lower	Lower Missouri	355.76	0.067%	1,500	637,000	744.0	745.0	0.00011	9.4	115,730	7,112	0.25
Lower	Lower Missouri	356.1	10%	10	247,000	729.5	730.4	0.00012	7.4	34,309	3,376	0.25
Lower	Lower Missouri	356.1	1%	100	405,000	736.8	737.9	0.00012	8.8	69,876	7,432	0.26
Lower	Lower Missouri	356.1	0.5%	200	459,000	738.6	739.7	0.00012	9.1	80,981	7,522	0.26
Lower	Lower Missouri	356.1	0.2%	500	537,000	741.2	742.4	0.00012	9.4	97,001	7,564	0.26
Lower	Lower Missouri	356.1	0.133%	750	573,000	742.1	743.3	0.00012	9.7	102,575	7,581	0.27
Lower	Lower Missouri	356.1	0.100%	1,000	600,000	743.0	744.1	0.00012	9.7	107,574	7,636	0.27
Lower	Lower Missouri	356.1	0.080%	1,250	621,000	743.6	744.8	0.00012	9.8	111,540	7,715	0.27
Lower	Lower Missouri	356.1	0.067%	1,500	637,000	744.1	745.3	0.00012	9.8	114,462	7,728	0.27
Lower	Lower Missouri	356.43	10%	10	247,000	729.6	730.7	0.00015	8.4	29,537	2,810	0.28
Lower	Lower Missouri	356.43	1%	100	405,000	736.8	738.2	0.00016	9.9	64,088	7,155	0.29
Lower	Lower Missouri	356.43	0.5%	200	459,000	738.7	740.1	0.00016	10.2	74,674	7,254	0.30
Lower	Lower Missouri	356.43	0.2%	500	537,000	741.3	742.7	0.00015	10.4	89,929	7,554	0.29
Lower	Lower Missouri	356.43	0.133%	750	573,000	742.2	743.6	0.00015	10.6	95,243	7,672	0.30
Lower	Lower Missouri	356.43	0.100%	1,000	600,000	743.0	744.4	0.00015	10.7	99,989	7,736	0.30
Lower	Lower Missouri	356.43	0.080%	1,250	621,000	743.7	745.1	0.00015	10.7	103,754	7,775	0.29
Lower	Lower Missouri	356.43	0.067%	1,500	637,000	744.2	745.6	0.00015	10.8	106,511	7,808	0.29
Lower	Lower Missouri	356.77	10%	10	247,000	730.0	730.9	0.00013	7.8	32,604	2,828	0.26
Lower	Lower Missouri	356.77	1%	100	405,000	737.2	738.4	0.00014	9.3	65,425	7,022	0.28
Lower	Lower Missouri	356.77	0.5%	200	459,000	739.1	740.3	0.00014	9.6	76,918	7,212	0.28
Lower	Lower Missouri	356.77	0.2%	500	537,000	741.7	742.9	0.00014	9.9	93,598	7,487	0.28
Lower	Lower Missouri	356.77	0.133%	750	573,000	742.6	743.9	0.00014	10.1	99,489	7,669	0.28
Lower	Lower Missouri	356.77	0.100%	1,000	600,000	743.4	744.7	0.00013	10.1	104,699	7,925	0.28
Lower	Lower Missouri	356.77	0.080%	1,250	621,000	744.1	745.3	0.00013	10.2	108,824	7,937	0.28
Lower	Lower Missouri	356.77	0.067%	1,500	637,000	744.5	745.8	0.00013	10.2	111,851	7,952	0.28
Lower	Lower Missouri	357.06	10%	10	247,000	730.1	731.2	0.00016	8.8	33,217	2,921	0.29
Lower	Lower Missouri	357.06	1%	100	405,000	737.3	738.7	0.00016	10.2	67,646	6,574	0.30
Lower	Lower Missouri	357.06	0.5%	200	459,000	739.2	740.6	0.00016	10.5	78,442	6,663	0.30

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	357.06	0.2%	500	537,000	741.8	743.2	0.00015	10.8	93,706	6,699	0.30
Lower	Lower Missouri	357.06	0.133%	750	573,000	742.7	744.2	0.00016	11.0	99,103	6,708	0.30
Lower	Lower Missouri	357.06	0.100%	1,000	600,000	743.5	745.0	0.00016	11.1	103,855	6,716	0.30
Lower	Lower Missouri	357.06	0.080%	1,250	621,000	744.2	745.6	0.00015	11.1	107,614	6,722	0.30
Lower	Lower Missouri	357.06	0.067%	1,500	637,000	744.6	746.1	0.00015	11.2	110,372	6,727	0.30
Lower	Lower Missouri	357.3	10%	10	247,000	730.3	731.5	0.00017	8.8	34,777	2,567	0.29
Lower	Lower Missouri	357.3	1%	100	405,000	737.6	739.0	0.00018	10.1	70,222	6,274	0.31
Lower	Lower Missouri	357.3	0.5%	200	459,000	739.4	740.8	0.00018	10.4	81,765	6,335	0.31
Lower	Lower Missouri	357.3	0.2%	500	537,000	742.0	743.4	0.00017	10.6	98,284	6,355	0.31
Lower	Lower Missouri	357.3	0.133%	750	573,000	742.9	744.4	0.00017	10.9	104,173	6,362	0.31
Lower	Lower Missouri	357.3	0.100%	1,000	600,000	743.8	745.2	0.00017	10.9	109,329	6,368	0.31
Lower	Lower Missouri	357.3	0.080%	1,250	621,000	744.4	745.8	0.00017	11.0	113,406	6,373	0.31
Lower	Lower Missouri	357.3	0.067%	1,500	637,000	744.9	746.3	0.00016	11.0	116,400	6,377	0.31
Lower	Lower Missouri	357.63	10%	10	245,000	730.9	731.7	0.00012	7.5	40,282	2,895	0.25
Lower	Lower Missouri	357.63	1%	100	401,000	738.3	739.3	0.00014	8.6	75,964	6,361	0.27
Lower	Lower Missouri	357.63	0.5%	200	454,000	740.1	741.1	0.00014	8.9	87,489	6,404	0.28
Lower	Lower Missouri	357.63	0.2%	500	530,000	742.6	743.7	0.00014	9.2	103,963	6,425	0.27
Lower	Lower Missouri	357.63	0.133%	750	565,000	743.6	744.7	0.00014	9.4	109,946	6,433	0.28
Lower	Lower Missouri	357.63	0.100%	1,000	590,000	744.4	745.5	0.00013	9.5	115,130	6,443	0.27
Lower	Lower Missouri	357.63	0.080%	1,250	610,000	745.0	746.1	0.00013	9.5	119,206	6,446	0.27
Lower	Lower Missouri	357.63	0.067%	1,500	625,000	745.5	746.6	0.00013	9.5	122,212	6,449	0.27
Lower	Lower Missouri	357.94	10%	10	245,000	731.1	731.9	0.00013	7.5	36,563	1,569	0.24
Lower	Lower Missouri	357.94	1%	100	401,000	738.3	739.6	0.00016	9.4	59,222	4,462	0.28
Lower	Lower Missouri	357.94	0.5%	200	454,000	740.1	741.5	0.00016	9.9	67,662	4,855	0.29
Lower	Lower Missouri	357.94	0.2%	500	530,000	742.6	744.1	0.00017	10.5	79,811	4,872	0.29
Lower	Lower Missouri	357.94	0.133%	750	565,000	743.5	745.1	0.00017	10.8	84,230	4,878	0.30
Lower	Lower Missouri	357.94	0.100%	1,000	590,000	744.3	745.9	0.00017	10.9	88,070	4,883	0.30
Lower	Lower Missouri	357.94	0.080%	1,250	610,000	744.9	746.5	0.00017	11.0	91,094	4,887	0.30
Lower	Lower Missouri	357.94	0.067%	1,500	625,000	745.3	747.0	0.00017	11.1	93,325	4,890	0.30
Lower	Lower Missouri	358.26	10%	10	245,000	731.2	732.3	0.00016	8.3	29,801	1,195	0.27
Lower	Lower Missouri	358.26	1%	100	401,000	738.3	740.0	0.00020	10.7	46,275	3,311	0.31
Lower	Lower Missouri	358.26	0.5%	200	454,000	740.0	742.0	0.00021	11.4	51,994	3,327	0.33
Lower	Lower Missouri	358.26	0.2%	500	530,000	742.4	744.6	0.00022	12.2	60,060	3,349	0.34
Lower	Lower Missouri	358.26	0.133%	750	565,000	743.3	745.6	0.00023	12.6	62,978	3,357	0.35
Lower	Lower Missouri	358.26	0.100%	1,000	590,000	744.1	746.4	0.00023	12.8	65,528	3,365	0.35
Lower	Lower Missouri	358.26	0.080%	1,250	610,000	744.7	747.1	0.00024	13.0	67,535	3,370	0.35
Lower	Lower Missouri	358.26	0.067%	1,500	625,000	745.1	747.6	0.00024	13.1	69,018	3,374	0.35
Lower	Lower Missouri	358.57	10%	10	245,000	731.7	732.5	0.00010	7.0	37,065	1,819	0.22
Lower	Lower Missouri	358.57	1%	100	401,000	739.1	740.3	0.00013	8.9	53,986	2,537	0.26
Lower	Lower Missouri	358.57	0.5%	200	454,000	740.9	742.3	0.00014	9.6	58,538	2,569	0.27
Lower	Lower Missouri	358.57	0.2%	500	530,000	743.4	745.0	0.00015	10.4	64,877	2,585	0.28
Lower	Lower Missouri	358.57	0.133%	750	565,000	744.3	746.0	0.00016	10.8	67,215	2,591	0.29
Lower	Lower Missouri	358.57	0.100%	1,000	590,000	745.0	746.8	0.00016	11.0	69,188	2,596	0.30
Lower	Lower Missouri	358.57	0.080%	1,250	610,000	745.6	747.5	0.00017	11.2	70,738	2,600	0.30
Lower	Lower Missouri	358.57	0.067%	1,500	625,000	746.1	748.0	0.00017	11.3	71,880	2,603	0.30
Lower	Lower Missouri	358.91	10%	10	245,000	731.9	732.7	0.00015	7.4	33,702	1,783	0.25
Lower	Lower Missouri	358.91	1%	100	401,000	739.3	740.6	0.00017	9.3	50,656	2,436	0.28
Lower	Lower Missouri	358.91	0.5%	200	454,000	741.1	742.6	0.00018	10.0	55,040	2,448	0.29
Lower	Lower Missouri	358.91	0.2%	500	530,000	743.6	745.3	0.00019	10.8	61,120	2,466	0.30
Lower	Lower Missouri	358.91	0.133%	750	565,000	744.5	746.3	0.00020	11.2	63,375	2,473	0.31
Lower	Lower Missouri	358.91	0.100%	1,000	590,000	745.3	747.2	0.00020	11.4	65,268	2,478	0.31
Lower	Lower Missouri	358.91	0.080%	1,250	610,000	745.9	747.8	0.00021	11.6	66,756	2,483	0.32
Lower	Lower Missouri	358.91	0.067%	1,500	625,000	746.3	748.3	0.00021	11.7	67,848	2,486	0.32
Lower	Lower Missouri	359.26	10%	10	245,000	732.0	733.1	0.00020	8.5	29,548	1,527	0.29
Lower	Lower Missouri	359.26	1%	100	401,000	739.4	741.1	0.00022	10.5	47,081	2,550	0.32

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	359.26	0.5%	200	454,000	741.2	743.1	0.00023	11.2	51,705	2,590	0.33
Lower	Lower Missouri	359.26	0.2%	500	530,000	743.7	745.8	0.00025	12.0	58,198	2,646	0.34
Lower	Lower Missouri	359.26	0.133%	750	565,000	744.6	746.9	0.00026	12.5	60,623	2,657	0.35
Lower	Lower Missouri	359.26	0.100%	1,000	590,000	745.4	747.7	0.00026	12.7	62,663	2,663	0.35
Lower	Lower Missouri	359.26	0.080%	1,250	610,000	746.0	748.4	0.00026	12.9	64,267	2,667	0.35
Lower	Lower Missouri	359.26	0.067%	1,500	625,000	746.4	748.9	0.00026	13.0	65,444	2,671	0.36
Lower	Lower Missouri	359.318*	10%	10	245,000	732.1	733.2	0.00018	8.4	29,580	1,575	0.28
Lower	Lower Missouri	359.318*	1%	100	401,000	739.5	741.2	0.00021	10.6	46,994	2,606	0.31
Lower	Lower Missouri	359.318*	0.5%	200	454,000	741.3	743.2	0.00023	11.3	51,688	2,609	0.32
Lower	Lower Missouri	359.318*	0.2%	500	530,000	743.8	745.9	0.00024	12.1	58,160	2,611	0.34
Lower	Lower Missouri	359.318*	0.133%	750	565,000	744.7	747.0	0.00025	12.6	60,562	2,612	0.35
Lower	Lower Missouri	359.318*	0.100%	1,000	590,000	745.5	747.8	0.00025	12.8	62,563	2,613	0.35
Lower	Lower Missouri	359.318*	0.080%	1,250	610,000	746.1	748.5	0.00026	13.0	64,133	2,614	0.35
Lower	Lower Missouri	359.318*	0.067%	1,500	625,000	746.5	749.0	0.00026	13.2	65,284	2,614	0.35
Lower		359.324	Turman Lift Bridge									
Lower	Lower Missouri	359.33	10%	10	245,000	732.2	733.3	0.00017	8.3	30,056	1,765	0.27
Lower	Lower Missouri	359.33	1%	100	401,000	739.8	741.4	0.00020	10.4	47,764	2,522	0.30
Lower	Lower Missouri	359.33	0.5%	200	454,000	741.6	743.4	0.00021	11.1	52,454	2,537	0.32
Lower	Lower Missouri	359.33	0.2%	500	530,000	744.2	746.3	0.00023	12.0	59,000	2,539	0.33
Lower	Lower Missouri	359.33	0.133%	750	565,000	745.2	747.4	0.00024	12.4	61,463	2,540	0.34
Lower	Lower Missouri	359.33	0.100%	1,000	590,000	746.0	748.3	0.00024	12.6	63,494	2,541	0.34
Lower	Lower Missouri	359.33	0.080%	1,250	610,000	746.6	748.9	0.00024	12.8	65,092	2,542	0.34
Lower	Lower Missouri	359.33	0.067%	1,500	625,000	747.0	749.5	0.00024	12.9	66,266	2,542	0.34
Lower	Lower Missouri	359.39	10%	10	245,000	732.3	733.4	0.00018	8.4	29,557	1,295	0.28
Lower	Lower Missouri	359.39	1%	100	401,000	739.8	741.5	0.00021	10.6	44,904	2,580	0.31
Lower	Lower Missouri	359.39	0.5%	200	454,000	741.6	743.5	0.00023	11.2	49,694	2,600	0.32
Lower	Lower Missouri	359.39	0.2%	500	530,000	744.2	746.4	0.00024	12.1	56,463	2,629	0.34
Lower	Lower Missouri	359.39	0.133%	750	565,000	745.2	747.5	0.00025	12.5	59,027	2,640	0.34
Lower	Lower Missouri	359.39	0.100%	1,000	590,000	746.0	748.3	0.00025	12.7	61,148	2,649	0.35
Lower	Lower Missouri	359.39	0.080%	1,250	610,000	746.6	749.0	0.00025	12.9	62,822	2,656	0.35
Lower	Lower Missouri	359.39	0.067%	1,500	625,000	747.1	749.5	0.00025	13.0	64,055	2,661	0.35
Lower	Lower Missouri	359.55	10%	10	245,000	732.3	733.6	0.00028	9.3	26,721	1,203	0.32
Lower	Lower Missouri	359.55	1%	100	401,000	739.8	741.8	0.00030	11.5	41,119	2,416	0.35
Lower	Lower Missouri	359.55	0.5%	200	454,000	741.6	743.8	0.00031	12.2	45,636	2,475	0.36
Lower	Lower Missouri	359.55	0.2%	500	530,000	744.2	746.7	0.00033	13.0	52,154	2,557	0.37
Lower	Lower Missouri	359.55	0.133%	750	565,000	745.2	747.8	0.00034	13.4	54,627	2,588	0.38
Lower	Lower Missouri	359.55	0.100%	1,000	590,000	746.0	748.7	0.00034	13.7	56,711	2,613	0.38
Lower	Lower Missouri	359.55	0.080%	1,250	610,000	746.6	749.4	0.00034	13.8	58,366	2,633	0.39
Lower	Lower Missouri	359.55	0.067%	1,500	625,000	747.1	749.9	0.00034	14.0	59,589	2,648	0.39
Lower	Lower Missouri	359.85	10%	10	245,000	733.0	734.0	0.00017	8.1	30,277	1,026	0.26
Lower	Lower Missouri	359.85	1%	100	401,000	740.5	742.2	0.00021	10.5	43,884	2,377	0.30
Lower	Lower Missouri	359.85	0.5%	200	454,000	742.4	744.3	0.00023	11.2	48,419	2,460	0.31
Lower	Lower Missouri	359.85	0.2%	500	530,000	745.0	747.1	0.00024	12.1	54,923	2,538	0.33
Lower	Lower Missouri	359.85	0.133%	750	565,000	746.0	748.3	0.00025	12.5	57,427	2,567	0.33
Lower	Lower Missouri	359.85	0.100%	1,000	590,000	746.8	749.2	0.00026	12.7	59,492	2,591	0.34
Lower	Lower Missouri	359.85	0.080%	1,250	610,000	747.4	749.9	0.00026	12.9	61,130	2,610	0.34
Lower	Lower Missouri	359.85	0.067%	1,500	625,000	747.9	750.4	0.00026	13.1	62,340	2,624	0.34
Lower	Lower Missouri	360.14	10%	10	245,000	733.4	734.2	0.00014	7.3	33,379	1,107	0.23
Lower	Lower Missouri	360.14	1%	100	401,000	741.1	742.5	0.00018	9.5	48,589	2,506	0.27
Lower	Lower Missouri	360.14	0.5%	200	454,000	743.1	744.6	0.00019	10.2	53,465	2,540	0.28
Lower	Lower Missouri	360.14	0.2%	500	530,000	745.8	747.5	0.00020	11.0	60,328	2,587	0.29
Lower	Lower Missouri	360.14	0.133%	750	565,000	746.8	748.7	0.00021	11.4	62,925	2,607	0.30
Lower	Lower Missouri	360.14	0.100%	1,000	590,000	747.6	749.6	0.00022	11.6	65,060	2,624	0.30
Lower	Lower Missouri	360.14	0.080%	1,250	610,000	748.2	750.3	0.00022	11.8	66,776	2,638	0.31
Lower	Lower Missouri	360.14	0.067%	1,500	625,000	748.7	750.8	0.00022	11.9	68,023	2,648	0.31

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	360.223*	10%	10	245,000	733.4	734.3	0.00015	7.8	31,334	996	0.25
Lower	Lower Missouri	360.223*	1%	100	401,000	741.1	742.6	0.00019	10.0	47,591	2,578	0.28
Lower	Lower Missouri	360.223*	0.5%	200	454,000	743.1	744.8	0.00020	10.6	52,664	2,656	0.29
Lower	Lower Missouri	360.223*	0.2%	500	530,000	745.8	747.7	0.00021	11.4	59,840	2,670	0.30
Lower	Lower Missouri	360.223*	0.133%	750	565,000	746.8	748.8	0.00022	11.8	62,535	2,675	0.31
Lower	Lower Missouri	360.223*	0.100%	1,000	590,000	747.6	749.7	0.00022	12.0	64,731	2,678	0.31
Lower	Lower Missouri	360.223*	0.080%	1,250	610,000	748.3	750.4	0.00022	12.2	66,485	2,680	0.32
Lower	Lower Missouri	360.223*	0.067%	1,500	625,000	748.7	750.9	0.00022	12.3	67,756	2,682	0.32
Lower		360.229	I-435 Bridge									
Lower	Lower Missouri	360.25	10%	10	245,000	733.5	734.4	0.00014	7.4	32,978	985	0.23
Lower	Lower Missouri	360.25	1%	100	401,000	741.3	742.7	0.00017	9.6	49,975	2,604	0.26
Lower	Lower Missouri	360.25	0.5%	200	454,000	743.3	744.9	0.00019	10.3	55,094	2,635	0.28
Lower	Lower Missouri	360.25	0.2%	500	530,000	745.9	747.7	0.00020	11.1	62,141	2,658	0.29
Lower	Lower Missouri	360.25	0.133%	750	565,000	746.9	748.9	0.00021	11.5	64,823	2,667	0.30
Lower	Lower Missouri	360.25	0.100%	1,000	590,000	747.8	749.8	0.00021	11.7	67,023	2,672	0.30
Lower	Lower Missouri	360.25	0.080%	1,250	610,000	748.4	750.5	0.00022	11.9	68,760	2,676	0.30
Lower	Lower Missouri	360.25	0.067%	1,500	625,000	748.9	751.0	0.00022	12.1	70,019	2,679	0.30
Lower	Lower Missouri	360.29	10%	10	245,000	733.5	734.5	0.00017	7.9	31,048	1,096	0.25
Lower	Lower Missouri	360.29	1%	100	401,000	741.2	742.8	0.00020	10.1	47,461	2,581	0.28
Lower	Lower Missouri	360.29	0.5%	200	454,000	743.2	744.9	0.00022	10.8	52,495	2,597	0.30
Lower	Lower Missouri	360.29	0.2%	500	530,000	745.8	747.8	0.00023	11.6	59,427	2,618	0.31
Lower	Lower Missouri	360.29	0.133%	750	565,000	746.8	749.0	0.00024	12.0	62,059	2,627	0.32
Lower	Lower Missouri	360.29	0.100%	1,000	590,000	747.7	749.9	0.00024	12.3	64,223	2,633	0.32
Lower	Lower Missouri	360.29	0.080%	1,250	610,000	748.3	750.6	0.00025	12.5	65,933	2,639	0.32
Lower	Lower Missouri	360.29	0.067%	1,500	625,000	748.8	751.1	0.00025	12.6	67,172	2,642	0.32
Lower	Lower Missouri	360.61	10%	10	245,000	733.7	734.8	0.00018	8.1	30,295	978	0.26
Lower	Lower Missouri	360.61	1%	100	401,000	741.5	743.2	0.00022	10.4	44,299	2,807	0.30
Lower	Lower Missouri	360.61	0.5%	200	454,000	743.5	745.3	0.00024	11.1	49,884	2,895	0.31
Lower	Lower Missouri	360.61	0.2%	500	530,000	746.2	748.3	0.00025	11.9	57,716	2,944	0.32
Lower	Lower Missouri	360.61	0.133%	750	565,000	747.2	749.4	0.00026	12.3	60,727	2,961	0.33
Lower	Lower Missouri	360.61	0.100%	1,000	590,000	748.0	750.3	0.00026	12.5	63,193	2,976	0.33
Lower	Lower Missouri	360.61	0.080%	1,250	610,000	748.7	751.0	0.00026	12.7	65,146	2,987	0.33
Lower	Lower Missouri	360.61	0.067%	1,500	625,000	749.1	751.5	0.00027	12.8	66,566	2,995	0.33
Lower	Lower Missouri	360.91	10%	10	245,000	734.0	735.0	0.00018	8.1	30,411	1,160	0.26
Lower	Lower Missouri	360.91	1%	100	401,000	741.9	743.5	0.00022	10.4	42,715	2,429	0.30
Lower	Lower Missouri	360.91	0.5%	200	454,000	743.8	745.7	0.00024	11.1	47,807	2,672	0.31
Lower	Lower Missouri	360.91	0.2%	500	530,000	746.5	748.7	0.00025	11.9	55,260	2,865	0.32
Lower	Lower Missouri	360.91	0.133%	750	565,000	747.6	749.8	0.00026	12.3	58,239	2,924	0.33
Lower	Lower Missouri	360.91	0.100%	1,000	590,000	748.4	750.7	0.00027	12.6	60,690	2,971	0.33
Lower	Lower Missouri	360.91	0.080%	1,250	610,000	749.0	751.5	0.00027	12.8	62,651	3,008	0.33
Lower	Lower Missouri	360.91	0.067%	1,500	625,000	749.5	752.0	0.00027	12.9	64,088	3,035	0.34
Lower	Lower Missouri	361.23	10%	10	245,000	734.4	735.4	0.00021	8.0	31,143	1,233	0.26
Lower	Lower Missouri	361.23	1%	100	401,000	742.4	743.9	0.00024	10.0	47,232	2,371	0.29
Lower	Lower Missouri	361.23	0.5%	200	454,000	744.5	746.1	0.00025	10.6	52,112	2,413	0.30
Lower	Lower Missouri	361.23	0.2%	500	530,000	747.2	749.1	0.00026	11.4	58,936	2,580	0.31
Lower	Lower Missouri	361.23	0.133%	750	565,000	748.3	750.3	0.00027	11.7	61,706	2,628	0.32
Lower	Lower Missouri	361.23	0.100%	1,000	590,000	749.1	751.2	0.00027	11.9	63,948	2,667	0.32
Lower	Lower Missouri	361.23	0.080%	1,250	610,000	749.8	751.9	0.00027	12.1	65,735	2,698	0.32
Lower	Lower Missouri	361.23	0.067%	1,500	625,000	750.3	752.4	0.00028	12.3	67,039	3,033	0.33
Lower	Lower Missouri	361.54	10%	10	245,000	734.8	735.7	0.00016	7.6	32,504	1,126	0.24
Lower	Lower Missouri	361.54	1%	100	401,000	742.8	744.3	0.00020	9.7	46,932	2,311	0.27
Lower	Lower Missouri	361.54	0.5%	200	454,000	744.9	746.5	0.00021	10.4	51,685	2,345	0.28
Lower	Lower Missouri	361.54	0.2%	500	530,000	747.6	749.5	0.00023	11.2	58,325	2,530	0.30
Lower	Lower Missouri	361.54	0.133%	750	565,000	748.7	750.7	0.00024	11.6	61,088	2,640	0.30

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	361.54	0.100%	1,000	590,000	749.6	751.6	0.00024	11.8	63,336	2,686	0.31
Lower	Lower Missouri	361.54	0.080%	1,250	610,000	750.2	752.3	0.00024	12.0	65,154	2,761	0.31
Lower	Lower Missouri	361.54	0.067%	1,500	625,000	750.7	752.9	0.00025	12.2	66,462	2,791	0.31
Lower	Lower Missouri	361.84	10%	10	245,000	735.0	736.0	0.00017	7.7	31,809	1,102	0.24
Lower	Lower Missouri	361.84	1%	100	401,000	743.1	744.6	0.00021	9.9	46,192	2,316	0.28
Lower	Lower Missouri	361.84	0.5%	200	454,000	745.2	746.9	0.00022	10.6	51,017	2,383	0.29
Lower	Lower Missouri	361.84	0.2%	500	530,000	748.0	749.9	0.00024	11.4	57,803	2,507	0.30
Lower	Lower Missouri	361.84	0.133%	750	565,000	749.0	751.1	0.00024	11.8	60,542	2,569	0.31
Lower	Lower Missouri	361.84	0.100%	1,000	590,000	749.9	752.0	0.00025	12.1	62,735	2,590	0.31
Lower	Lower Missouri	361.84	0.080%	1,250	610,000	750.6	752.7	0.00025	12.2	64,471	2,602	0.31
Lower	Lower Missouri	361.84	0.067%	1,500	625,000	751.0	753.3	0.00025	12.4	65,709	2,610	0.31
Lower	Lower Missouri	362.17	10%	10	245,000	735.5	736.3	0.00014	6.8	40,222	2,302	0.22
Lower	Lower Missouri	362.17	1%	100	401,000	744.0	745.0	0.00015	8.4	59,858	2,357	0.24
Lower	Lower Missouri	362.17	0.5%	200	454,000	746.1	747.3	0.00016	8.9	64,945	2,372	0.24
Lower	Lower Missouri	362.17	0.2%	500	530,000	749.0	750.3	0.00017	9.6	71,841	2,394	0.25
Lower	Lower Missouri	362.17	0.133%	750	565,000	750.2	751.5	0.00017	9.9	74,574	2,410	0.26
Lower	Lower Missouri	362.17	0.100%	1,000	590,000	751.0	752.5	0.00017	10.1	76,700	2,426	0.26
Lower	Lower Missouri	362.17	0.080%	1,250	610,000	751.7	753.2	0.00018	10.2	78,380	2,439	0.26
Lower	Lower Missouri	362.17	0.067%	1,500	625,000	752.2	753.7	0.00018	10.4	79,585	2,456	0.26
Lower	Lower Missouri	362.234*	10%	10	245,000	735.5	736.4	0.00016	7.5	34,329	1,568	0.24
Lower	Lower Missouri	362.234*	1%	100	401,000	743.8	745.1	0.00019	9.3	52,653	2,437	0.26
Lower	Lower Missouri	362.234*	0.5%	200	454,000	746.0	747.4	0.00019	9.9	57,877	2,447	0.27
Lower	Lower Missouri	362.234*	0.2%	500	530,000	748.8	750.5	0.00020	10.6	64,929	2,456	0.28
Lower	Lower Missouri	362.234*	0.133%	750	565,000	750.0	751.7	0.00021	10.9	67,707	2,459	0.29
Lower	Lower Missouri	362.234*	0.100%	1,000	590,000	750.9	752.6	0.00021	11.1	69,860	2,468	0.29
Lower	Lower Missouri	362.234*	0.080%	1,250	610,000	751.5	753.4	0.00022	11.3	71,560	2,477	0.29
Lower	Lower Missouri	362.234*	0.067%	1,500	625,000	752.0	753.9	0.00022	11.4	72,777	2,479	0.29
Lower		362.24	Choteau Bridge									
Lower	Lower Missouri	362.25	10%	10	245,000	735.5	736.4	0.00018	7.6	33,621	1,329	0.24
Lower	Lower Missouri	362.25	1%	100	401,000	743.9	745.2	0.00021	9.5	51,299	2,414	0.27
Lower	Lower Missouri	362.25	0.5%	200	454,000	746.0	747.5	0.00022	10.1	56,514	2,428	0.27
Lower	Lower Missouri	362.25	0.2%	500	530,000	749.0	750.6	0.00023	10.8	63,646	2,447	0.28
Lower	Lower Missouri	362.25	0.133%	750	565,000	750.1	751.9	0.00023	11.1	66,442	2,455	0.29
Lower	Lower Missouri	362.25	0.100%	1,000	590,000	751.0	752.8	0.00024	11.3	68,626	2,462	0.29
Lower	Lower Missouri	362.25	0.080%	1,250	610,000	751.7	753.6	0.00024	11.5	70,352	2,477	0.29
Lower	Lower Missouri	362.25	0.067%	1,500	625,000	752.2	754.1	0.00024	11.6	71,585	2,483	0.30
Lower	Lower Missouri	362.27	10%	10	245,000	735.5	736.4	0.00018	7.6	33,927	1,361	0.24
Lower	Lower Missouri	362.27	1%	100	401,000	743.9	745.3	0.00021	9.5	51,394	2,388	0.26
Lower	Lower Missouri	362.27	0.5%	200	454,000	746.1	747.6	0.00022	10.1	56,559	2,412	0.27
Lower	Lower Missouri	362.27	0.2%	500	530,000	749.0	750.7	0.00023	10.8	63,653	2,445	0.28
Lower	Lower Missouri	362.27	0.133%	750	565,000	750.1	751.9	0.00023	11.1	66,450	2,462	0.29
Lower	Lower Missouri	362.27	0.100%	1,000	590,000	751.0	752.9	0.00024	11.3	68,645	2,482	0.29
Lower	Lower Missouri	362.27	0.080%	1,250	610,000	751.7	753.6	0.00024	11.5	70,388	2,498	0.29
Lower	Lower Missouri	362.27	0.067%	1,500	625,000	752.2	754.1	0.00024	11.6	71,625	2,507	0.30
Lower	Lower Missouri	362.54	10%	10	245,000	736.0	736.7	0.00016	6.8	36,956	1,635	0.22
Lower	Lower Missouri	362.54	1%	100	401,000	744.5	745.5	0.00017	8.4	55,299	3,137	0.24
Lower	Lower Missouri	362.54	0.5%	200	454,000	746.7	747.8	0.00018	8.9	61,080	3,164	0.25
Lower	Lower Missouri	362.54	0.2%	500	530,000	749.7	751.0	0.00019	9.5	68,970	3,199	0.25
Lower	Lower Missouri	362.54	0.133%	750	565,000	750.8	752.2	0.00019	9.8	72,088	3,222	0.26
Lower	Lower Missouri	362.54	0.100%	1,000	590,000	751.7	753.2	0.00019	10.0	74,502	3,243	0.26
Lower	Lower Missouri	362.54	0.080%	1,250	610,000	752.4	753.9	0.00019	10.1	76,407	3,260	0.26
Lower	Lower Missouri	362.54	0.067%	1,500	625,000	752.9	754.5	0.00019	10.2	77,766	3,272	0.26
Lower	Lower Missouri	362.85	10%	10	245,000	736.3	736.9	0.00015	6.2	39,693	1,686	0.21
Lower	Lower Missouri	362.85	1%	100	401,000	744.9	745.8	0.00015	7.5	59,558	3,288	0.22

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	362.85	0.5%	200	454,000	747.2	748.1	0.00016	8.0	65,552	4,087	0.23
Lower	Lower Missouri	362.85	0.2%	500	530,000	750.2	751.3	0.00016	8.5	73,782	4,683	0.23
Lower	Lower Missouri	362.85	0.133%	750	565,000	751.4	752.5	0.00016	8.7	77,092	4,760	0.24
Lower	Lower Missouri	362.85	0.100%	1,000	590,000	752.3	753.5	0.00016	8.9	79,662	4,811	0.24
Lower	Lower Missouri	362.85	0.080%	1,250	610,000	753.0	754.2	0.00017	9.0	81,703	4,856	0.24
Lower	Lower Missouri	362.85	0.067%	1,500	625,000	753.5	754.8	0.00017	9.1	83,170	4,892	0.24
Lower	Lower Missouri	363.14	10%	10	245,000	736.5	737.2	0.00015	6.8	36,785	2,171	0.22
Lower	Lower Missouri	363.14	1%	100	401,000	745.1	746.1	0.00017	8.3	57,483	5,124	0.24
Lower	Lower Missouri	363.14	0.5%	200	454,000	747.3	748.4	0.00018	8.7	63,207	5,412	0.24
Lower	Lower Missouri	363.14	0.2%	500	530,000	750.3	751.6	0.00018	9.3	71,015	5,820	0.25
Lower	Lower Missouri	363.14	0.133%	750	565,000	751.5	752.8	0.00019	9.6	74,128	5,849	0.26
Lower	Lower Missouri	363.14	0.100%	1,000	590,000	752.4	753.8	0.00019	9.8	76,516	5,899	0.26
Lower	Lower Missouri	363.14	0.080%	1,250	610,000	753.1	754.6	0.00019	9.9	78,398	5,991	0.26
Lower	Lower Missouri	363.14	0.067%	1,500	625,000	753.7	755.1	0.00019	10.0	79,743	6,037	0.26
Lower	Lower Missouri	363.43	10%	10	245,000	736.4	737.7	0.00035	9.1	27,297	1,305	0.31
Lower	Lower Missouri	363.43	1%	100	401,000	744.9	746.7	0.00035	11.0	42,457	2,032	0.33
Lower	Lower Missouri	363.43	0.5%	200	454,000	747.1	749.1	0.00036	11.6	46,925	2,046	0.34
Lower	Lower Missouri	363.43	0.2%	500	530,000	750.0	752.3	0.00037	12.3	53,022	2,066	0.34
Lower	Lower Missouri	363.43	0.133%	750	565,000	751.2	753.5	0.00038	12.7	55,443	2,074	0.35
Lower	Lower Missouri	363.43	0.100%	1,000	590,000	752.1	754.5	0.00038	12.9	57,310	2,081	0.35
Lower	Lower Missouri	363.43	0.080%	1,250	610,000	752.8	755.3	0.00038	13.0	58,783	2,085	0.35
Lower	Lower Missouri	363.43	0.067%	1,500	625,000	753.3	755.8	0.00038	13.2	59,836	2,089	0.35
Lower	Lower Missouri	363.73	10%	10	245,000	737.2	738.2	0.00020	7.7	32,634	1,395	0.24
Lower	Lower Missouri	363.73	1%	100	401,000	745.8	747.2	0.00023	9.7	46,446	1,706	0.27
Lower	Lower Missouri	363.73	0.5%	200	454,000	748.0	749.6	0.00024	10.3	50,222	1,720	0.28
Lower	Lower Missouri	363.73	0.2%	500	530,000	751.0	752.8	0.00026	11.2	55,351	1,738	0.29
Lower	Lower Missouri	363.73	0.133%	750	565,000	752.1	754.1	0.00027	11.5	57,406	1,745	0.30
Lower	Lower Missouri	363.73	0.100%	1,000	590,000	753.0	755.1	0.00027	11.8	58,971	1,751	0.30
Lower	Lower Missouri	363.73	0.080%	1,250	610,000	753.7	755.8	0.00027	12.0	60,206	1,755	0.30
Lower	Lower Missouri	363.73	0.067%	1,500	625,000	754.2	756.4	0.00028	12.1	61,090	1,758	0.31
Lower	Lower Missouri	364.05	10%	10	245,000	737.6	738.5	0.00020	7.7	32,984	1,283	0.24
Lower	Lower Missouri	364.05	1%	100	401,000	746.2	747.6	0.00023	9.7	45,801	1,566	0.27
Lower	Lower Missouri	364.05	0.5%	200	454,000	748.4	750.0	0.00025	10.3	49,290	1,581	0.28
Lower	Lower Missouri	364.05	0.2%	500	530,000	751.4	753.2	0.00026	11.2	54,030	1,602	0.29
Lower	Lower Missouri	364.05	0.133%	750	565,000	752.6	754.5	0.00027	11.5	55,941	1,610	0.30
Lower	Lower Missouri	364.05	0.100%	1,000	590,000	753.5	755.5	0.00028	11.8	57,394	1,617	0.30
Lower	Lower Missouri	364.05	0.080%	1,250	610,000	754.2	756.3	0.00028	12.0	58,541	1,622	0.31
Lower	Lower Missouri	364.05	0.067%	1,500	625,000	754.7	756.9	0.00028	12.1	59,364	1,625	0.31
Lower	Lower Missouri	364.34	10%	10	245,000	737.9	738.8	0.00017	7.4	34,479	1,297	0.22
Lower	Lower Missouri	364.34	1%	100	401,000	746.6	747.9	0.00021	9.4	46,421	1,432	0.26
Lower	Lower Missouri	364.34	0.5%	200	454,000	748.8	750.4	0.00022	10.1	49,634	1,447	0.27
Lower	Lower Missouri	364.34	0.2%	500	530,000	751.8	753.6	0.00024	11.0	53,999	1,459	0.28
Lower	Lower Missouri	364.34	0.133%	750	565,000	753.0	755.0	0.00025	11.4	55,734	1,463	0.29
Lower	Lower Missouri	364.34	0.100%	1,000	590,000	753.9	755.9	0.00025	11.6	57,059	1,466	0.29
Lower	Lower Missouri	364.34	0.080%	1,250	610,000	754.6	756.7	0.00026	11.9	58,101	1,469	0.29
Lower	Lower Missouri	364.34	0.067%	1,500	625,000	755.1	757.3	0.00026	12.0	58,849	1,470	0.30
Lower	Lower Missouri	364.65	10%	10	245,000	738.2	739.1	0.00018	7.5	33,526	1,341	0.23
Lower	Lower Missouri	364.65	1%	100	401,000	746.9	748.3	0.00021	9.6	45,481	1,406	0.26
Lower	Lower Missouri	364.65	0.5%	200	454,000	749.1	750.7	0.00023	10.2	48,665	1,422	0.27
Lower	Lower Missouri	364.65	0.2%	500	530,000	752.2	754.0	0.00024	11.1	53,038	1,472	0.29
Lower	Lower Missouri	364.65	0.133%	750	565,000	753.4	755.4	0.00025	11.5	54,816	1,483	0.29
Lower	Lower Missouri	364.65	0.100%	1,000	590,000	754.3	756.4	0.00026	11.8	56,172	1,491	0.30
Lower	Lower Missouri	364.65	0.080%	1,250	610,000	755.0	757.2	0.00026	12.0	57,243	1,498	0.30
Lower	Lower Missouri	364.65	0.067%	1,500	625,000	755.5	757.7	0.00027	12.1	58,015	1,503	0.30
Lower	Lower Missouri	364.730*	10%	10	245,000	738.2	739.2	0.00020	7.7	32,517	1,354	0.24

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	364.730*	1%	100	401,000	747.0	748.4	0.00023	9.7	44,563	1,411	0.27
Lower	Lower Missouri	364.730*	0.5%	200	454,000	749.2	750.8	0.00024	10.4	47,772	1,435	0.28
Lower	Lower Missouri	364.730*	0.2%	500	530,000	752.2	754.2	0.00026	11.2	52,167	1,459	0.29
Lower	Lower Missouri	364.730*	0.133%	750	565,000	753.5	755.5	0.00027	11.7	53,932	1,468	0.30
Lower	Lower Missouri	364.730*	0.100%	1,000	590,000	754.4	756.5	0.00028	11.9	55,277	1,474	0.30
Lower	Lower Missouri	364.730*	0.080%	1,250	610,000	755.1	757.3	0.00028	12.1	56,338	1,479	0.31
Lower	Lower Missouri	364.730*	0.067%	1,500	625,000	755.6	757.9	0.00028	12.3	57,102	1,490	0.31
Lower		364.734	Paseo Bridge									
Lower	Lower Missouri	364.75	10%	10	245,000	738.3	739.2	0.00022	7.8	32,301	1,355	0.25
Lower	Lower Missouri	364.75	1%	100	401,000	747.0	748.5	0.00025	9.8	44,401	1,413	0.27
Lower	Lower Missouri	364.75	0.5%	200	454,000	749.3	750.9	0.00027	10.4	47,624	1,428	0.28
Lower	Lower Missouri	364.75	0.2%	500	530,000	752.3	754.3	0.00028	11.3	52,021	1,462	0.30
Lower	Lower Missouri	364.75	0.133%	750	565,000	753.6	755.6	0.00029	11.7	53,801	1,471	0.30
Lower	Lower Missouri	364.75	0.100%	1,000	590,000	754.5	756.6	0.00030	11.9	55,155	1,478	0.31
Lower	Lower Missouri	364.75	0.080%	1,250	610,000	755.2	757.4	0.00030	12.1	56,224	1,483	0.31
Lower	Lower Missouri	364.75	0.067%	1,500	625,000	755.7	758.0	0.00031	12.3	56,993	1,487	0.31
Lower	Lower Missouri	364.78	10%	10	245,000	738.3	739.3	0.00025	8.1	30,957	1,229	0.26
Lower	Lower Missouri	364.78	1%	100	401,000	747.0	748.6	0.00028	10.1	42,597	1,396	0.29
Lower	Lower Missouri	364.78	0.5%	200	454,000	749.3	751.0	0.00029	10.8	45,775	1,412	0.30
Lower	Lower Missouri	364.78	0.2%	500	530,000	752.3	754.3	0.00031	11.6	50,115	1,443	0.31
Lower	Lower Missouri	364.78	0.133%	750	565,000	753.5	755.7	0.00032	12.0	51,868	1,453	0.31
Lower	Lower Missouri	364.78	0.100%	1,000	590,000	754.4	756.7	0.00033	12.3	53,202	1,459	0.32
Lower	Lower Missouri	364.78	0.080%	1,250	610,000	755.2	757.5	0.00033	12.5	54,256	1,465	0.32
Lower	Lower Missouri	364.78	0.067%	1,500	625,000	755.7	758.1	0.00034	12.6	55,014	1,469	0.32
Lower	Lower Missouri	365.1	10%	10	245,000	738.8	739.7	0.00019	7.5	33,312	1,274	0.23
Lower	Lower Missouri	365.1	1%	100	401,000	747.6	749.0	0.00023	9.5	45,270	1,396	0.26
Lower	Lower Missouri	365.1	0.5%	200	454,000	749.9	751.5	0.00024	10.1	48,506	1,411	0.27
Lower	Lower Missouri	365.1	0.2%	500	530,000	753.0	754.8	0.00026	11.0	52,925	1,452	0.28
Lower	Lower Missouri	365.1	0.133%	750	565,000	754.3	756.2	0.00027	11.4	54,741	1,478	0.29
Lower	Lower Missouri	365.1	0.100%	1,000	590,000	755.2	757.2	0.00028	11.6	56,123	1,486	0.29
Lower	Lower Missouri	365.1	0.080%	1,250	610,000	755.9	758.0	0.00028	11.8	57,215	1,492	0.30
Lower	Lower Missouri	365.1	0.067%	1,500	625,000	756.5	758.6	0.00028	12.0	58,003	1,497	0.30
Lower	Lower Missouri	365.43	10%	10	245,000	739.1	740.0	0.00023	7.9	32,229	1,335	0.25
Lower	Lower Missouri	365.43	1%	100	401,000	748.0	749.4	0.00026	9.8	44,367	1,396	0.27
Lower	Lower Missouri	365.43	0.5%	200	454,000	750.3	751.9	0.00027	10.4	47,633	1,412	0.28
Lower	Lower Missouri	365.43	0.2%	500	530,000	753.4	755.3	0.00029	11.3	52,105	1,456	0.30
Lower	Lower Missouri	365.43	0.133%	750	565,000	754.7	756.7	0.00030	11.7	53,944	1,474	0.30
Lower	Lower Missouri	365.43	0.100%	1,000	590,000	755.6	757.7	0.00030	11.9	55,335	1,485	0.31
Lower	Lower Missouri	365.43	0.080%	1,250	610,000	756.4	758.5	0.00030	12.1	56,436	1,493	0.31
Lower	Lower Missouri	365.43	0.067%	1,500	625,000	756.9	759.1	0.00031	12.3	57,234	1,508	0.31
Lower	Lower Missouri	365.521*	10%	10	245,000	739.4	740.2	0.00019	7.1	35,076	1,403	0.22
Lower	Lower Missouri	365.521*	1%	100	401,000	748.4	749.6	0.00021	8.9	47,910	1,458	0.25
Lower	Lower Missouri	365.521*	0.5%	200	454,000	750.7	752.1	0.00022	9.5	51,392	1,473	0.26
Lower	Lower Missouri	365.521*	0.2%	500	530,000	753.9	755.5	0.00023	10.3	56,116	1,508	0.27
Lower	Lower Missouri	365.521*	0.133%	750	565,000	755.2	756.9	0.00024	10.6	58,065	1,530	0.27
Lower	Lower Missouri	365.521*	0.100%	1,000	590,000	756.1	757.9	0.00024	10.8	59,538	1,547	0.28
Lower	Lower Missouri	365.521*	0.080%	1,250	610,000	756.9	758.7	0.00024	11.0	60,708	1,564	0.28
Lower	Lower Missouri	365.521*	0.067%	1,500	625,000	757.4	759.3	0.00025	11.2	61,560	12,976	0.28
Lower		365.53	Heart of America Bridge									
Lower	Lower Missouri	365.56	10%	10	245,000	739.5	740.2	0.00017	6.9	36,350	1,430	0.21
Lower	Lower Missouri	365.56	1%	100	401,000	748.5	749.7	0.00019	8.6	49,486	1,484	0.24
Lower	Lower Missouri	365.56	0.5%	200	454,000	750.9	752.2	0.00020	9.2	53,055	1,499	0.25
Lower	Lower Missouri	365.56	0.2%	500	530,000	754.1	755.6	0.00021	9.9	57,892	1,529	0.26
Lower	Lower Missouri	365.56	0.133%	750	565,000	755.4	757.0	0.00022	10.2	59,869	1,552	0.26

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	365.56	0.100%	1,000	590,000	756.4	758.0	0.00022	10.5	61,375	1,569	0.26
Lower	Lower Missouri	365.56	0.080%	1,250	610,000	757.1	758.8	0.00023	10.6	62,569	1,588	0.27
Lower	Lower Missouri	365.56	0.067%	1,500	625,000	757.7	759.4	0.00023	10.8	63,440	1,599	0.27
Lower		365.57	ASB Bridge									
Lower	Lower Missouri	365.6	10%	10	245,000	739.7	740.3	0.00013	6.3	39,284	1,327	0.19
Lower	Lower Missouri	365.6	1%	100	401,000	748.7	749.7	0.00016	8.1	51,678	1,398	0.21
Lower	Lower Missouri	365.6	0.5%	200	454,000	751.1	752.3	0.00017	8.7	55,049	1,411	0.22
Lower	Lower Missouri	365.6	0.2%	500	530,000	754.3	755.7	0.00019	9.4	59,613	1,442	0.24
Lower	Lower Missouri	365.6	0.133%	750	565,000	755.6	757.1	0.00020	9.8	61,488	1,470	0.24
Lower	Lower Missouri	365.6	0.100%	1,000	590,000	756.6	758.1	0.00020	10.0	62,915	1,482	0.24
Lower	Lower Missouri	365.6	0.080%	1,250	610,000	757.3	758.9	0.00020	10.2	64,045	1,491	0.25
Lower	Lower Missouri	365.6	0.067%	1,500	625,000	757.9	759.5	0.00021	10.3	64,863	1,497	0.25
Lower	Lower Missouri	365.84	10%	10	245,000	739.8	740.6	0.00020	7.1	35,206	1,365	0.22
Lower	Lower Missouri	365.84	1%	100	401,000	748.8	750.0	0.00022	8.9	48,066	1,467	0.25
Lower	Lower Missouri	365.84	0.5%	200	454,000	751.2	752.6	0.00023	9.4	51,626	1,553	0.25
Lower	Lower Missouri	365.84	0.2%	500	530,000	754.5	756.0	0.00024	10.2	56,684	1,569	0.26
Lower	Lower Missouri	365.84	0.133%	750	565,000	755.8	757.4	0.00025	10.5	58,720	1,572	0.27
Lower	Lower Missouri	365.84	0.100%	1,000	590,000	756.7	758.5	0.00025	10.7	60,250	1,575	0.27
Lower	Lower Missouri	365.84	0.080%	1,250	610,000	757.5	759.3	0.00026	10.9	61,453	1,582	0.27
Lower	Lower Missouri	365.84	0.067%	1,500	625,000	758.0	759.9	0.00026	11.0	62,326	1,587	0.28
Lower	Lower Missouri	366.06	10%	10	245,000	739.9	740.9	0.00026	8.1	31,392	1,350	0.25
Lower	Lower Missouri	366.06	1%	100	401,000	748.9	750.4	0.00028	10.0	43,902	1,416	0.28
Lower	Lower Missouri	366.06	0.5%	200	454,000	751.3	753.0	0.00029	10.6	47,301	1,424	0.29
Lower	Lower Missouri	366.06	0.2%	500	530,000	754.5	756.5	0.00031	11.4	51,893	1,434	0.30
Lower	Lower Missouri	366.06	0.133%	750	565,000	755.8	757.9	0.00032	11.8	53,747	1,439	0.30
Lower	Lower Missouri	366.06	0.100%	1,000	590,000	756.8	758.9	0.00032	12.0	55,139	1,442	0.31
Lower	Lower Missouri	366.06	0.080%	1,250	610,000	757.5	759.7	0.00032	12.2	56,236	1,445	0.31
Lower	Lower Missouri	366.06	0.067%	1,500	625,000	758.1	760.3	0.00033	12.4	57,028	1,446	0.31
Lower	Lower Missouri	366.121*	10%	10	245,000	739.9	741.0	0.00028	8.4	30,334	1,350	0.27
Lower	Lower Missouri	366.121*	1%	100	401,000	749.0	750.6	0.00030	10.3	42,894	1,432	0.29
Lower	Lower Missouri	366.121*	0.5%	200	454,000	751.4	753.1	0.00031	10.9	46,335	1,440	0.30
Lower	Lower Missouri	366.121*	0.2%	500	530,000	754.6	756.6	0.00033	11.7	50,994	1,451	0.31
Lower	Lower Missouri	366.121*	0.133%	750	565,000	755.9	758.0	0.00034	12.1	52,868	1,456	0.31
Lower	Lower Missouri	366.121*	0.100%	1,000	590,000	756.8	759.1	0.00034	12.3	54,281	1,459	0.32
Lower	Lower Missouri	366.121*	0.080%	1,250	610,000	757.6	759.9	0.00034	12.5	55,385	1,462	0.32
Lower	Lower Missouri	366.121*	0.067%	1,500	625,000	758.1	760.5	0.00035	12.7	56,183	1,464	0.32
Lower		366.124	Hannibal Bridge									
Lower	Lower Missouri	366.14	10%	10	245,000	740.0	741.2	0.00029	8.5	30,155	1,357	0.27
Lower	Lower Missouri	366.14	1%	100	401,000	749.1	750.7	0.00031	10.4	42,770	1,442	0.29
Lower	Lower Missouri	366.14	0.5%	200	454,000	751.5	753.3	0.00032	11.1	46,245	1,450	0.30
Lower	Lower Missouri	366.14	0.2%	500	530,000	754.7	756.8	0.00034	11.9	50,947	1,461	0.31
Lower	Lower Missouri	366.14	0.133%	750	565,000	756.0	758.3	0.00035	12.3	52,842	1,465	0.32
Lower	Lower Missouri	366.14	0.100%	1,000	590,000	757.0	759.3	0.00035	12.5	54,259	1,469	0.32
Lower	Lower Missouri	366.14	0.080%	1,250	610,000	757.8	760.2	0.00035	12.7	55,466	1,471	0.32
Lower	Lower Missouri	366.14	0.067%	1,500	625,000	758.4	760.8	0.00035	12.8	56,331	1,474	0.32
Lower	Lower Missouri	366.180*	10%	10	245,000	740.1	741.2	0.00033	8.8	29,155	1,351	0.29
Lower	Lower Missouri	366.180*	1%	100	401,000	749.1	750.8	0.00034	10.7	41,974	1,462	0.30
Lower	Lower Missouri	366.180*	0.5%	200	454,000	751.5	753.4	0.00035	11.3	45,505	1,467	0.31
Lower	Lower Missouri	366.180*	0.2%	500	530,000	754.8	756.9	0.00036	12.1	50,255	1,467	0.32
Lower	Lower Missouri	366.180*	0.133%	750	565,000	756.1	758.4	0.00037	12.5	52,159	1,467	0.33
Lower	Lower Missouri	366.180*	0.100%	1,000	590,000	757.0	759.4	0.00038	12.7	53,578	1,467	0.33
Lower	Lower Missouri	366.180*	0.080%	1,250	610,000	757.9	760.3	0.00038	12.9	54,779	1,467	0.33
Lower	Lower Missouri	366.180*	0.067%	1,500	625,000	758.4	760.9	0.00038	13.0	55,638	1,467	0.33

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower		366.183	Broadway Bridge									
Lower	Lower Missouri	366.2	10%	10	245,000	740.3	741.3	0.00028	8.1	31,591	1,362	0.26
Lower	Lower Missouri	366.2	1%	100	401,000	749.4	750.9	0.00030	9.9	44,537	1,445	0.28
Lower	Lower Missouri	366.2	0.5%	200	454,000	751.9	753.5	0.00031	10.5	48,095	1,469	0.28
Lower	Lower Missouri	366.2	0.2%	500	530,000	755.1	757.0	0.00032	11.3	52,895	1,469	0.29
Lower	Lower Missouri	366.2	0.133%	750	565,000	756.5	758.5	0.00033	11.7	54,827	1,469	0.30
Lower	Lower Missouri	366.2	0.100%	1,000	590,000	757.4	759.5	0.00034	11.9	56,262	1,469	0.30
Lower	Lower Missouri	366.2	0.080%	1,250	610,000	758.3	760.4	0.00034	12.1	57,474	1,469	0.30
Lower	Lower Missouri	366.2	0.067%	1,500	625,000	758.9	761.0	0.00034	12.2	58,340	1,469	0.31
Lower	Lower Missouri	366.23	10%	10	245,000	740.5	741.4	0.00025	7.7	33,138	1,392	0.24
Lower	Lower Missouri	366.23	1%	100	401,000	749.6	751.0	0.00027	9.4	46,204	1,448	0.26
Lower	Lower Missouri	366.23	0.5%	200	454,000	752.1	753.6	0.00028	10.0	49,786	1,469	0.27
Lower	Lower Missouri	366.23	0.2%	500	530,000	755.4	757.1	0.00030	10.8	54,615	1,469	0.28
Lower	Lower Missouri	366.23	0.133%	750	565,000	756.7	758.5	0.00030	11.1	56,563	1,469	0.28
Lower	Lower Missouri	366.23	0.100%	1,000	590,000	757.7	759.6	0.00031	11.3	58,008	1,469	0.29
Lower	Lower Missouri	366.23	0.080%	1,250	610,000	758.5	760.5	0.00031	11.5	59,226	1,469	0.29
Lower	Lower Missouri	366.23	0.067%	1,500	625,000	759.1	761.1	0.00031	11.6	60,097	16,798	0.29
Lower	Lower Missouri	366.48	10%	10	245,000	740.9	741.7	0.00020	7.1	37,811	1,580	0.22
Lower	Lower Missouri	366.48	1%	100	401,000	750.2	751.3	0.00022	8.7	52,824	1,666	0.24
Lower	Lower Missouri	366.48	0.5%	200	454,000	752.7	754.0	0.00023	9.2	56,992	1,675	0.24
Lower	Lower Missouri	366.48	0.2%	500	530,000	756.1	757.5	0.00023	9.8	62,626	1,686	0.25
Lower	Lower Missouri	366.48	0.133%	750	565,000	757.4	758.9	0.00024	10.2	64,923	1,690	0.26
Lower	Lower Missouri	366.48	0.100%	1,000	590,000	758.4	760.0	0.00024	10.4	66,623	1,694	0.26
Lower	Lower Missouri	366.48	0.080%	1,250	610,000	759.3	760.9	0.00025	10.5	68,053	1,696	0.26
Lower	Lower Missouri	366.48	0.067%	1,500	625,000	759.9	761.5	0.00025	10.6	69,081	2,278	0.26
Lower	Lower Missouri	366.75	10%	10	245,000	741.3	742.0	0.00016	6.5	41,664	1,890	0.20
Lower	Lower Missouri	366.75	1%	100	401,000	750.7	751.6	0.00017	7.9	59,779	1,972	0.21
Lower	Lower Missouri	366.75	0.5%	200	454,000	753.3	754.3	0.00018	8.4	64,795	1,981	0.22
Lower	Lower Missouri	366.75	0.2%	500	530,000	756.7	757.8	0.00018	9.0	71,572	1,992	0.22
Lower	Lower Missouri	366.75	0.133%	750	565,000	758.1	759.2	0.00019	9.2	74,347	1,996	0.23
Lower	Lower Missouri	366.75	0.100%	1,000	590,000	759.1	760.3	0.00019	9.4	76,394	2,000	0.23
Lower	Lower Missouri	366.75	0.080%	1,250	610,000	759.9	761.2	0.00019	9.5	78,109	2,441	0.23
Lower	Lower Missouri	366.75	0.067%	1,500	625,000	760.6	761.8	0.00019	9.6	79,344	2,443	0.23
Lower	Lower Missouri	367.04	10%	10	245,000	741.5	742.3	0.00020	7.2	37,460	1,974	0.22
Lower	Lower Missouri	367.04	1%	100	401,000	750.9	751.9	0.00021	8.5	57,780	2,204	0.23
Lower	Lower Missouri	367.04	0.5%	200	454,000	753.4	754.6	0.00021	8.9	63,581	2,364	0.23
Lower	Lower Missouri	367.04	0.2%	500	530,000	756.9	758.1	0.00021	9.4	71,932	2,459	0.24
Lower	Lower Missouri	367.04	0.133%	750	565,000	758.3	759.6	0.00021	9.6	75,386	2,463	0.24
Lower	Lower Missouri	367.04	0.100%	1,000	590,000	759.3	760.6	0.00021	9.8	77,932	2,467	0.24
Lower	Lower Missouri	367.04	0.080%	1,250	610,000	760.2	761.5	0.00021	9.9	80,062	3,023	0.24
Lower	Lower Missouri	367.04	0.067%	1,500	625,000	760.8	762.1	0.00021	10.0	81,595	3,025	0.24
Upper	Lower Missouri	367.57	10%	10	168,000	741.8	742.3	0.00013	5.2	34,898	2,071	0.18
Upper	Lower Missouri	367.57	1%	100	261,000	751.5	751.9	0.00010	5.6	58,570	2,531	0.18
Upper	Lower Missouri	367.57	0.5%	200	295,000	754.1	754.6	0.00010	5.8	65,201	2,573	0.18
Upper	Lower Missouri	367.57	0.2%	500	348,000	757.6	758.1	0.00010	6.2	74,283	2,660	0.18
Upper	Lower Missouri	367.57	0.133%	750	374,000	759.0	759.6	0.00010	6.4	78,206	2,723	0.19
Upper	Lower Missouri	367.57	0.100%	1,000	390,000	760.1	760.6	0.00010	6.4	81,122	2,797	0.19
Upper	Lower Missouri	367.57	0.080%	1,250	403,000	760.9	761.5	0.00010	6.5	83,575	3,953	0.19
Upper	Lower Missouri	367.57	0.067%	1,500	414,000	761.6	762.2	0.00010	6.5	85,381	19,376	0.19
Upper	Lower Missouri	367.89	10%	10	168,000	741.9	742.6	0.00017	6.3	27,613	1,579	0.20
Upper	Lower Missouri	367.89	1%	100	261,000	751.5	752.2	0.00015	7.0	45,227	1,928	0.20
Upper	Lower Missouri	367.89	0.5%	200	295,000	754.1	754.8	0.00015	7.3	50,238	1,950	0.20
Upper	Lower Missouri	367.89	0.2%	500	348,000	757.5	758.4	0.00015	7.8	57,004	1,979	0.20
Upper	Lower Missouri	367.89	0.133%	750	374,000	759.0	759.9	0.00016	8.0	59,873	1,991	0.21
Upper	Lower Missouri	367.89	0.100%	1,000	390,000	760.0	760.9	0.00016	8.1	61,963	1,999	0.21

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	367.89	0.080%	1,250	403,000	760.9	761.8	0.00016	8.2	63,698	3,727	0.21
Upper	Lower Missouri	367.89	0.067%	1,500	414,000	761.5	762.5	0.00016	8.3	64,973	3,755	0.21
Upper	Lower Missouri	368.19	10%	10	168,000	742.2	742.9	0.00020	6.5	26,987	1,364	0.21
Upper	Lower Missouri	368.19	1%	100	261,000	751.7	752.5	0.00017	7.3	42,159	1,702	0.21
Upper	Lower Missouri	368.19	0.5%	200	295,000	754.3	755.1	0.00017	7.6	46,591	1,739	0.21
Upper	Lower Missouri	368.19	0.2%	500	348,000	757.7	758.6	0.00017	8.1	52,650	1,787	0.21
Upper	Lower Missouri	368.19	0.133%	750	374,000	759.2	760.1	0.00018	8.3	55,247	1,808	0.22
Upper	Lower Missouri	368.19	0.100%	1,000	390,000	760.2	761.2	0.00018	8.5	57,151	1,835	0.22
Upper	Lower Missouri	368.19	0.080%	1,250	403,000	761.1	762.1	0.00018	8.5	58,736	4,152	0.22
Upper	Lower Missouri	368.19	0.067%	1,500	414,000	761.7	762.7	0.00018	8.6	59,899	17,862	0.22
Upper	Lower Missouri	368.48	10%	10	168,000	742.6	743.1	0.00013	5.7	31,321	1,587	0.18
Upper	Lower Missouri	368.48	1%	100	261,000	752.1	752.7	0.00012	6.5	46,607	1,650	0.18
Upper	Lower Missouri	368.48	0.5%	200	295,000	754.7	755.3	0.00012	6.9	50,883	1,667	0.18
Upper	Lower Missouri	368.48	0.2%	500	348,000	758.1	758.9	0.00013	7.4	56,672	1,693	0.19
Upper	Lower Missouri	368.48	0.133%	750	374,000	759.6	760.4	0.00013	7.7	59,142	1,708	0.19
Upper	Lower Missouri	368.48	0.100%	1,000	390,000	760.6	761.5	0.00014	7.8	60,927	1,742	0.19
Upper	Lower Missouri	368.48	0.080%	1,250	403,000	761.5	762.3	0.00014	7.9	62,428	1,752	0.19
Upper	Lower Missouri	368.48	0.067%	1,500	414,000	762.1	763.0	0.00014	8.0	63,539	5,220	0.20
Upper	Lower Missouri	368.73	10%	10	168,000	742.9	743.3	0.00010	5.2	33,786	1,583	0.16
Upper	Lower Missouri	368.73	1%	100	261,000	752.3	752.9	0.00010	6.1	49,049	1,651	0.16
Upper	Lower Missouri	368.73	0.5%	200	295,000	754.9	755.5	0.00010	6.4	53,339	1,669	0.17
Upper	Lower Missouri	368.73	0.2%	500	348,000	758.4	759.1	0.00011	6.9	59,163	1,694	0.17
Upper	Lower Missouri	368.73	0.133%	750	374,000	759.8	760.6	0.00011	7.2	61,651	1,705	0.18
Upper	Lower Missouri	368.73	0.100%	1,000	390,000	760.9	761.6	0.00012	7.3	63,439	1,729	0.18
Upper	Lower Missouri	368.73	0.080%	1,250	403,000	761.7	762.5	0.00012	7.4	64,931	1,739	0.18
Upper	Lower Missouri	368.73	0.067%	1,500	414,000	762.4	763.2	0.00012	7.5	66,037	17,114	0.18
Upper	Lower Missouri	369.05	10%	10	168,000	743.0	743.5	0.00016	5.9	29,269	1,444	0.19
Upper	Lower Missouri	369.05	1%	100	261,000	752.4	753.1	0.00014	6.7	44,019	1,606	0.19
Upper	Lower Missouri	369.05	0.5%	200	295,000	755.0	755.7	0.00014	7.0	48,196	1,625	0.19
Upper	Lower Missouri	369.05	0.2%	500	348,000	758.5	759.3	0.00015	7.6	53,923	1,691	0.20
Upper	Lower Missouri	369.05	0.133%	750	374,000	759.9	760.8	0.00015	7.8	56,416	1,703	0.20
Upper	Lower Missouri	369.05	0.100%	1,000	390,000	761.0	761.9	0.00015	7.9	58,201	1,707	0.20
Upper	Lower Missouri	369.05	0.080%	1,250	403,000	761.8	762.8	0.00015	8.0	59,672	11,291	0.20
Upper	Lower Missouri	369.05	0.067%	1,500	414,000	762.5	763.4	0.00015	8.1	60,764	17,162	0.20
Upper	Lower Missouri	369.38	10%	10	168,000	743.3	743.8	0.00017	6.1	28,778	1,459	0.20
Upper	Lower Missouri	369.38	1%	100	261,000	752.7	753.4	0.00015	6.8	45,086	1,798	0.19
Upper	Lower Missouri	369.38	0.5%	200	295,000	755.3	756.0	0.00015	7.1	49,768	1,815	0.20
Upper	Lower Missouri	369.38	0.2%	500	348,000	758.7	759.6	0.00015	7.6	56,134	1,839	0.20
Upper	Lower Missouri	369.38	0.133%	750	374,000	760.2	761.1	0.00015	7.9	58,859	1,849	0.20
Upper	Lower Missouri	369.38	0.100%	1,000	390,000	761.3	762.2	0.00015	8.0	60,804	1,867	0.20
Upper	Lower Missouri	369.38	0.080%	1,250	403,000	762.1	763.1	0.00015	8.1	62,418	1,875	0.20
Upper	Lower Missouri	369.38	0.067%	1,500	414,000	762.8	763.7	0.00015	8.2	63,618	8,471	0.21
Upper	Upper Missouri	369.66	10%	10	192,000	743.6	744.3	0.00020	6.8	31,236	1,689	0.22
Upper	Lower Missouri	369.66	1%	100	261,000	752.9	753.6	0.00014	6.7	47,531	1,785	0.19
Upper	Lower Missouri	369.66	0.5%	200	295,000	755.5	756.2	0.00014	7.0	52,184	1,803	0.19
Upper	Lower Missouri	369.66	0.2%	500	348,000	759.0	759.8	0.00014	7.5	58,526	1,828	0.19
Upper	Lower Missouri	369.66	0.133%	750	374,000	760.5	761.3	0.00014	7.8	61,247	1,839	0.20
Upper	Lower Missouri	369.66	0.100%	1,000	390,000	761.5	762.4	0.00014	7.9	63,185	1,864	0.20
Upper	Lower Missouri	369.66	0.080%	1,250	403,000	762.4	763.3	0.00014	8.0	64,809	7,745	0.20
Upper	Lower Missouri	369.66	0.067%	1,500	414,000	763.0	763.9	0.00014	8.1	66,042	7,748	0.20
Upper	Upper Missouri	369.96	10%	10	192,000	743.8	744.7	0.00029	7.8	28,230	1,645	0.26
Upper	Lower Missouri	369.96	1%	100	261,000	753.1	753.9	0.00018	7.5	43,630	1,688	0.21
Upper	Lower Missouri	369.96	0.5%	200	295,000	755.7	756.5	0.00018	7.8	48,021	1,700	0.22
Upper	Lower Missouri	369.96	0.2%	500	348,000	759.2	760.1	0.00018	8.2	53,988	1,717	0.22
Upper	Lower Missouri	369.96	0.133%	750	374,000	760.6	761.6	0.00019	8.5	56,544	1,723	0.22

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	369.96	0.100%	1,000	390,000	761.7	762.7	0.00018	8.6	58,355	1,732	0.22
Upper	Lower Missouri	369.96	0.080%	1,250	403,000	762.5	763.6	0.00018	8.7	59,851	1,785	0.22
Upper	Lower Missouri	369.96	0.067%	1,500	414,000	763.2	764.2	0.00018	8.8	60,999	6,190	0.22
Upper	Upper Missouri	370.26	10%	10	192,000	744.4	745.2	0.00027	7.3	29,970	1,675	0.25
Upper	Upper Missouri	370.26	1%	100	287,000	753.5	754.3	0.00020	7.7	45,415	1,726	0.22
Upper	Lower Missouri	370.26	0.5%	200	295,000	756.1	756.8	0.00017	7.3	49,884	1,739	0.21
Upper	Lower Missouri	370.26	0.2%	500	348,000	759.6	760.4	0.00017	7.7	56,016	1,756	0.21
Upper	Lower Missouri	370.26	0.133%	750	374,000	761.1	761.9	0.00017	7.9	58,653	1,763	0.21
Upper	Lower Missouri	370.26	0.100%	1,000	390,000	762.1	763.0	0.00017	8.0	60,508	1,769	0.21
Upper	Lower Missouri	370.26	0.080%	1,250	403,000	763.0	763.9	0.00017	8.1	62,029	1,780	0.21
Upper	Lower Missouri	370.26	0.067%	1,500	414,000	763.6	764.5	0.00017	8.2	63,179	1,787	0.21
Upper	Upper Missouri	370.54	10%	10	192,000	744.9	745.5	0.00020	6.6	32,272	1,642	0.21
Upper	Upper Missouri	370.54	1%	100	287,000	753.8	754.6	0.00016	7.2	48,083	1,934	0.20
Upper	Lower Missouri	370.54	0.5%	200	295,000	756.3	757.0	0.00014	6.8	53,036	1,982	0.19
Upper	Lower Missouri	370.54	0.2%	500	348,000	759.9	760.6	0.00014	7.2	60,053	2,007	0.19
Upper	Lower Missouri	370.54	0.133%	750	374,000	761.4	762.1	0.00014	7.5	63,086	2,018	0.19
Upper	Lower Missouri	370.54	0.100%	1,000	390,000	762.4	763.2	0.00014	7.6	65,213	2,025	0.19
Upper	Lower Missouri	370.54	0.080%	1,250	403,000	763.3	764.1	0.00014	7.6	66,967	3,458	0.19
Upper	Lower Missouri	370.54	0.067%	1,500	414,000	763.9	764.7	0.00014	7.7	68,294	3,505	0.19
Upper	Upper Missouri	370.83	10%	10	192,000	745.3	745.8	0.00017	6.2	40,099	2,963	0.20
Upper	Upper Missouri	370.83	1%	100	287,000	754.3	754.8	0.00012	6.4	64,209	3,141	0.18
Upper	Lower Missouri	370.83	0.5%	200	295,000	756.7	757.2	0.00010	6.0	70,978	3,221	0.16
Upper	Lower Missouri	370.83	0.2%	500	348,000	760.3	760.8	0.00010	6.3	80,839	3,248	0.16
Upper	Lower Missouri	370.83	0.133%	750	374,000	761.8	762.3	0.00010	6.4	85,095	3,259	0.17
Upper	Lower Missouri	370.83	0.100%	1,000	390,000	762.9	763.4	0.00010	6.5	88,055	3,272	0.17
Upper	Lower Missouri	370.83	0.080%	1,250	403,000	763.8	764.3	0.00010	6.5	90,486	3,274	0.16
Upper	Lower Missouri	370.83	0.067%	1,500	414,000	764.4	764.9	0.00010	6.6	92,319	11,848	0.17
Upper	Upper Missouri	371.14	10%	10	192,000	745.5	746.1	0.00016	6.5	38,791	3,429	0.20
Upper	Upper Missouri	371.14	1%	100	287,000	754.4	755.0	0.00013	6.6	63,438	3,735	0.18
Upper	Lower Missouri	371.14	0.5%	200	295,000	756.9	757.4	0.00010	6.2	70,342	3,761	0.16
Upper	Lower Missouri	371.14	0.2%	500	348,000	760.4	760.9	0.00010	6.5	80,510	3,802	0.16
Upper	Lower Missouri	371.14	0.133%	750	374,000	762.0	762.5	0.00010	6.7	84,900	3,813	0.17
Upper	Lower Missouri	371.14	0.100%	1,000	390,000	763.0	763.6	0.00010	6.7	87,946	3,825	0.17
Upper	Lower Missouri	371.14	0.080%	1,250	403,000	763.9	764.4	0.00010	6.8	90,448	3,831	0.17
Upper	Lower Missouri	371.14	0.067%	1,500	414,000	764.6	765.1	0.00010	6.8	92,337	3,833	0.17
Upper	Upper Missouri	371.47	10%	10	192,000	745.9	746.4	0.00018	6.2	40,202	3,762	0.20
Upper	Upper Missouri	371.47	1%	100	287,000	754.8	755.2	0.00012	6.0	68,553	4,172	0.17
Upper	Lower Missouri	371.47	0.5%	200	295,000	757.1	757.5	0.00010	5.6	76,234	4,203	0.16
Upper	Lower Missouri	371.47	0.2%	500	348,000	760.7	761.1	0.00009	5.8	87,780	4,352	0.16
Upper	Lower Missouri	371.47	0.133%	750	374,000	762.3	762.7	0.00009	6.0	92,769	4,361	0.16
Upper	Lower Missouri	371.47	0.100%	1,000	390,000	763.3	763.7	0.00009	6.0	96,218	4,367	0.16
Upper	Lower Missouri	371.47	0.080%	1,250	403,000	764.2	764.6	0.00009	6.0	99,048	4,380	0.16
Upper	Lower Missouri	371.47	0.067%	1,500	414,000	764.8	765.3	0.00009	6.1	101,189	4,381	0.16
Upper	Upper Missouri	371.83	10%	10	192,000	746.1	746.8	0.00016	6.5	35,520	2,815	0.20
Upper	Upper Missouri	371.83	1%	100	287,000	754.9	755.5	0.00013	6.8	62,345	4,810	0.19
Upper	Lower Missouri	371.83	0.5%	200	295,000	757.2	757.8	0.00011	6.4	70,447	4,833	0.17
Upper	Lower Missouri	371.83	0.2%	500	348,000	760.8	761.3	0.00010	6.6	82,787	4,867	0.17
Upper	Lower Missouri	371.83	0.133%	750	374,000	762.3	762.9	0.00010	6.7	88,143	4,900	0.17
Upper	Lower Missouri	371.83	0.100%	1,000	390,000	763.4	763.9	0.00010	6.7	91,849	4,922	0.17
Upper	Lower Missouri	371.83	0.080%	1,250	403,000	764.3	764.8	0.00010	6.8	94,888	4,938	0.17
Upper	Lower Missouri	371.83	0.067%	1,500	414,000	764.9	765.5	0.00010	6.8	97,196	4,943	0.17
Upper	Upper Missouri	372.13	10%	10	192,000	746.4	747.1	0.00022	6.9	34,054	3,768	0.22
Upper	Upper Missouri	372.13	1%	100	287,000	755.1	755.7	0.00015	6.8	64,170	6,536	0.19
Upper	Lower Missouri	372.13	0.5%	200	295,000	757.5	757.9	0.00012	6.3	72,686	6,559	0.17
Upper	Lower Missouri	372.13	0.2%	500	348,000	761.0	761.5	0.00011	6.4	85,843	6,915	0.17

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	372.13	0.133%	750	374,000	762.6	763.1	0.00011	6.5	91,540	7,025	0.17
Upper	Lower Missouri	372.13	0.100%	1,000	390,000	763.6	764.1	0.00010	6.5	95,462	7,112	0.17
Upper	Lower Missouri	372.13	0.080%	1,250	403,000	764.5	765.0	0.00010	6.5	98,677	7,163	0.17
Upper	Lower Missouri	372.13	0.067%	1,500	414,000	765.2	765.6	0.00010	6.5	101,115	7,203	0.17
Upper	Upper Missouri	372.47	10%	10	192,000	746.9	747.4	0.00015	6.0	37,069	1,911	0.19
Upper	Upper Missouri	372.47	1%	100	287,000	755.4	756.0	0.00012	6.5	58,516	5,950	0.18
Upper	Upper Missouri	372.47	0.5%	200	316,000	757.7	758.2	0.00012	6.6	63,948	6,058	0.18
Upper	Lower Missouri	372.47	0.2%	500	348,000	761.2	761.7	0.00010	6.5	72,501	6,175	0.17
Upper	Lower Missouri	372.47	0.133%	750	374,000	762.7	763.3	0.00011	6.7	76,224	6,203	0.17
Upper	Lower Missouri	372.47	0.100%	1,000	390,000	763.8	764.4	0.00011	6.7	78,790	6,224	0.17
Upper	Lower Missouri	372.47	0.080%	1,250	403,000	764.6	765.2	0.00010	6.8	80,892	6,235	0.17
Upper	Lower Missouri	372.47	0.067%	1,500	414,000	765.3	765.9	0.00010	6.9	82,486	6,244	0.17
Upper	Upper Missouri	372.562*	10%	10	192,000	746.9	747.5	0.00018	6.2	34,962	1,866	0.20
Upper	Upper Missouri	372.562*	1%	100	287,000	755.4	756.1	0.00015	6.7	52,766	3,572	0.19
Upper	Upper Missouri	372.562*	0.5%	200	316,000	757.7	758.3	0.00014	6.9	57,466	3,898	0.19
Upper	Lower Missouri	372.562*	0.2%	500	348,000	761.2	761.8	0.00012	6.8	64,911	4,533	0.18
Upper	Lower Missouri	372.562*	0.133%	750	374,000	762.7	763.4	0.00013	7.0	68,189	4,732	0.18
Upper	Lower Missouri	372.562*	0.100%	1,000	390,000	763.8	764.5	0.00012	7.1	70,445	4,958	0.18
Upper	Lower Missouri	372.562*	0.080%	1,250	403,000	764.6	765.3	0.00012	7.1	72,293	5,127	0.18
Upper	Lower Missouri	372.562*	0.067%	1,500	414,000	765.3	766.0	0.00012	7.2	73,697	5,356	0.18
Upper		372.567	Fairfax Bridge (northbound)									
Upper	Upper Missouri	372.577*	10%	10	192,000	747.0	747.6	0.00019	6.3	34,476	1,880	0.21
Upper	Upper Missouri	372.577*	1%	100	287,000	755.5	756.1	0.00015	6.8	52,324	3,559	0.20
Upper	Upper Missouri	372.577*	0.5%	200	316,000	757.7	758.4	0.00015	6.9	57,038	3,767	0.19
Upper	Lower Missouri	372.577*	0.2%	500	348,000	761.2	761.9	0.00013	6.8	64,474	4,311	0.18
Upper	Lower Missouri	372.577*	0.133%	750	374,000	762.8	763.4	0.00013	7.0	67,732	4,606	0.19
Upper	Lower Missouri	372.577*	0.100%	1,000	390,000	763.8	764.5	0.00013	7.1	69,974	4,713	0.19
Upper	Lower Missouri	372.577*	0.080%	1,250	403,000	764.7	765.4	0.00013	7.1	71,813	4,798	0.19
Upper	Lower Missouri	372.577*	0.067%	1,500	414,000	765.3	766.0	0.00013	7.2	73,212	4,854	0.19
Upper	Upper Missouri	372.58	10%	10	192,000	747.0	747.6	0.00019	6.3	34,391	1,882	0.21
Upper	Upper Missouri	372.58	1%	100	287,000	755.5	756.1	0.00015	6.8	52,246	3,552	0.20
Upper	Upper Missouri	372.58	0.5%	200	316,000	757.7	758.4	0.00015	6.9	56,963	3,755	0.19
Upper	Lower Missouri	372.58	0.2%	500	348,000	761.2	761.9	0.00013	6.8	64,401	4,265	0.18
Upper	Lower Missouri	372.58	0.133%	750	374,000	762.8	763.4	0.00013	7.0	67,660	4,579	0.19
Upper	Lower Missouri	372.58	0.100%	1,000	390,000	763.8	764.5	0.00013	7.1	69,906	4,687	0.19
Upper	Lower Missouri	372.58	0.080%	1,250	403,000	764.7	765.4	0.00013	7.1	71,755	4,777	0.19
Upper	Lower Missouri	372.58	0.067%	1,500	414,000	765.3	766.0	0.00013	7.2	73,161	4,837	0.19
Upper	Upper Missouri	372.584*	10%	10	192,000	747.0	747.6	0.00019	6.4	34,164	1,882	0.21
Upper	Upper Missouri	372.584*	1%	100	287,000	755.5	756.1	0.00016	6.8	52,008	3,635	0.20
Upper	Upper Missouri	372.584*	0.5%	200	316,000	757.7	758.4	0.00015	6.9	56,731	3,904	0.20
Upper	Lower Missouri	372.584*	0.2%	500	348,000	761.2	761.9	0.00013	6.8	64,195	4,673	0.18
Upper	Lower Missouri	372.584*	0.133%	750	374,000	762.8	763.4	0.00013	7.0	67,470	4,849	0.19
Upper	Lower Missouri	372.584*	0.100%	1,000	390,000	763.8	764.5	0.00013	7.1	69,722	4,930	0.19
Upper	Lower Missouri	372.584*	0.080%	1,250	403,000	764.7	765.4	0.00013	7.2	71,567	5,108	0.19
Upper	Lower Missouri	372.584*	0.067%	1,500	414,000	765.3	766.0	0.00013	7.2	72,986	5,336	0.19
Upper		372.585	Fairfax Bridge (southbound)									
Upper	Upper Missouri	372.597*	10%	10	192,000	747.1	747.6	0.00019	6.3	34,483	1,884	0.21
Upper	Upper Missouri	372.597*	1%	100	287,000	755.5	756.2	0.00015	6.7	52,457	5,290	0.20
Upper	Upper Missouri	372.597*	0.5%	200	316,000	757.8	758.4	0.00015	6.9	57,244	6,185	0.19
Upper	Lower Missouri	372.597*	0.2%	500	348,000	761.3	761.9	0.00013	6.8	64,843	6,377	0.18
Upper	Lower Missouri	372.597*	0.133%	750	374,000	762.8	763.5	0.00013	7.0	68,176	6,463	0.18
Upper	Lower Missouri	372.597*	0.100%	1,000	390,000	763.9	764.6	0.00013	7.0	70,460	6,536	0.18
Upper	Lower Missouri	372.597*	0.080%	1,250	403,000	764.8	765.4	0.00013	7.1	72,328	6,595	0.18
Upper	Lower Missouri	372.597*	0.067%	1,500	414,000	765.4	766.1	0.00013	7.2	73,747	6,635	0.18

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Upper Missouri	372.61	10%	10	192,000	747.1	747.7	0.00016	6.0	36,036	1,889	0.19
Upper	Upper Missouri	372.61	1%	100	287,000	755.7	756.2	0.00012	6.2	59,933	6,141	0.18
Upper	Upper Missouri	372.61	0.5%	200	316,000	758.0	758.5	0.00012	6.3	65,552	6,360	0.17
Upper	Lower Missouri	372.61	0.2%	500	348,000	761.5	762.0	0.00010	6.2	74,339	6,530	0.16
Upper	Lower Missouri	372.61	0.133%	750	374,000	763.0	763.5	0.00010	6.4	78,218	6,591	0.17
Upper	Lower Missouri	372.61	0.100%	1,000	390,000	764.1	764.6	0.00010	6.4	80,882	6,622	0.17
Upper	Lower Missouri	372.61	0.080%	1,250	403,000	764.9	765.5	0.00010	6.5	83,069	6,637	0.17
Upper	Lower Missouri	372.61	0.067%	1,500	414,000	765.6	766.2	0.00010	6.6	84,731	6,649	0.17
Upper	Upper Missouri	372.86	10%	10	192,000	747.3	747.9	0.00016	6.2	34,207	1,705	0.20
Upper	Upper Missouri	372.86	1%	100	287,000	755.8	756.4	0.00012	6.4	62,157	6,848	0.18
Upper	Upper Missouri	372.86	0.5%	200	316,000	758.1	758.7	0.00012	6.5	68,159	6,960	0.18
Upper	Lower Missouri	372.86	0.2%	500	348,000	761.6	762.1	0.00010	6.4	77,555	7,149	0.17
Upper	Lower Missouri	372.86	0.133%	750	374,000	763.1	763.7	0.00010	6.5	81,726	7,219	0.17
Upper	Lower Missouri	372.86	0.100%	1,000	390,000	764.2	764.8	0.00010	6.6	84,584	7,239	0.17
Upper	Lower Missouri	372.86	0.080%	1,250	403,000	765.1	765.6	0.00010	6.7	86,933	7,244	0.17
Upper	Lower Missouri	372.86	0.067%	1,500	414,000	765.7	766.3	0.00010	6.7	88,721	7,245	0.17
Upper	Upper Missouri	373.15	10%	10	192,000	747.6	748.1	0.00015	6.0	34,922	1,538	0.19
Upper	Upper Missouri	373.15	1%	100	287,000	756.1	756.6	0.00011	6.0	66,955	7,566	0.17
Upper	Upper Missouri	373.15	0.5%	200	316,000	758.3	758.8	0.00011	6.1	73,317	7,791	0.17
Upper	Lower Missouri	373.15	0.2%	500	348,000	761.8	762.3	0.00009	6.0	83,194	7,908	0.16
Upper	Lower Missouri	373.15	0.133%	750	374,000	763.4	763.8	0.00009	6.2	87,625	7,941	0.16
Upper	Lower Missouri	373.15	0.100%	1,000	390,000	764.4	764.9	0.00009	6.3	90,654	7,950	0.16
Upper	Lower Missouri	373.15	0.080%	1,250	403,000	765.3	765.8	0.00009	6.3	93,132	7,955	0.16
Upper	Lower Missouri	373.15	0.067%	1,500	414,000	765.9	766.4	0.00009	6.4	95,021	7,959	0.16
Upper	Upper Missouri	373.46	10%	10	192,000	747.9	748.4	0.00011	5.4	37,870	1,572	0.17
Upper	Upper Missouri	373.46	1%	100	287,000	756.3	756.7	0.00009	5.6	72,279	8,148	0.15
Upper	Upper Missouri	373.46	0.5%	200	316,000	758.6	759.0	0.00009	5.7	78,972	8,204	0.15
Upper	Lower Missouri	373.46	0.2%	500	348,000	762.0	762.4	0.00008	5.6	89,276	8,331	0.14
Upper	Lower Missouri	373.46	0.133%	750	374,000	763.6	764.0	0.00008	5.8	93,924	8,335	0.15
Upper	Lower Missouri	373.46	0.100%	1,000	390,000	764.6	765.0	0.00008	5.8	97,084	8,337	0.15
Upper	Lower Missouri	373.46	0.080%	1,250	403,000	765.5	765.9	0.00008	5.9	99,668	8,339	0.15
Upper	Lower Missouri	373.46	0.067%	1,500	414,000	766.1	766.6	0.00008	5.9	101,640	9,840	0.15
Upper	Upper Missouri	373.79	10%	10	192,000	748.0	748.7	0.00020	6.5	30,889	1,413	0.21
Upper	Upper Missouri	373.79	1%	100	287,000	756.4	757.0	0.00014	6.5	62,660	8,651	0.19
Upper	Upper Missouri	373.79	0.5%	200	316,000	758.6	759.2	0.00013	6.6	69,117	8,735	0.19
Upper	Lower Missouri	373.79	0.2%	500	348,000	762.1	762.6	0.00012	6.5	79,079	8,858	0.17
Upper	Lower Missouri	373.79	0.133%	750	374,000	763.6	764.2	0.00011	6.6	83,604	8,869	0.17
Upper	Lower Missouri	373.79	0.100%	1,000	390,000	764.7	765.2	0.00011	6.7	86,683	8,876	0.17
Upper	Lower Missouri	373.79	0.080%	1,250	403,000	765.6	766.1	0.00011	6.7	89,204	8,881	0.17
Upper	Lower Missouri	373.79	0.067%	1,500	414,000	766.2	766.8	0.00011	6.8	91,132	8,886	0.17
Upper	Upper Missouri	374.02	10%	10	192,000	748.2	749.0	0.00022	7.1	28,571	1,219	0.23
Upper	Upper Missouri	374.02	1%	100	287,000	756.5	757.3	0.00017	7.5	53,383	8,623	0.21
Upper	Upper Missouri	374.02	0.5%	200	316,000	758.7	759.5	0.00017	7.6	58,592	8,776	0.21
Upper	Lower Missouri	374.02	0.2%	500	348,000	762.1	762.9	0.00015	7.5	66,717	8,957	0.20
Upper	Lower Missouri	374.02	0.133%	750	374,000	763.7	764.4	0.00015	7.7	70,419	8,965	0.20
Upper	Lower Missouri	374.02	0.100%	1,000	390,000	764.7	765.5	0.00015	7.8	72,936	8,970	0.20
Upper	Lower Missouri	374.02	0.080%	1,250	403,000	765.6	766.4	0.00015	7.8	74,995	8,974	0.20
Upper	Lower Missouri	374.02	0.067%	1,500	414,000	766.2	767.0	0.00014	7.9	76,570	8,977	0.20
Upper	Upper Missouri	374.081*	10%	10	192,000	748.2	749.1	0.00026	7.7	26,062	1,109	0.25
Upper	Upper Missouri	374.081*	1%	100	287,000	756.4	757.5	0.00024	8.7	38,814	8,188	0.25
Upper	Upper Missouri	374.081*	0.5%	200	316,000	758.6	759.8	0.00024	8.9	42,036	8,255	0.25
Upper	Lower Missouri	374.081*	0.2%	500	348,000	762.0	763.1	0.00022	8.9	47,096	8,350	0.24
Upper	Lower Missouri	374.081*	0.133%	750	374,000	763.5	764.7	0.00022	9.2	49,404	8,411	0.24
Upper	Lower Missouri	374.081*	0.100%	1,000	390,000	764.5	765.8	0.00022	9.4	50,983	8,546	0.24
Upper	Lower Missouri	374.081*	0.080%	1,250	403,000	765.4	766.7	0.00022	9.5	52,279	8,569	0.24

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	374.081*	0.067%	1,500	414,000	766.0	767.3	0.00022	9.6	53,270	8,587	0.24
Upper		374.087	I-635 Bridge									
Upper	Upper Missouri	374.11	10%	10	192,000	748.3	749.3	0.00030	8.0	24,968	1,074	0.26
Upper	Upper Missouri	374.11	1%	100	287,000	756.5	757.6	0.00027	8.9	37,414	8,080	0.26
Upper	Upper Missouri	374.11	0.5%	200	316,000	758.7	759.9	0.00026	9.2	40,477	8,121	0.26
Upper	Lower Missouri	374.11	0.2%	500	348,000	762.0	763.3	0.00024	9.2	45,257	8,227	0.25
Upper	Lower Missouri	374.11	0.133%	750	374,000	763.6	764.9	0.00024	9.5	47,487	8,255	0.25
Upper	Lower Missouri	374.11	0.100%	1,000	390,000	764.6	766.0	0.00024	9.7	49,010	8,273	0.25
Upper	Lower Missouri	374.11	0.080%	1,250	403,000	765.5	766.8	0.00024	9.8	50,259	8,289	0.25
Upper	Lower Missouri	374.11	0.067%	1,500	414,000	766.1	767.5	0.00024	9.9	51,215	8,302	0.25
Upper	Upper Missouri	374.14	10%	10	192,000	748.3	749.3	0.00030	8.2	24,216	1,001	0.27
Upper	Upper Missouri	374.14	1%	100	287,000	756.6	757.7	0.00025	8.8	40,880	8,844	0.25
Upper	Upper Missouri	374.14	0.5%	200	316,000	758.8	760.0	0.00025	9.1	44,564	8,855	0.25
Upper	Lower Missouri	374.14	0.2%	500	348,000	762.2	763.3	0.00022	9.0	50,263	8,909	0.24
Upper	Lower Missouri	374.14	0.133%	750	374,000	763.8	765.0	0.00022	9.2	52,914	8,916	0.24
Upper	Lower Missouri	374.14	0.100%	1,000	390,000	764.8	766.0	0.00022	9.4	54,715	8,921	0.24
Upper	Lower Missouri	374.14	0.080%	1,250	403,000	765.7	766.9	0.00022	9.5	56,189	8,925	0.24
Upper	Lower Missouri	374.14	0.067%	1,500	414,000	766.4	767.6	0.00022	9.5	57,317	8,928	0.24
Upper	Upper Missouri	374.43	10%	10	192,000	748.9	749.8	0.00025	7.6	27,974	1,265	0.24
Upper	Upper Missouri	374.43	1%	100	287,000	757.6	758.2	0.00015	7.0	70,319	8,881	0.20
Upper	Upper Missouri	374.43	0.5%	200	316,000	759.8	760.4	0.00014	7.0	78,902	8,976	0.19
Upper	Lower Missouri	374.43	0.2%	500	348,000	763.3	763.8	0.00012	6.7	91,695	8,997	0.18
Upper	Lower Missouri	374.43	0.133%	750	374,000	764.9	765.4	0.00012	6.8	97,777	9,004	0.18
Upper	Lower Missouri	374.43	0.100%	1,000	390,000	766.0	766.5	0.00011	6.9	101,855	9,009	0.18
Upper	Lower Missouri	374.43	0.080%	1,250	403,000	766.8	767.4	0.00011	6.9	105,183	9,019	0.17
Upper	Lower Missouri	374.43	0.067%	1,500	414,000	767.5	768.0	0.00011	6.9	107,753	9,031	0.17
Upper	Upper Missouri	374.76	10%	10	192,000	749.7	750.2	0.00017	6.2	41,678	2,507	0.20
Upper	Upper Missouri	374.76	1%	100	287,000	758.1	758.4	0.00009	5.4	99,750	9,468	0.15
Upper	Upper Missouri	374.76	0.5%	200	316,000	760.3	760.6	0.00009	5.4	111,770	9,494	0.15
Upper	Lower Missouri	374.76	0.2%	500	348,000	763.7	763.9	0.00007	5.1	129,547	9,546	0.14
Upper	Lower Missouri	374.76	0.133%	750	374,000	765.3	765.6	0.00007	5.2	138,150	9,557	0.14
Upper	Lower Missouri	374.76	0.100%	1,000	390,000	766.4	766.6	0.00007	5.2	143,899	9,564	0.13
Upper	Lower Missouri	374.76	0.080%	1,250	403,000	767.2	767.5	0.00007	5.2	148,588	9,571	0.13
Upper	Lower Missouri	374.76	0.067%	1,500	414,000	767.9	768.2	0.00006	5.2	152,212	9,578	0.13
Upper	Upper Missouri	375.07	10%	10	192,000	750.1	750.5	0.00014	5.5	50,819	4,080	0.18
Upper	Upper Missouri	375.07	1%	100	287,000	758.3	758.5	0.00007	4.5	127,134	10,089	0.13
Upper	Upper Missouri	375.07	0.5%	200	316,000	760.6	760.8	0.00006	4.4	142,764	10,213	0.12
Upper	Lower Missouri	375.07	0.2%	500	348,000	763.9	764.0	0.00005	4.2	165,824	10,246	0.11
Upper	Lower Missouri	375.07	0.133%	750	374,000	765.5	765.6	0.00005	4.2	177,114	10,267	0.11
Upper	Lower Missouri	375.07	0.100%	1,000	390,000	766.6	766.7	0.00004	4.2	184,661	10,280	0.11
Upper	Lower Missouri	375.07	0.080%	1,250	403,000	767.4	767.6	0.00004	4.2	190,820	10,289	0.11
Upper	Lower Missouri	375.07	0.067%	1,500	414,000	768.1	768.3	0.00004	4.2	195,591	10,294	0.11
Upper	Upper Missouri	375.33	10%	10	192,000	750.2	750.7	0.00013	5.6	58,271	5,148	0.18
Upper	Upper Missouri	375.33	1%	100	287,000	758.4	758.6	0.00006	4.5	135,946	10,405	0.13
Upper	Upper Missouri	375.33	0.5%	200	316,000	760.7	760.8	0.00006	4.4	152,743	10,494	0.12
Upper	Lower Missouri	375.33	0.2%	500	348,000	763.9	764.1	0.00004	4.2	177,493	10,569	0.11
Upper	Lower Missouri	375.33	0.133%	750	374,000	765.6	765.7	0.00004	4.2	189,638	10,606	0.11
Upper	Lower Missouri	375.33	0.100%	1,000	390,000	766.6	766.8	0.00004	4.2	197,763	10,611	0.11
Upper	Lower Missouri	375.33	0.080%	1,250	403,000	767.5	767.7	0.00004	4.2	204,392	10,612	0.11
Upper	Lower Missouri	375.33	0.067%	1,500	414,000	768.2	768.3	0.00004	4.2	209,522	10,613	0.10
Upper	Upper Missouri	375.71	10%	10	192,000	750.6	750.9	0.00014	5.2	72,122	7,666	0.18
Upper	Upper Missouri	375.71	1%	100	287,000	758.6	758.7	0.00005	3.8	171,969	10,640	0.11
Upper	Upper Missouri	375.71	0.5%	200	316,000	760.8	760.9	0.00005	3.6	195,881	10,806	0.11
Upper	Lower Missouri	375.71	0.2%	500	348,000	764.1	764.2	0.00003	3.4	231,290	10,864	0.09

Missouri River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	375.71	0.133%	750	374,000	765.7	765.8	0.00003	3.4	248,804	10,877	0.09
Upper	Lower Missouri	375.71	0.100%	1,000	390,000	766.8	766.9	0.00003	3.3	260,488	10,906	0.09
Upper	Lower Missouri	375.71	0.080%	1,250	403,000	767.7	767.7	0.00003	3.3	270,039	10,929	0.09
Upper	Lower Missouri	375.71	0.067%	1,500	414,000	768.3	768.4	0.00003	3.3	277,451	10,947	0.09
Upper	Upper Missouri	376.11	10%	10	192,000	750.9	751.2	0.00011	5.1	75,613	8,543	0.16
Upper	Upper Missouri	376.11	1%	100	287,000	758.7	758.8	0.00006	4.3	144,617	9,001	0.12
Upper	Upper Missouri	376.11	0.5%	200	316,000	760.9	761.0	0.00005	4.2	164,545	9,016	0.12
Upper	Lower Missouri	376.11	0.2%	500	348,000	764.1	764.3	0.00004	3.9	193,965	9,094	0.10
Upper	Lower Missouri	376.11	0.133%	750	374,000	765.7	765.9	0.00004	3.9	208,604	9,111	0.10
Upper	Lower Missouri	376.11	0.100%	1,000	390,000	766.8	766.9	0.00004	3.9	218,358	9,115	0.10
Upper	Lower Missouri	376.11	0.080%	1,250	403,000	767.7	767.8	0.00004	3.8	226,317	9,119	0.10
Upper	Lower Missouri	376.11	0.067%	1,500	414,000	768.4	768.5	0.00004	3.8	232,486	9,122	0.10
Upper	Upper Missouri	376.77	10%	10	192,000	751.3	751.5	0.00010	4.8	78,091	8,480	0.15
Upper	Upper Missouri	376.77	1%	100	287,000	758.9	759.0	0.00006	4.3	143,295	8,635	0.12
Upper	Upper Missouri	376.77	0.5%	200	316,000	761.1	761.2	0.00005	4.1	162,237	8,702	0.11
Upper	Lower Missouri	376.77	0.2%	500	348,000	764.3	764.4	0.00004	3.9	190,242	8,721	0.10
Upper	Lower Missouri	376.77	0.133%	750	374,000	765.9	766.0	0.00004	3.9	204,199	8,729	0.10
Upper	Lower Missouri	376.77	0.100%	1,000	390,000	766.9	767.1	0.00004	3.8	213,495	8,735	0.10
Upper	Lower Missouri	376.77	0.080%	1,250	403,000	767.8	767.9	0.00004	3.8	221,084	8,740	0.10
Upper	Lower Missouri	376.77	0.067%	1,500	414,000	768.5	768.6	0.00004	3.8	226,973	8,743	0.10
Upper	Upper Missouri	377.43	10%	10	192,000	751.6	751.9	0.00009	4.4	88,149	8,970	0.14
Upper	Upper Missouri	377.43	1%	100	287,000	759.1	759.2	0.00005	3.9	156,299	9,425	0.11
Upper	Upper Missouri	377.43	0.5%	200	316,000	761.2	761.4	0.00005	3.8	176,684	9,506	0.11
Upper	Lower Missouri	377.43	0.2%	500	348,000	764.4	764.5	0.00004	3.6	206,822	9,577	0.10
Upper	Lower Missouri	377.43	0.133%	750	374,000	766.0	766.1	0.00003	3.6	222,000	9,619	0.10
Upper	Lower Missouri	377.43	0.100%	1,000	390,000	767.1	767.2	0.00003	3.6	232,110	9,633	0.09
Upper	Lower Missouri	377.43	0.080%	1,250	403,000	767.9	768.0	0.00003	3.5	240,364	9,650	0.09
Upper	Lower Missouri	377.43	0.067%	1,500	414,000	768.6	768.7	0.00003	3.5	246,793	9,704	0.09
Upper	Upper Missouri	378.26	10%	10	192,000	752.0	752.4	0.00013	5.5	67,640	9,141	0.18
Upper	Upper Missouri	378.26	1%	100	287,000	759.3	759.5	0.00009	5.1	119,295	10,089	0.15
Upper	Upper Missouri	378.26	0.5%	200	316,000	761.4	761.6	0.00008	5.0	134,741	10,196	0.14
Upper	Lower Missouri	378.26	0.2%	500	348,000	764.6	764.7	0.00006	4.7	157,564	10,293	0.13
Upper	Lower Missouri	378.26	0.133%	750	374,000	766.1	766.3	0.00006	4.7	169,124	10,345	0.13
Upper	Lower Missouri	378.26	0.100%	1,000	390,000	767.2	767.4	0.00006	4.7	176,832	10,400	0.12
Upper	Lower Missouri	378.26	0.080%	1,250	403,000	768.0	768.2	0.00006	4.7	183,140	10,419	0.12
Upper	Lower Missouri	378.26	0.067%	1,500	414,000	768.7	768.9	0.00005	4.7	188,050	10,442	0.12
Upper	Upper Missouri	378.85	10%	10	192,000	752.4	752.8	0.00016	5.9	60,771	7,123	0.19
Upper	Upper Missouri	378.85	1%	100	287,000	759.6	759.8	0.00008	4.8	135,427	10,260	0.14
Upper	Upper Missouri	378.85	0.5%	200	316,000	761.7	761.9	0.00007	4.7	153,379	10,310	0.13
Upper	Lower Missouri	378.85	0.2%	500	348,000	764.8	764.9	0.00006	4.4	179,811	10,411	0.12
Upper	Lower Missouri	378.85	0.133%	750	374,000	766.4	766.5	0.00005	4.3	193,360	10,453	0.12
Upper	Lower Missouri	378.85	0.100%	1,000	390,000	767.4	767.5	0.00005	4.3	202,376	10,493	0.12
Upper	Lower Missouri	378.85	0.080%	1,250	403,000	768.2	768.4	0.00005	4.3	209,741	10,524	0.11
Upper	Lower Missouri	378.85	0.067%	1,500	414,000	768.9	769.1	0.00005	4.3	215,483	10,543	0.11
Upper	Upper Missouri	379.53	10%	10	192,000	752.9	753.7	0.00026	7.2	32,121	2,123	0.24
Upper	Upper Missouri	379.53	1%	100	287,000	759.9	760.0	0.00007	4.2	162,716	10,272	0.13
Upper	Upper Missouri	379.53	0.5%	200	316,000	762.0	762.1	0.00006	4.1	183,906	10,282	0.12
Upper	Lower Missouri	379.53	0.2%	500	348,000	765.0	765.1	0.00004	3.8	215,058	10,296	0.11
Upper	Lower Missouri	379.53	0.133%	750	374,000	766.6	766.7	0.00004	3.7	231,141	10,303	0.10
Upper	Lower Missouri	379.53	0.100%	1,000	390,000	767.6	767.7	0.00004	3.7	241,826	10,307	0.10
Upper	Lower Missouri	379.53	0.080%	1,250	403,000	768.4	768.5	0.00004	3.7	250,550	10,311	0.10
Upper	Lower Missouri	379.53	0.067%	1,500	414,000	769.1	769.2	0.00004	3.7	257,362	10,314	0.10

***denotes interpolated cross-section**

EXHIBIT A-2.106

Kansas River Existing Conditions Water Surface Elevations

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	0.010	10%	10	121,000	742.4	742.9	0.00026	5.9	20554	812	0.21
Kansas	Missouri Control	0.010	1.0%	100	192,000	751.2	751.9	0.00025	6.8	28954	1044	0.23
Kansas	Missouri Control	0.010	0.5%	200	237,000	753.6	754.6	0.00030	7.8	31524	1090	0.25
Kansas	Missouri Control	0.010	0.2%	500	308,000	756.8	758.1	0.00037	9.3	35063	1151	0.29
Kansas	Missouri Control	0.010	0.133%	750	343,000	758.0	759.6	0.00041	10.0	36549	1275	0.30
Kansas	Missouri Control	0.010	0.100%	1,000	369,000	758.9	760.6	0.00044	10.5	37738	1333	0.31
Kansas	Missouri Control	0.010	0.080%	1,250	391,000	759.7	761.5	0.00046	10.9	38765	1381	0.32
Kansas	Missouri Control	0.010	0.067%	1,500	407,000	760.2	762.1	0.00048	11.2	39534	1434	0.33
Kansas	Kansas Control	0.140	10%	10	121,000	742.5	743.1	0.00028	6.2	19438	737	0.21
Kansas	Missouri Control	0.140	1%	100	192,000	751.3	752.2	0.00027	7.4	26178	803	0.22
Kansas	Missouri Control	0.140	0.5%	200	237,000	753.7	754.8	0.00033	8.5	28133	821	0.25
Kansas	Missouri Control	0.140	0.2%	500	308,000	756.9	758.5	0.00043	10.2	30811	925	0.28
Kansas	Missouri Control	0.140	0.133%	750	343,000	758.1	760.0	0.00048	11.0	31988	1009	0.30
Kansas	Missouri Control	0.140	0.100%	1,000	369,000	759.0	761.1	0.00051	11.5	32906	1025	0.31
Kansas	Missouri Control	0.140	0.080%	1,250	391,000	759.8	762.0	0.00054	12.0	33679	1038	0.32
Kansas	Missouri Control	0.140	0.067%	1,500	407,000	760.3	762.6	0.00056	12.3	34242	1044	0.33
Kansas	Kansas Control	0.220	10%	10	121,000	742.6	743.3	0.00039	7.0	17193	697	0.25
Kansas	Missouri Control	0.220	1%	100	192,000	751.3	752.3	0.00036	8.2	23734	786	0.25
Kansas	Missouri Control	0.220	0.5%	200	237,000	753.7	755.1	0.00043	9.4	25639	803	0.28
Kansas	Missouri Control	0.220	0.2%	500	308,000	756.8	758.8	0.00055	11.2	28186	826	0.32
Kansas	Missouri Control	0.220	0.133%	750	343,000	758.1	760.3	0.00061	12.1	29207	836	0.34
Kansas	Missouri Control	0.220	0.100%	1,000	369,000	758.9	761.4	0.00065	12.7	29955	843	0.35
Kansas	Missouri Control	0.220	0.080%	1,250	391,000	759.7	762.4	0.00069	13.2	30593	920	0.36
Kansas	Missouri Control	0.220	0.067%	1,500	407,000	760.2	763.1	0.00072	13.6	31092	991	0.37
Kansas	Kansas Control	0.253	10%	10	121,000	742.6	743.4	0.00043	7.4	16381	667	0.26
Kansas	Missouri Control	0.253	1%	100	192,000	751.3	752.4	0.00040	8.6	22638	758	0.26
Kansas	Missouri Control	0.253	0.5%	200	237,000	753.7	755.2	0.00048	9.9	24467	775	0.29
Kansas	Missouri Control	0.253	0.2%	500	308,000	756.8	758.9	0.00060	11.7	26917	798	0.33
Kansas	Missouri Control	0.253	0.133%	750	343,000	758.0	760.5	0.00067	12.7	27895	805	0.36
Kansas	Missouri Control	0.253	0.100%	1,000	369,000	758.9	761.6	0.00072	13.3	28623	834	0.37
Kansas	Missouri Control	0.253	0.080%	1,250	391,000	759.6	762.6	0.00076	13.9	29233	836	0.38
Kansas	Missouri Control	0.253	0.067%	1,500	407,000	760.2	763.3	0.00079	14.2	29686	836	0.39
Kansas		0.256	Missouri Pacific Bridge No. 1									
Kansas	Kansas Control	0.259	10%	10	121,000	742.6	743.5	0.00044	7.4	16268	667	0.27
Kansas	Missouri Control	0.259	1%	100	192,000	751.4	752.5	0.00041	8.6	22560	764	0.27
Kansas	Missouri Control	0.259	0.5%	200	237,000	753.8	755.3	0.00048	9.9	24420	781	0.29
Kansas	Missouri Control	0.259	0.2%	500	308,000	756.9	759.1	0.00061	11.8	26923	806	0.34
Kansas	Missouri Control	0.259	0.133%	750	343,000	758.2	760.6	0.00068	12.7	27930	814	0.36
Kansas	Missouri Control	0.259	0.100%	1,000	369,000	759.1	761.8	0.00073	13.3	28667	817	0.37
Kansas	Missouri Control	0.259	0.080%	1,250	391,000	759.9	762.8	0.00076	13.8	29317	820	0.38
Kansas	Missouri Control	0.259	0.067%	1,500	407,000	760.5	763.5	0.00078	14.2	29811	5634	0.39
Kansas	Kansas Control	0.274	10%	10	121,000	742.9	743.6	0.00039	6.6	18241	810	0.25
Kansas	Missouri Control	0.274	1%	100	192,000	751.7	752.6	0.00033	7.5	25741	886	0.24
Kansas	Missouri Control	0.274	0.5%	200	237,000	754.3	755.4	0.00038	8.6	28007	903	0.26
Kansas	Missouri Control	0.274	0.2%	500	308,000	757.6	759.2	0.00047	10.1	31093	926	0.29
Kansas	Missouri Control	0.274	0.133%	750	343,000	759.0	760.8	0.00051	10.9	32377	964	0.31
Kansas	Missouri Control	0.274	0.100%	1,000	369,000	760.0	762.0	0.00054	11.4	33354	1003	0.32
Kansas	Missouri Control	0.274	0.080%	1,250	391,000	760.9	763.0	0.00057	11.8	34253	5879	0.33
Kansas	Missouri Control	0.274	0.067%	1,500	407,000	761.5	763.8	0.00058	12.1	34945	6010	0.33
Kansas		0.280	I-70 Bridge (westbound)									
Kansas	Kansas Control	0.286	10%	10	121,000	743.0	743.7	0.00039	6.7	18171	808	0.25
Kansas	Missouri Control	0.286	1%	100	192,000	751.8	752.7	0.00034	7.5	25680	886	0.24
Kansas	Missouri Control	0.286	0.5%	200	237,000	754.4	755.5	0.00040	8.5	27976	903	0.26
Kansas	Missouri Control	0.286	0.2%	500	308,000	757.8	759.3	0.00048	10.0	31104	927	0.29
Kansas	Missouri Control	0.286	0.133%	750	343,000	759.2	760.9	0.00052	10.7	32412	960	0.31
Kansas	Missouri Control	0.286	0.100%	1,000	369,000	760.2	762.1	0.00055	11.2	33396	1011	0.32

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	0.286	0.080%	1,250	391,000	761.1	763.1	0.00057	11.6	34298	5875	0.33
Kansas	Missouri Control	0.286	0.067%	1,500	407,000	761.7	763.9	0.00059	11.8	34974	5993	0.33
Kansas	Kansas Control	0.297	10%	10	121,000	743.0	743.7	0.00040	6.7	18062	801	0.25
Kansas	Missouri Control	0.297	1%	100	192,000	751.8	752.7	0.00035	7.5	25519	881	0.24
Kansas	Missouri Control	0.297	0.5%	200	237,000	754.4	755.5	0.00040	8.6	27806	899	0.27
Kansas	Missouri Control	0.297	0.2%	500	308,000	757.8	759.4	0.00048	10.0	30920	923	0.30
Kansas	Missouri Control	0.297	0.133%	750	343,000	759.2	761.0	0.00053	10.8	32223	956	0.31
Kansas	Missouri Control	0.297	0.100%	1,000	369,000	760.2	762.2	0.00056	11.3	33200	1005	0.32
Kansas	Missouri Control	0.297	0.080%	1,250	391,000	761.1	763.2	0.00058	11.7	34099	5867	0.33
Kansas	Missouri Control	0.297	0.067%	1,500	407,000	761.8	764.0	0.00059	11.9	34771	5984	0.33
Kansas		0.303	I-70 Bridge (eastbound)									
Kansas	Kansas Control	0.309	10%	10	121,000	743.1	743.8	0.00040	6.8	17926	786	0.25
Kansas	Kansas Control	0.309	1%	100	241,000	751.9	753.3	0.00055	9.6	25247	865	0.31
Kansas	Missouri Control	0.309	0.5%	200	237,000	754.5	755.6	0.00041	8.7	27517	887	0.27
Kansas	Missouri Control	0.309	0.2%	500	308,000	757.9	759.5	0.00049	10.2	30650	924	0.30
Kansas	Missouri Control	0.309	0.133%	750	343,000	759.3	761.2	0.00053	10.9	31974	958	0.31
Kansas	Missouri Control	0.309	0.100%	1,000	369,000	760.4	762.4	0.00056	11.4	32967	994	0.32
Kansas	Missouri Control	0.309	0.080%	1,250	391,000	761.3	763.4	0.00058	11.8	33869	5873	0.33
Kansas	Missouri Control	0.309	0.067%	1,500	407,000	761.9	764.2	0.00060	12.0	34542	5991	0.34
Kansas	Kansas Control	0.440	10%	10	121,000	743.2	744.1	0.00050	7.4	16372	742	0.28
Kansas	Kansas Control	0.440	1%	100	241,000	752.0	753.7	0.00066	10.5	23231	817	0.33
Kansas	Missouri Control	0.440	0.5%	200	237,000	754.6	755.9	0.00049	9.5	25330	837	0.29
Kansas	Missouri Control	0.440	0.2%	500	308,000	758.0	759.9	0.00059	11.1	28261	865	0.32
Kansas	Missouri Control	0.440	0.133%	750	343,000	759.4	761.6	0.00064	11.9	29509	904	0.34
Kansas	Missouri Control	0.440	0.100%	1,000	369,000	760.4	762.8	0.00068	12.5	30435	5276	0.35
Kansas	Missouri Control	0.440	0.080%	1,250	391,000	761.3	763.9	0.00070	12.9	31261	5467	0.36
Kansas	Missouri Control	0.440	0.067%	1,500	407,000	762.0	764.7	0.00072	13.2	31877	5609	0.37
Kansas	Kansas Control	0.496	10%	10	121,000	743.5	744.2	0.00041	6.7	17977	804	0.25
Kansas	Kansas Control	0.496	1%	100	241,000	752.5	753.9	0.00052	9.5	25630	889	0.30
Kansas	Missouri Control	0.496	0.5%	200	237,000	754.9	756.1	0.00039	8.7	27807	909	0.26
Kansas	Missouri Control	0.496	0.2%	500	308,000	758.5	760.1	0.00047	10.1	31160	957	0.29
Kansas	Missouri Control	0.496	0.133%	750	343,000	760.0	761.8	0.00051	10.8	32583	966	0.31
Kansas	Missouri Control	0.496	0.100%	1,000	369,000	761.1	763.0	0.00054	11.3	33619	5555	0.32
Kansas	Missouri Control	0.496	0.080%	1,250	391,000	762.0	764.1	0.00056	11.7	34532	5734	0.32
Kansas	Missouri Control	0.496	0.067%	1,500	407,000	762.7	764.9	0.00057	12.0	35209	5867	0.33
Kansas		0.500	James Street Bridge									
Kansas	Kansas Control	0.504	10%	10	121,000	743.6	744.3	0.00040	6.7	18043	798	0.25
Kansas	Kansas Control	0.504	1%	100	241,000	752.7	754.0	0.00052	9.5	25677	877	0.30
Kansas	Missouri Control	0.504	0.5%	200	237,000	755.1	756.2	0.00039	8.6	27803	896	0.26
Kansas	Missouri Control	0.504	0.2%	500	308,000	758.7	760.3	0.00047	10.1	31113	951	0.29
Kansas	Missouri Control	0.504	0.133%	750	343,000	760.2	762.0	0.00050	10.8	32552	956	0.31
Kansas	Missouri Control	0.504	0.100%	1,000	369,000	761.3	763.2	0.00053	11.3	33598	5592	0.32
Kansas	Missouri Control	0.504	0.080%	1,250	391,000	762.2	764.3	0.00055	11.7	34525	5778	0.32
Kansas	Missouri Control	0.504	0.067%	1,500	407,000	763.0	765.1	0.00056	11.9	35219	5916	0.33
Kansas	Kansas Control	0.640	10%	10	121,000	743.8	744.6	0.00032	7.2	17464	692	0.23
Kansas	Kansas Control	0.640	1%	100	241,000	752.9	754.6	0.00050	10.7	24045	759	0.30
Kansas	Missouri Control	0.640	0.5%	200	237,000	755.2	756.7	0.00040	9.8	25810	774	0.27
Kansas	Missouri Control	0.640	0.2%	500	308,000	758.8	760.8	0.00050	11.7	28639	799	0.31
Kansas	Missouri Control	0.640	0.133%	750	343,000	760.3	762.6	0.00055	12.5	29841	818	0.33
Kansas	Missouri Control	0.640	0.100%	1,000	369,000	761.4	763.9	0.00059	13.2	30980	5804	0.34
Kansas	Missouri Control	0.640	0.080%	1,250	391,000	762.3	765.1	0.00061	13.6	31971	5990	0.35
Kansas	Missouri Control	0.640	0.067%	1,500	407,000	763.0	765.9	0.00063	13.9	32712	6128	0.35
Kansas	Kansas Control	0.812	10%	10	121,000	744.0	745.0	0.00039	8.0	15835	657	0.26
Kansas	Kansas Control	0.812	1%	100	241,000	753.1	755.2	0.00060	11.9	22124	723	0.33
Kansas	Kansas Control	0.812	0.5%	200	283,000	755.4	757.9	0.00068	13.1	23772	737	0.36

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	0.812	0.2%	500	308,000	758.9	761.4	0.00060	13.0	26447	751	0.34
Kansas	Missouri Control	0.812	0.133%	750	343,000	760.5	763.3	0.00066	13.9	27582	756	0.36
Kansas	Missouri Control	0.812	0.100%	1,000	369,000	761.5	764.7	0.00070	14.6	28402	6066	0.37
Kansas	Missouri Control	0.812	0.080%	1,250	391,000	762.5	765.8	0.00073	15.1	29130	6233	0.38
Kansas	Missouri Control	0.812	0.067%	1,500	407,000	763.2	766.7	0.00075	15.5	29672	6357	0.39
Kansas		0.815	KC Southern Bridge									
Kansas	Kansas Control	0.817	10%	10	121,000	744.1	745.1	0.00040	8.0	15818	656	0.26
Kansas	Kansas Control	0.817	1%	100	241,000	753.2	755.3	0.00062	11.9	22133	722	0.33
Kansas	Kansas Control	0.817	0.5%	200	283,000	755.5	758.0	0.00070	13.1	23793	736	0.36
Kansas	Missouri Control	0.817	0.2%	500	308,000	759.1	761.6	0.00061	13.0	26458	752	0.34
Kansas	Missouri Control	0.817	0.133%	750	343,000	760.7	763.5	0.00067	13.9	27688	760	0.36
Kansas	Missouri Control	0.817	0.100%	1,000	369,000	761.9	765.0	0.00071	14.5	28609	1471	0.37
Kansas	Missouri Control	0.817	0.080%	1,250	391,000	763.0	766.3	0.00073	15.0	29431	6322	0.38
Kansas	Missouri Control	0.817	0.067%	1,500	407,000	763.8	767.2	0.00074	15.3	30057	6467	0.38
Kansas	Kansas Control	1.106	10%	10	121,000	744.6	745.6	0.00039	8.0	15748	643	0.25
Kansas	Kansas Control	1.106	1%	100	241,000	754.1	756.2	0.00060	11.9	22115	695	0.33
Kansas	Kansas Control	1.106	0.5%	200	283,000	756.5	759.0	0.00067	13.1	23787	703	0.35
Kansas	Missouri Control	1.106	0.2%	500	308,000	759.9	762.5	0.00060	13.1	26225	715	0.34
Kansas	Missouri Control	1.106	0.133%	750	343,000	761.6	764.5	0.00066	14.0	27451	720	0.36
Kansas	Missouri Control	1.106	0.100%	1,000	369,000	762.9	766.0	0.00069	14.6	28360	7009	0.37
Kansas	Missouri Control	1.106	0.080%	1,250	391,000	764.0	767.3	0.00072	15.1	29163	7211	0.37
Kansas	Missouri Control	1.106	0.067%	1,500	407,000	764.8	768.3	0.00073	15.4	29766	7360	0.38
Kansas		1.112	Central Avenue Bridge									
Kansas	Kansas Control	1.117	10%	10	121,000	744.7	745.7	0.00038	8.0	15815	643	0.25
Kansas	Kansas Control	1.117	1%	100	241,000	754.2	756.3	0.00059	11.9	22206	694	0.33
Kansas	Kansas Control	1.117	0.5%	200	283,000	756.6	759.2	0.00066	13.0	23884	702	0.35
Kansas	Missouri Control	1.117	0.2%	500	308,000	760.0	762.6	0.00060	13.0	26301	713	0.34
Kansas	Missouri Control	1.117	0.133%	750	343,000	761.9	764.7	0.00064	13.9	27642	5397	0.35
Kansas	Missouri Control	1.117	0.100%	1,000	369,000	763.3	766.4	0.00067	14.5	28642	7145	0.36
Kansas	Missouri Control	1.117	0.080%	1,250	391,000	764.6	767.8	0.00069	14.9	29545	7382	0.37
Kansas	Missouri Control	1.117	0.067%	1,500	407,000	765.5	768.9	0.00070	15.2	30229	7551	0.37
Kansas	Kansas Control	1.270	10%	10	121,000	745.2	746.0	0.00037	7.1	17040	648	0.24
Kansas	Kansas Control	1.270	1%	100	241,000	755.2	756.8	0.00051	10.3	23825	709	0.30
Kansas	Kansas Control	1.270	0.5%	200	283,000	757.7	759.7	0.00056	11.3	25658	719	0.32
Kansas	Kansas Control	1.270	0.2%	500	341,000	761.1	763.5	0.00061	12.5	28093	731	0.34
Kansas	Missouri Control	1.270	0.133%	750	343,000	763.1	765.3	0.00053	12.0	29533	6424	0.32
Kansas	Missouri Control	1.270	0.100%	1,000	369,000	764.5	766.9	0.00055	12.5	30619	6623	0.32
Kansas	Missouri Control	1.270	0.080%	1,250	391,000	765.8	768.4	0.00056	12.8	31578	6799	0.33
Kansas	Missouri Control	1.270	0.067%	1,500	407,000	766.8	769.4	0.00057	13.1	32301	6931	0.33
Kansas	Kansas Control	1.385	10%	10	121,000	745.4	746.3	0.00041	7.4	16410	626	0.25
Kansas	Kansas Control	1.385	1%	100	241,000	755.4	757.1	0.00055	10.6	22930	674	0.31
Kansas	Kansas Control	1.385	0.5%	200	283,000	758.0	760.1	0.00060	11.6	24684	683	0.33
Kansas	Kansas Control	1.385	0.2%	500	341,000	761.4	763.9	0.00066	12.9	27008	695	0.35
Kansas	Missouri Control	1.385	0.133%	750	343,000	763.3	765.6	0.00057	12.4	28349	6028	0.33
Kansas	Missouri Control	1.385	0.100%	1,000	369,000	764.8	767.3	0.00059	12.9	29385	6266	0.34
Kansas	Missouri Control	1.385	0.080%	1,250	391,000	766.1	768.8	0.00060	13.2	30298	6500	0.34
Kansas	Missouri Control	1.385	0.067%	1,500	407,000	767.0	769.8	0.00061	13.5	30985	6653	0.34
Kansas		1.399	I-670 Bridge									
Kansas	Kansas Control	1.413	10%	10	121,000	745.6	746.4	0.00040	7.4	16417	624	0.25
Kansas	Kansas Control	1.413	1%	100	241,000	755.6	757.4	0.00054	10.6	23002	674	0.31
Kansas	Kansas Control	1.413	0.5%	200	283,000	758.3	760.4	0.00059	11.6	24786	684	0.33
Kansas	Kansas Control	1.413	0.2%	500	341,000	761.7	764.2	0.00065	12.8	27137	696	0.35
Kansas	Missouri Control	1.413	0.133%	750	343,000	763.6	765.9	0.00057	12.3	28444	6079	0.33
Kansas	Missouri Control	1.413	0.100%	1,000	369,000	765.1	767.6	0.00058	12.8	29513	6347	0.33
Kansas	Missouri Control	1.413	0.080%	1,250	391,000	766.4	769.1	0.00059	13.2	30450	6592	0.34

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	1.413	0.067%	1,500	407,000	770.0	770.4	0.00051	12.8	33240	7115	0.32
Kansas	Kansas Control	1.614	10%	10	121,000	745.6	746.5	0.00042	7.6	15942	597	0.26
Kansas	Kansas Control	1.614	1%	100	241,000	755.7	757.5	0.00059	10.8	22387	669	0.32
Kansas	Kansas Control	1.614	0.5%	200	283,000	758.3	760.5	0.00064	11.8	24160	679	0.34
Kansas	Kansas Control	1.614	0.2%	500	341,000	761.8	764.4	0.00069	13.1	26496	691	0.36
Kansas	Missouri Control	1.614	0.133%	750	343,000	763.6	766.1	0.00061	12.6	27791	6111	0.34
Kansas	Missouri Control	1.614	0.100%	1,000	369,000	765.1	767.8	0.00062	13.1	28870	6315	0.34
Kansas	Missouri Control	1.614	0.080%	1,250	391,000	766.5	769.3	0.00063	13.4	29816	6493	0.35
Kansas	Missouri Control	1.614	0.067%	1,500	407,000	770.2	772.7	0.00053	12.9	32413	6988	0.32
Kansas		1.619	Missouri Pacific Bridge No. 72									
Kansas	Kansas Control	1.624	10%	10	121,000	745.7	746.6	0.00042	7.6	15991	598	0.26
Kansas	Kansas Control	1.624	1%	100	241,000	755.9	757.7	0.00058	10.8	22486	670	0.32
Kansas	Kansas Control	1.624	0.5%	200	283,000	758.5	760.7	0.00063	11.8	24281	679	0.34
Kansas	Kansas Control	1.624	0.2%	500	341,000	762.3	764.8	0.00067	12.9	26838	692	0.35
Kansas	Missouri Control	1.624	0.133%	750	343,000	764.2	766.6	0.00058	12.4	28201	6190	0.33
Kansas	Missouri Control	1.624	0.100%	1,000	369,000	765.9	768.5	0.00059	12.8	29405	6421	0.33
Kansas	Missouri Control	1.624	0.080%	1,250	391,000	767.4	770.0	0.00059	13.2	30402	6612	0.34
Kansas	Missouri Control	1.624	0.067%	1,500	407,000	770.9	773.3	0.00051	12.7	32822	6994	0.31
Kansas	Kansas Control	1.634	10%	10	121,000	745.7	746.6	0.00042	7.6	15941	594	0.26
Kansas	Kansas Control	1.634	1%	100	241,000	755.9	757.7	0.00059	10.8	22411	671	0.32
Kansas	Kansas Control	1.634	0.5%	200	283,000	758.5	760.7	0.00063	11.8	24211	681	0.34
Kansas	Kansas Control	1.634	0.2%	500	341,000	762.3	764.9	0.00067	12.9	26778	694	0.35
Kansas	Missouri Control	1.634	0.133%	750	343,000	764.2	766.6	0.00058	12.4	28144	6130	0.33
Kansas	Missouri Control	1.634	0.100%	1,000	369,000	766.0	768.5	0.00059	12.8	29352	6352	0.33
Kansas	Missouri Control	1.634	0.080%	1,250	391,000	767.4	770.1	0.00060	13.2	30352	6535	0.34
Kansas	Missouri Control	1.634	0.067%	1,500	407,000	770.9	773.4	0.00051	12.7	32777	6912	0.32
Kansas		1.638	Union Pacific Bridge No. 3									
Kansas	Kansas Control	1.643	10%	10	121,000	745.8	746.7	0.00042	7.6	15990	595	0.26
Kansas	Kansas Control	1.643	1%	100	241,000	756.0	757.8	0.00058	10.8	22512	670	0.32
Kansas	Kansas Control	1.643	0.5%	200	283,000	758.7	760.9	0.00062	11.8	24325	680	0.33
Kansas	Kansas Control	1.643	0.2%	500	341,000	762.5	765.0	0.00066	12.9	26903	693	0.35
Kansas	Missouri Control	1.643	0.133%	750	343,000	764.6	766.9	0.00057	12.3	28350	6171	0.33
Kansas	Missouri Control	1.643	0.100%	1,000	369,000	766.4	768.9	0.00057	12.7	29622	6405	0.33
Kansas	Missouri Control	1.643	0.080%	1,250	391,000	767.8	770.4	0.00058	13.1	30623	6589	0.33
Kansas	Missouri Control	1.643	0.067%	1,500	407,000	771.2	773.7	0.00050	12.7	32988	6916	0.31
Kansas	Kansas Control	2.016	10%	10	121,000	746.6	747.4	0.00035	7.5	16254	585	0.24
Kansas	Kansas Control	2.016	1%	100	241,000	757.1	758.9	0.00051	11.0	22806	663	0.30
Kansas	Kansas Control	2.016	0.5%	200	283,000	759.8	762.0	0.00056	12.0	24669	684	0.32
Kansas	Kansas Control	2.016	0.2%	500	341,000	763.7	766.3	0.00060	13.2	27335	712	0.34
Kansas	Kansas Control	2.016	0.133%	750	367,000	765.6	768.4	0.00060	13.6	28761	6508	0.34
Kansas	Kansas Control	2.016	0.100%	1,000	388,000	767.4	770.3	0.00059	13.9	30061	6805	0.34
Kansas	Missouri Control	2.016	0.080%	1,250	391,000	768.8	771.6	0.00055	13.5	31104	7035	0.33
Kansas	Missouri Control	2.016	0.067%	1,500	407,000	772.1	774.7	0.00048	13.2	33465	7228	0.31
Kansas	Kansas Control	2.097	10%	10	121,000	746.7	747.6	0.00038	7.6	16006	586	0.25
Kansas	Kansas Control	2.097	1%	100	241,000	757.3	759.2	0.00051	10.9	22682	673	0.31
Kansas	Kansas Control	2.097	0.5%	200	283,000	760.1	762.3	0.00056	11.9	24603	696	0.32
Kansas	Kansas Control	2.097	0.2%	500	341,000	764.0	766.6	0.00060	13.1	27348	5104	0.34
Kansas	Kansas Control	2.097	0.133%	750	367,000	766.0	768.7	0.00060	13.4	28789	5282	0.34
Kansas	Kansas Control	2.097	0.100%	1,000	388,000	767.8	770.6	0.00059	13.6	30090	6101	0.34
Kansas	Missouri Control	2.097	0.080%	1,250	391,000	769.2	771.9	0.00054	13.3	31115	6724	0.33
Kansas	Missouri Control	2.097	0.067%	1,500	407,000	772.4	774.9	0.00047	13.0	33452	7112	0.31
Kansas		2.104	CRI&P Bridge									
Kansas	Kansas Control	2.111	10%	10	121,000	746.8	747.7	0.00037	7.5	16073	589	0.25
Kansas	Kansas Control	2.111	1%	100	241,000	757.5	759.3	0.00049	10.8	22844	679	0.31

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	2.111	0.5%	200	283,000	760.3	762.5	0.00053	11.8	24799	702	0.32
Kansas	Kansas Control	2.111	0.2%	500	341,000	764.3	766.9	0.00056	12.9	27671	5122	0.34
Kansas	Kansas Control	2.111	0.133%	750	367,000	766.5	769.2	0.00056	13.2	29253	5477	0.34
Kansas	Kansas Control	2.111	0.100%	1,000	388,000	768.4	771.2	0.00054	13.4	30683	6364	0.33
Kansas	Missouri Control	2.111	0.080%	1,250	391,000	769.8	772.4	0.00050	13.1	31665	6977	0.32
Kansas	Missouri Control	2.111	0.067%	1,500	407,000	772.9	775.4	0.00044	12.8	33949	7111	0.31
Kansas	Kansas Control	2.165	10%	10	121,000	747.0	747.8	0.00038	7.1	16988	692	0.25
Kansas	Kansas Control	2.165	1%	100	241,000	758.0	759.5	0.00045	9.8	25258	824	0.29
Kansas	Kansas Control	2.165	0.5%	200	283,000	760.9	762.7	0.00047	10.6	27739	852	0.30
Kansas	Kansas Control	2.165	0.2%	500	341,000	765.1	767.1	0.00048	11.4	31309	5371	0.31
Kansas	Kansas Control	2.165	0.133%	750	343,000	767.0	768.8	0.00042	11.0	32952	6085	0.29
Kansas	Kansas Control	2.165	0.100%	1,000	369,000	769.1	771.0	0.00041	11.2	34725	6672	0.29
Kansas	Missouri Control	2.165	0.080%	1,250	391,000	770.6	772.6	0.00042	11.5	36029	6948	0.29
Kansas	Missouri Control	2.165	0.067%	1,500	407,000	773.6	775.5	0.00036	11.2	38675	6971	0.28
Kansas		2.172	Kansas Avenue East Bridge									
Kansas	Kansas Control	2.179	10%	10	121,000	747.1	747.9	0.00038	7.1	17056	697	0.25
Kansas	Kansas Control	2.179	1%	100	241,000	758.1	759.6	0.00045	9.7	25293	796	0.29
Kansas	Kansas Control	2.179	0.5%	200	283,000	761.1	762.8	0.00047	10.5	27713	817	0.30
Kansas	Kansas Control	2.179	0.2%	500	341,000	765.5	767.4	0.00047	11.3	31333	5430	0.30
Kansas	Kansas Control	2.179	0.133%	750	367,000	767.8	769.8	0.00045	11.5	33271	5898	0.30
Kansas	Kansas Control	2.179	0.100%	1,000	388,000	769.9	772.0	0.00043	11.6	35004	6899	0.30
Kansas	Kansas Control	2.179	0.080%	1,250	403,000	771.3	773.3	0.00042	11.7	36108	6946	0.29
Kansas	Missouri Control	2.179	0.067%	1,500	407000	774.4	776.3	0.00035	11.0	38753	6958	0.27
Kansas	Kansas Control	2.491	10%	10	121,000	747.7	748.5	0.00034	7.2	16755	597	0.24
Kansas	Kansas Control	2.491	1%	100	241,000	758.7	760.3	0.00045	10.2	23818	681	0.29
Kansas	Kansas Control	2.491	0.5%	200	283,000	761.7	763.6	0.00048	11.1	25886	693	0.30
Kansas	Kansas Control	2.491	0.2%	500	341,000	766.1	768.3	0.00049	12.1	28918	6601	0.32
Kansas	Kansas Control	2.491	0.133%	750	367,000	768.4	770.7	0.00048	12.4	30559	6608	0.31
Kansas	Kansas Control	2.491	0.100%	1,000	388,000	770.4	772.8	0.00047	12.5	32018	6614	0.31
Kansas	Kansas Control	2.491	0.080%	1,250	403,000	771.7	774.2	0.00046	12.6	32952	6618	0.31
Kansas	Missouri Control	2.491	0.067%	1,500	407000	774.8	777.0	0.00039	12.0	35148	6626	0.29
Kansas	Kansas Control	2.525	10%	10	121,000	747.7	748.5	0.00033	7.3	16649	609	0.24
Kansas	Kansas Control	2.525	1%	100	241,000	758.8	760.4	0.00044	10.4	23939	709	0.29
Kansas	Kansas Control	2.525	0.5%	200	283,000	761.8	763.7	0.00047	11.3	26099	723	0.30
Kansas	Kansas Control	2.525	0.2%	500	341,000	766.1	768.4	0.00049	12.3	29248	6556	0.32
Kansas	Kansas Control	2.525	0.133%	750	367,000	768.4	770.8	0.00048	12.6	30912	6575	0.31
Kansas	Kansas Control	2.525	0.100%	1,000	388,000	770.5	772.9	0.00047	12.7	32391	6591	0.31
Kansas	Kansas Control	2.525	0.080%	1,250	403,000	771.8	774.3	0.00046	12.9	33337	6601	0.31
Kansas	Missouri Control	2.525	0.067%	1,500	407000	774.8	777.1	0.00039	12.2	35557	6624	0.29
Kansas		2.531	KC Terminal Bridge									
Kansas	Kansas Control	2.536	10%	10	121,000	747.8	748.6	0.00035	7.2	16815	624	0.24
Kansas	Kansas Control	2.536	1%	100	241,000	759.0	760.6	0.00043	10.1	24346	710	0.29
Kansas	Kansas Control	2.536	0.5%	200	283,000	762.1	764.0	0.00046	11.0	26560	710	0.30
Kansas	Kansas Control	2.536	0.2%	500	341,000	766.7	768.8	0.00047	11.9	29780	6567	0.31
Kansas	Kansas Control	2.536	0.133%	750	367,000	769.2	771.4	0.00045	12.1	31579	6588	0.30
Kansas	Kansas Control	2.536	0.100%	1,000	388,000	771.4	773.7	0.00043	12.2	33157	6603	0.30
Kansas	Kansas Control	2.536	0.080%	1,250	403,000	772.9	775.2	0.00043	12.3	34177	6611	0.30
Kansas	Missouri Control	2.536	0.067%	1,500	407000	776.0	778.1	0.00035	11.7	36438	6649	0.28
Kansas	Kansas Control	3.050	10%	10	121,000	749.0	749.7	0.00035	6.7	18044	740	0.24
Kansas	Kansas Control	3.050	1%	100	241,000	760.7	761.9	0.00037	9.0	27109	805	0.26
Kansas	Kansas Control	3.050	0.5%	200	283,000	763.9	765.4	0.00039	9.7	29755	818	0.27
Kansas	Kansas Control	3.050	0.2%	500	341,000	768.6	770.2	0.00038	10.4	33595	6368	0.28
Kansas	Kansas Control	3.050	0.133%	750	367,000	771.1	772.8	0.00037	10.6	35692	6471	0.27
Kansas	Kansas Control	3.050	0.100%	1,000	388,000	773.2	775.0	0.00035	10.7	37510	6499	0.27
Kansas	Kansas Control	3.050	0.080%	1,250	403,000	774.7	776.4	0.00034	10.8	38698	6518	0.27
Kansas	Kansas Control	3.050	0.067%	1,500	417,000	775.9	777.7	0.00034	10.9	39732	6535	0.27

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	3.405	10%	10	121,000	749.7	750.4	0.00038	6.7	18183	801	0.25
Kansas	Kansas Control	3.405	1%	100	241,000	761.5	762.6	0.00037	8.7	28096	876	0.26
Kansas	Kansas Control	3.405	0.5%	200	283,000	764.8	766.1	0.00038	9.3	31257	980	0.27
Kansas	Kansas Control	3.405	0.2%	500	341,000	769.5	771.0	0.00036	9.9	35997	6777	0.27
Kansas	Kansas Control	3.405	0.133%	750	367,000	772.0	773.5	0.00035	10.0	38616	6835	0.26
Kansas	Kansas Control	3.405	0.100%	1,000	388,000	774.1	775.7	0.00033	10.0	40885	6895	0.26
Kansas	Kansas Control	3.405	0.080%	1,250	403,000	775.5	777.1	0.00032	10.1	42377	6923	0.26
Kansas	Missouri Control	3.405	0.067%	1,500	407000	778.3	779.7	0.00027	9.6	45322	6977	0.24
Kansas		3.416	7th Street Bridge									
Kansas	Kansas Control	3.427	10%	10	121,000	749.8	750.4	0.00037	6.3	19149	803	0.23
Kansas	Kansas Control	3.427	1%	100	241,000	761.6	762.7	0.00038	8.4	29031	879	0.25
Kansas	Kansas Control	3.427	0.5%	200	283,000	765.0	766.2	0.00039	9.0	32303	1017	0.25
Kansas	Kansas Control	3.427	0.2%	500	341,000	769.8	771.2	0.00038	9.6	37269	6850	0.25
Kansas	Kansas Control	3.427	0.133%	750	367,000	772.4	773.8	0.00036	9.7	39955	6914	0.25
Kansas	Kansas Control	3.427	0.100%	1,000	388,000	774.6	776.0	0.00034	9.7	42288	6976	0.25
Kansas	Kansas Control	3.427	0.080%	1,250	403,000	776.0	777.5	0.00033	9.8	43831	7024	0.24
Kansas	Missouri Control	3.427	0.067%	1,500	407000	778.9	780.2	0.00028	9.3	46839	7116	0.22
Kansas	Kansas Control	3.960	10%	10	121,000	750.7	751.3	0.00022	6.2	20834	840	0.19
Kansas	Kansas Control	3.960	1%	100	241,000	762.6	763.7	0.00029	8.8	31373	948	0.23
Kansas	Kansas Control	3.960	0.5%	200	283,000	765.9	767.2	0.00031	9.5	34710	1045	0.24
Kansas	Kansas Control	3.960	0.2%	500	341,000	770.7	772.2	0.00032	10.2	39802	7119	0.24
Kansas	Kansas Control	3.960	0.133%	750	367,000	773.3	774.8	0.00031	10.3	42518	7161	0.24
Kansas	Kansas Control	3.960	0.100%	1,000	388,000	775.4	777.0	0.00030	10.4	44869	7203	0.24
Kansas	Kansas Control	3.960	0.080%	1,250	403,000	776.9	778.4	0.00029	10.5	46442	7245	0.24
Kansas	Missouri Control	3.960	0.067%	1,500	407000	779.6	781.0	0.00026	10.1	49596	7405	0.22
Kansas	Kansas Control	4.276	10%	10	121,000	751.0	751.6	0.00029	6.5	20014	889	0.21
Kansas	Kansas Control	4.276	1%	100	241,000	763.0	764.1	0.00033	8.7	31167	970	0.24
Kansas	Kansas Control	4.276	0.5%	200	283,000	766.4	767.7	0.00034	9.3	34506	993	0.24
Kansas	Kansas Control	4.276	0.2%	500	341,000	771.2	772.7	0.00034	10.0	39371	7370	0.25
Kansas	Kansas Control	4.276	0.133%	750	367,000	773.8	775.2	0.00033	10.1	41943	7374	0.25
Kansas	Kansas Control	4.276	0.100%	1,000	388,000	775.9	777.4	0.00032	10.2	44164	7378	0.24
Kansas	Kansas Control	4.276	0.080%	1,250	403,000	777.4	778.8	0.00031	10.3	45643	7380	0.24
Kansas	Missouri Control	4.276	0.067%	1,500	407000	780.0	781.4	0.00027	9.8	48380	7384	0.23
Kansas		4.280	12th Street Bridge									
Kansas	Kansas Control	4.284	10%	10	121,000	751.0	751.7	0.00033	6.4	20063	889	0.21
Kansas	Kansas Control	4.284	1%	100	241,000	763.1	764.2	0.00038	8.6	31252	971	0.24
Kansas	Kansas Control	4.284	0.5%	200	283,000	766.5	767.7	0.00039	9.2	34603	994	0.24
Kansas	Kansas Control	4.284	0.2%	500	341,000	771.4	772.8	0.00039	9.9	39566	7371	0.25
Kansas	Kansas Control	4.284	0.133%	750	367,000	774.0	775.4	0.00037	10.0	42202	7375	0.24
Kansas	Kansas Control	4.284	0.100%	1,000	388,000	776.2	777.7	0.00036	10.0	44496	7378	0.24
Kansas	Kansas Control	4.284	0.080%	1,250	403,000	777.7	779.2	0.00035	10.1	46029	7381	0.24
Kansas	Missouri Control	4.284	0.067%	1,500	407000	780.4	781.7	0.00030	9.6	48820	7385	0.22
Kansas	Kansas Control	4.480	10%	10	121,000	751.4	752.0	0.00032	6.6	19963	808	0.20
Kansas	Kansas Control	4.480	1%	100	241,000	763.5	764.7	0.00039	9.0	30300	926	0.24
Kansas	Kansas Control	4.480	0.5%	200	283,000	766.9	768.2	0.00041	9.7	33580	1000	0.25
Kansas	Kansas Control	4.480	0.2%	500	341,000	771.8	773.3	0.00041	10.4	38714	7407	0.25
Kansas	Kansas Control	4.480	0.133%	750	367,000	774.4	775.9	0.00039	10.5	41475	7450	0.25
Kansas	Kansas Control	4.480	0.100%	1,000	388,000	776.6	778.1	0.00037	10.5	43879	7483	0.25
Kansas	Kansas Control	4.480	0.080%	1,250	403,000	778.1	779.6	0.00037	10.6	45489	7505	0.24
Kansas	Missouri Control	4.480	0.067%	1,500	417,000	779.4	780.9	0.00036	10.6	46929	7525	0.24
Kansas	Kansas Control	4.949	10%	10	121,000	752.2	752.5	0.00015	4.3	28189	1067	0.14
Kansas	Kansas Control	4.949	1%	100	241,000	764.7	765.2	0.00018	5.9	42299	1189	0.16
Kansas	Kansas Control	4.949	0.5%	200	283,000	768.2	768.8	0.00019	6.4	46555	1221	0.17
Kansas	Kansas Control	4.949	0.2%	500	341,000	773.2	773.9	0.00019	6.8	52875	7113	0.17
Kansas	Kansas Control	4.949	0.133%	750	367,000	775.7	776.5	0.00019	7.0	56159	7149	0.17

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	4.949	0.100%	1,000	388,000	777.9	778.7	0.00018	7.0	58985	7180	0.17
Kansas	Kansas Control	4.949	0.080%	1,250	403,000	779.4	780.1	0.00018	7.1	60880	7201	0.17
Kansas	Missouri Control	4.949	0.067%	1,500	407000	781.9	782.6	0.00016	6.8	64100	7232	0.16
Kansas		4.960	18th Street Bridge									
Kansas	Kansas Control	4.970	10%	10	121,000	752.3	752.5	0.00014	4.1	29739	1143	0.14
Kansas	Kansas Control	4.970	1%	100	241,000	764.8	765.3	0.00016	5.5	44814	1261	0.15
Kansas	Kansas Control	4.970	0.5%	200	283,000	768.4	768.9	0.00017	5.9	49372	1294	0.16
Kansas	Kansas Control	4.970	0.2%	500	341,000	773.4	774.0	0.00017	6.3	56075	6860	0.16
Kansas	Kansas Control	4.970	0.133%	750	367,000	776.0	776.6	0.00017	6.4	59553	6947	0.16
Kansas	Kansas Control	4.970	0.100%	1,000	388,000	778.2	778.9	0.00016	6.5	62549	7023	0.16
Kansas	Kansas Control	4.970	0.080%	1,250	403,000	779.7	780.4	0.00016	6.5	64563	7073	0.16
Kansas	Missouri Control	4.970	0.067%	1,500	417,000	781.1	781.7	0.00016	6.6	66369	7107	0.16
Kansas	Kansas Control	5.506	10%	10	121,000	752.7	752.9	0.00016	3.9	31109	1163	0.13
Kansas	Kansas Control	5.506	1%	100	241,000	765.3	765.7	0.00019	5.3	46383	1252	0.15
Kansas	Kansas Control	5.506	0.5%	200	283,000	768.9	769.4	0.00020	5.7	50899	1265	0.15
Kansas	Kansas Control	5.506	0.2%	500	341,000	773.9	774.5	0.00020	6.1	57335	9185	0.15
Kansas	Kansas Control	5.506	0.133%	750	367,000	776.5	777.1	0.00019	6.2	60663	9222	0.15
Kansas	Kansas Control	5.506	0.100%	1,000	388,000	778.7	779.3	0.00019	6.3	63568	9236	0.15
Kansas	Kansas Control	5.506	0.080%	1,250	403,000	780.2	780.8	0.00019	6.3	65538	9244	0.15
Kansas	Missouri Control	5.506	0.067%	1,500	407000	782.7	783.2	0.00016	6.1	68782	9244	0.14
Kansas		5.513	Kaw Power Plant Intake Structure									
Kansas	Kansas Control	5.520	10%	10	121,000	752.7	752.9	0.00016	3.9	31127	1163	0.13
Kansas	Kansas Control	5.520	1%	100	241,000	765.3	765.7	0.00019	5.3	46423	1252	0.15
Kansas	Kansas Control	5.520	0.5%	200	283,000	768.9	769.4	0.00020	5.7	50942	1265	0.15
Kansas	Kansas Control	5.520	0.2%	500	341,000	774.0	774.5	0.00020	6.1	57387	9186	0.15
Kansas	Kansas Control	5.520	0.133%	750	367,000	776.6	777.1	0.00019	6.2	60687	9222	0.15
Kansas	Kansas Control	5.520	0.100%	1,000	388,000	778.8	779.4	0.00019	6.3	63523	9236	0.15
Kansas	Kansas Control	5.520	0.080%	1,250	403,000	780.3	780.9	0.00018	6.3	65433	9244	0.15
Kansas	Missouri Control	5.520	0.067%	1,500	407000	782.7	783.3	0.00016	6.1	68565	9244	0.14
Kansas	Kansas Control	5.811	10%	10	121,000	753.0	753.1	0.00008	3.1	38857	1616	0.11
Kansas	Kansas Control	5.811	1%	100	241,000	765.7	766.0	0.00010	4.1	60698	1806	0.12
Kansas	Kansas Control	5.811	0.5%	200	283,000	769.4	769.7	0.00010	4.3	67303	1827	0.12
Kansas	Kansas Control	5.811	0.2%	500	341,000	774.5	774.8	0.00010	4.6	76744	9776	0.12
Kansas	Kansas Control	5.811	0.133%	750	367,000	777.1	777.4	0.00010	4.7	81619	9861	0.12
Kansas	Kansas Control	5.811	0.100%	1,000	388,000	779.3	779.6	0.00009	4.7	85802	9934	0.12
Kansas	Kansas Control	5.811	0.080%	1,250	403,000	780.8	781.1	0.00009	4.8	88624	10101	0.12
Kansas	Missouri Control	5.811	0.067%	1,500	407000	783.2	783.5	0.00008	4.6	93156	10148	0.11
Kansas		5.821	Kansas Avenue Bridge									
Kansas	Kansas Control	5.831	10%	10	121,000	753.0	753.1	0.00010	3.1	38925	1616	0.11
Kansas	Kansas Control	5.831	1%	100	241,000	765.8	766.0	0.00010	4.1	60769	1806	0.12
Kansas	Kansas Control	5.831	0.5%	200	283,000	769.4	769.7	0.00010	4.3	67375	1827	0.12
Kansas	Kansas Control	5.831	0.2%	500	341,000	774.5	774.8	0.00009	4.6	76831	9777	0.12
Kansas	Kansas Control	5.831	0.133%	750	367,000	777.1	777.4	0.00009	4.7	81744	9863	0.12
Kansas	Kansas Control	5.831	0.100%	1,000	388,000	779.3	779.7	0.00009	4.7	85952	9936	0.12
Kansas	Kansas Control	5.831	0.080%	1,250	403,000	780.8	781.2	0.00008	4.8	88793	10102	0.12
Kansas	Missouri Control	5.831	0.067%	1,500	407000	783.3	783.6	0.00007	4.6	93353	10150	0.11
Kansas	Kansas Control	5.967	10%	10	121,000	753.0	753.2	0.00011	3.6	34161	1244	0.12
Kansas	Kansas Control	5.967	1%	100	241,000	765.8	766.1	0.00012	4.8	50626	1341	0.13
Kansas	Kansas Control	5.967	0.5%	200	283,000	769.4	769.8	0.00013	5.2	55525	1368	0.14
Kansas	Kansas Control	5.967	0.2%	500	341,000	774.5	774.9	0.00013	5.6	62561	8606	0.14
Kansas	Kansas Control	5.967	0.133%	750	367,000	777.1	777.6	0.00012	5.7	66183	8632	0.14
Kansas	Kansas Control	5.967	0.100%	1,000	388,000	779.3	779.8	0.00012	5.8	69285	8655	0.14
Kansas	Kansas Control	5.967	0.080%	1,250	403,000	780.8	781.3	0.00012	5.8	71380	8682	0.14
Kansas	Missouri Control	5.967	0.067%	1,500	407000	783.2	783.7	0.00010	5.6	74750	8744	0.13

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	6.880	10%	10	121,000	753.5	753.7	0.00018	3.9	31290	1340	0.14
Kansas	Kansas Control	6.880	1%	100	241,000	766.3	766.6	0.00017	5.0	49120	1443	0.15
Kansas	Kansas Control	6.880	0.5%	200	283,000	769.9	770.3	0.00017	5.3	54401	1466	0.15
Kansas	Kansas Control	6.880	0.2%	500	341,000	775.0	775.5	0.00016	5.7	61969	8085	0.15
Kansas	Kansas Control	6.880	0.133%	750	367,000	777.6	778.1	0.00015	5.8	65836	8136	0.15
Kansas	Kansas Control	6.880	0.100%	1,000	388,000	779.8	780.3	0.00015	5.8	69143	8178	0.14
Kansas	Kansas Control	6.880	0.080%	1,250	403,000	781.3	781.8	0.00014	5.9	71380	8211	0.14
Kansas	Missouri Control	6.880	0.067%	1,500	407000	783.6	784.1	0.00013	5.6	74915	8263	0.14
Kansas	Kansas Control	7.329	10%	10	121,000	753.9	754.3	0.00024	5.1	24772	1185	0.17
Kansas	Kansas Control	7.329	1%	100	241,000	766.5	767.2	0.00026	6.7	40815	1410	0.18
Kansas	Kansas Control	7.329	0.5%	200	283,000	770.2	770.9	0.00026	7.1	46199	1534	0.19
Kansas	Kansas Control	7.329	0.2%	500	341,000	775.2	776.0	0.00025	7.5	54338	8637	0.19
Kansas	Kansas Control	7.329	0.133%	750	367,000	777.8	778.6	0.00024	7.6	58763	8701	0.19
Kansas	Kansas Control	7.329	0.100%	1,000	388,000	780.0	780.8	0.00023	7.6	62599	8736	0.18
Kansas	Kansas Control	7.329	0.080%	1,250	403,000	781.5	782.3	0.00022	7.6	65212	8754	0.18
Kansas	Missouri Control	7.329	0.067%	1,500	407000	783.8	784.5	0.00019	7.3	69327	8783	0.17
Kansas	Kansas Control	7.333	10%	10	121,000	753.9	754.3	0.00024	5.1	24781	1186	0.17
Kansas	Kansas Control	7.333	1%	100	241,000	766.5	767.2	0.00026	6.7	40826	1411	0.18
Kansas	Kansas Control	7.333	0.5%	200	283,000	770.2	770.9	0.00026	7.1	46211	1534	0.19
Kansas	Kansas Control	7.333	0.2%	500	341,000	775.2	776.0	0.00025	7.5	54351	8637	0.19
Kansas	Kansas Control	7.333	0.133%	750	367,000	777.8	778.6	0.00024	7.6	58775	8701	0.19
Kansas	Kansas Control	7.333	0.100%	1,000	388,000	780.0	780.8	0.00023	7.6	62611	8736	0.18
Kansas	Kansas Control	7.333	0.080%	1,250	403,000	781.5	782.3	0.00022	7.6	65223	8754	0.18
Kansas	Missouri Control	7.333	0.067%	1,500	407000	783.8	784.6	0.00019	7.3	69338	8784	0.17
Kansas		7.338	I-635 Bridge (northbound)									
Kansas	Kansas Control	7.342	10%	10	121,000	753.9	754.3	0.00024	5.1	24809	1186	0.17
Kansas	Kansas Control	7.342	1%	100	241,000	766.6	767.2	0.00026	6.7	40861	1412	0.18
Kansas	Kansas Control	7.342	0.5%	200	283,000	770.2	770.9	0.00026	7.1	46249	1535	0.19
Kansas	Kansas Control	7.342	0.2%	500	341,000	775.2	776.1	0.00025	7.5	54395	8638	0.19
Kansas	Kansas Control	7.342	0.133%	750	367,000	777.8	778.6	0.00024	7.6	58814	8701	0.19
Kansas	Kansas Control	7.342	0.100%	1,000	388,000	780.0	780.8	0.00023	7.6	62652	8736	0.18
Kansas	Kansas Control	7.342	0.080%	1,250	403,000	781.5	782.3	0.00022	7.6	65261	8755	0.18
Kansas	Missouri Control	7.342	0.067%	1,500	407000	783.8	784.6	0.00019	7.3	69382	8784	0.17
Kansas	Kansas Control	7.351	10%	10	121,000	753.9	754.3	0.00024	5.1	24827	1186	0.17
Kansas	Kansas Control	7.351	1%	100	241,000	766.6	767.3	0.00026	6.7	40882	1413	0.18
Kansas	Kansas Control	7.351	0.5%	200	283,000	770.2	770.9	0.00026	7.1	46271	1536	0.19
Kansas	Kansas Control	7.351	0.2%	500	341,000	775.3	776.1	0.00025	7.5	54425	8639	0.19
Kansas	Kansas Control	7.351	0.133%	750	367,000	777.8	778.6	0.00024	7.6	58833	8702	0.19
Kansas	Kansas Control	7.351	0.100%	1,000	388,000	780.0	780.8	0.00023	7.6	62677	8736	0.18
Kansas	Kansas Control	7.351	0.080%	1,250	403,000	781.5	782.3	0.00022	7.6	65279	8755	0.18
Kansas	Missouri Control	7.351	0.067%	1,500	407000	783.9	784.6	0.00019	7.3	69407	8784	0.17
Kansas		7.355	I-635 Bridge (southbound)									
Kansas	Kansas Control	7.360	10%	10	121,000	753.9	754.3	0.00024	5.1	24839	1187	0.17
Kansas	Kansas Control	7.360	1%	100	241,000	766.6	767.3	0.00026	6.7	40913	1415	0.18
Kansas	Kansas Control	7.360	0.5%	200	283,000	770.2	771.0	0.00026	7.1	46311	1537	0.19
Kansas	Kansas Control	7.360	0.2%	500	341,000	775.3	776.1	0.00025	7.5	54467	8641	0.19
Kansas	Kansas Control	7.360	0.133%	750	367,000	777.9	778.7	0.00024	7.6	58872	8702	0.19
Kansas	Kansas Control	7.360	0.100%	1,000	388,000	780.1	780.9	0.00023	7.6	62721	8737	0.18
Kansas	Kansas Control	7.360	0.080%	1,250	403,000	781.5	782.4	0.00022	7.6	65321	8755	0.18
Kansas	Missouri Control	7.360	0.067%	1,500	407000	783.9	784.6	0.00019	7.3	69453	8784	0.17
Kansas	Kansas Control	7.364	10%	10	121,000	753.9	754.3	0.00024	5.1	24864	1187	0.17
Kansas	Kansas Control	7.364	1%	100	241,000	766.6	767.3	0.00025	6.7	40939	1416	0.18
Kansas	Kansas Control	7.364	0.5%	200	283,000	770.2	771.0	0.00026	7.1	46338	1537	0.19
Kansas	Kansas Control	7.364	0.2%	500	341,000	775.3	776.1	0.00025	7.5	54498	8641	0.19
Kansas	Kansas Control	7.364	0.133%	750	367,000	777.9	778.7	0.00024	7.6	58909	8702	0.18
Kansas	Kansas Control	7.364	0.100%	1,000	388,000	780.1	780.9	0.00023	7.6	62749	8737	0.18

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	7.364	0.080%	1,250	403,000	781.6	782.4	0.00022	7.6	65350	8755	0.18
Kansas	Missouri Control	7.364	0.067%	1,500	407000	783.9	784.6	0.00019	7.3	69478	8785	0.17
Kansas	Kansas Control	7.650	10%	10	121,000	754.3	754.7	0.00028	5.2	23615	1097	0.18
Kansas	Kansas Control	7.650	1%	100	241,000	767.0	767.7	0.00028	6.8	39372	1349	0.19
Kansas	Kansas Control	7.650	0.5%	200	283,000	770.6	771.4	0.00028	7.2	44448	1483	0.19
Kansas	Kansas Control	7.650	0.2%	500	341,000	775.7	776.5	0.00027	7.6	52071	7983	0.19
Kansas	Kansas Control	7.650	0.133%	750	367,000	778.2	779.0	0.00026	7.7	55978	8133	0.19
Kansas	Kansas Control	7.650	0.100%	1,000	388,000	780.4	781.2	0.00024	7.7	59343	8242	0.19
Kansas	Kansas Control	7.650	0.080%	1,250	403,000	781.9	782.7	0.00024	7.7	61619	8255	0.18
Kansas	Missouri Control	7.650	0.067%	1,500	407000	784.2	784.9	0.00021	7.4	65194	8276	0.17
Kansas	Kansas Control	8.420	10%	10	121,000	755.2	755.7	0.00021	5.6	25825	1543	0.16
Kansas	Kansas Control	8.420	1%	100	241,000	768.0	768.7	0.00023	7.1	48418	1985	0.18
Kansas	Kansas Control	8.420	0.5%	200	283,000	771.7	772.4	0.00023	7.5	55766	2020	0.18
Kansas	Kansas Control	8.420	0.2%	500	341,000	776.8	777.5	0.00022	7.7	66139	7022	0.18
Kansas	Kansas Control	8.420	0.133%	750	367,000	779.3	780.0	0.00021	7.8	71375	7041	0.17
Kansas	Kansas Control	8.420	0.100%	1,000	388,000	781.4	782.1	0.00020	7.7	75858	7061	0.17
Kansas	Kansas Control	8.420	0.080%	1,250	403,000	782.9	783.6	0.00019	7.7	78898	7075	0.17
Kansas	Missouri Control	8.420	0.067%	1,500	407000	785.1	785.7	0.00017	7.4	83480	7095	0.16
Kansas	Kansas Control	9.040	10%	10	121,000	755.8	756.3	0.00024	5.7	24955	2621	0.17
Kansas	Kansas Control	9.040	1%	100	241,000	768.7	769.4	0.00026	7.4	44094	3243	0.19
Kansas	Kansas Control	9.040	0.5%	200	283,000	772.3	773.1	0.00026	7.8	50102	3269	0.19
Kansas	Kansas Control	9.040	0.2%	500	341,000	777.3	778.1	0.00025	8.2	58453	7222	0.19
Kansas	Kansas Control	9.040	0.133%	750	367,000	779.8	780.6	0.00024	8.2	62613	7266	0.19
Kansas	Kansas Control	9.040	0.100%	1,000	388,000	781.9	782.7	0.00023	8.2	66164	7304	0.18
Kansas	Kansas Control	9.040	0.080%	1,250	403,000	783.3	784.2	0.00023	8.3	68571	7329	0.18
Kansas	Missouri Control	9.040	0.067%	1,500	407000	785.5	786.2	0.00020	7.9	72126	7367	0.17
Kansas	Kansas Control	9.490	10%	10	121,000	756.5	756.9	0.00022	4.6	26483	1128	0.16
Kansas	Kansas Control	9.490	1%	100	241,000	769.4	770.0	0.00022	6.1	42254	4376	0.17
Kansas	Kansas Control	9.490	0.5%	200	283,000	773.0	773.7	0.00023	6.5	46892	4462	0.17
Kansas	Kansas Control	9.490	0.2%	500	341,000	778.0	778.7	0.00022	6.9	53407	6668	0.18
Kansas	Kansas Control	9.490	0.133%	750	367,000	780.4	781.2	0.00022	7.1	56670	6767	0.17
Kansas	Kansas Control	9.490	0.100%	1,000	388,000	782.5	783.3	0.00021	7.1	59452	6804	0.17
Kansas	Kansas Control	9.490	0.080%	1,250	403,000	783.9	784.7	0.00021	7.2	61342	6815	0.17
Kansas	Missouri Control	9.490	0.067%	1,500	407000	786.0	786.7	0.00018	7.0	64072	6832	0.16
Kansas		9.498	Kansas Avenue West Bridge									
Kansas	Kansas Control	9.505	10%	10	121,000	756.6	756.9	0.00022	4.6	26537	1130	0.16
Kansas	Kansas Control	9.505	1%	100	241,000	769.4	770.0	0.00022	6.1	42325	4377	0.17
Kansas	Kansas Control	9.505	0.5%	200	283,000	773.1	773.7	0.00023	6.5	46966	4463	0.17
Kansas	Kansas Control	9.505	0.2%	500	341,000	778.0	778.7	0.00022	6.9	53474	6669	0.18
Kansas	Kansas Control	9.505	0.133%	750	367,000	780.5	781.3	0.00022	7.0	56814	6769	0.17
Kansas	Kansas Control	9.505	0.100%	1,000	388,000	782.6	783.4	0.00021	7.1	59647	6805	0.17
Kansas	Kansas Control	9.505	0.080%	1,250	403,000	784.1	784.8	0.00020	7.2	61575	6816	0.17
Kansas	Missouri Control	9.505	0.067%	1,500	407000	786.1	786.8	0.00018	6.9	64341	6833	0.16
Kansas	Kansas Control	9.820	10%	10	121,000	756.8	757.3	0.00021	5.6	26480	1260	0.16
Kansas	Kansas Control	9.820	0.5%	200	283,000	773.5	774.1	0.00019	6.8	68774	4523	0.16
Kansas	Kansas Control	9.820	0.2%	500	341,000	778.6	779.1	0.00017	6.9	83190	5848	0.16
Kansas	Kansas Control	9.820	0.133%	750	367,000	781.1	781.6	0.00016	6.8	90393	5872	0.15
Kansas	Kansas Control	9.820	0.100%	1,000	388,000	783.2	783.7	0.00015	6.7	96482	5887	0.15
Kansas	Kansas Control	9.820	0.080%	1,250	403,000	784.7	785.1	0.00014	6.7	100628	5898	0.15
Kansas	Missouri Control	9.820	0.067%	1,500	407,000	786.7	787.1	0.00013	6.4	106421	5913	0.14
Kansas	Kansas Control	10.400	10%	10	121,000	757.2	757.8	0.00019	6.1	21399	647	0.17
Kansas	Kansas Control	10.400	1%	100	241,000	770.1	771.1	0.00026	8.5	53720	4829	0.21
Kansas	Kansas Control	10.400	0.5%	200	283,000	773.8	774.8	0.00025	8.8	71229	4899	0.21
Kansas	Kansas Control	10.400	0.2%	500	341,000	778.8	779.8	0.00023	8.9	95947	4957	0.20
Kansas	Kansas Control	10.400	0.133%	750	367,000	781.3	782.2	0.00022	8.8	108244	5016	0.19
Kansas	Kansas Control	10.400	0.100%	1000	388,000	783.4	784.3	0.00020	8.7	118877	5039	0.19

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	10.400	0.080%	1250	403,000	784.8	785.7	0.00019	8.6	126200	5055	0.19
Kansas	Kansas Control	10.400	0.067%	1500	417,000	786.2	787.0	0.00019	8.6	132899	5070	0.18
Kansas	Kansas Control	10.600	10%	10	121,000	757.4	758.1	0.00022	6.4	20595	646	0.18
Kansas	Kansas Control	10.600	1%	100	241,000	770.4	771.5	0.00028	8.8	50930	4130	0.21
Kansas	Kansas Control	10.600	0.5%	200	283,000	774.0	775.2	0.00029	9.3	65414	4543	0.22
Kansas	Kansas Control	10.600	0.2%	500	341,000	779.0	780.1	0.00027	9.5	89325	4954	0.21
Kansas	Kansas Control	10.600	0.133%	750	367,000	781.5	782.5	0.00025	9.4	101635	5028	0.21
Kansas	Kansas Control	10.600	0.100%	1000	388,000	783.6	784.6	0.00023	9.3	112281	5067	0.20
Kansas	Kansas Control	10.600	0.080%	1250	403,000	785.0	786.0	0.00022	9.2	119636	5094	0.20
Kansas	Kansas Control	10.600	0.067%	1500	417,000	786.3	787.3	0.00022	9.1	126382	5118	0.19
Kansas	Kansas Control	10.900	10%	10	121,000	758.0	758.4	0.00017	5.4	25219	1059	0.16
Kansas	Kansas Control	10.900	1%	100	241,000	771.2	771.9	0.00019	7.1	61421	4365	0.18
Kansas	Kansas Control	10.900	0.5%	200	283,000	774.9	775.6	0.00018	7.3	77891	5067	0.17
Kansas	Kansas Control	10.900	0.2%	500	341,000	779.9	780.5	0.00017	7.5	102995	5343	0.17
Kansas	Kansas Control	10.900	0.133%	750	367,000	782.3	782.9	0.00016	7.4	115863	5377	0.17
Kansas	Kansas Control	10.900	0.100%	1000	388,000	784.3	784.9	0.00015	7.3	126919	5403	0.16
Kansas	Kansas Control	10.900	0.080%	1250	403,000	785.7	786.3	0.00015	7.3	134566	5421	0.16
Kansas	Kansas Control	10.900	0.067%	1500	417,000	787.0	787.6	0.00014	7.3	141582	5438	0.16
Kansas	Kansas Control	11.350	10%	10	121,000	758.3	758.7	0.00018	5.5	25153	1683	0.16
Kansas	Kansas Control	11.350	1%	100	241,000	771.7	772.3	0.00017	6.6	60912	3699	0.17
Kansas	Kansas Control	11.350	0.5%	200	283,000	775.4	775.9	0.00017	6.9	77320	5105	0.17
Kansas	Kansas Control	11.350	0.2%	500	341,000	780.3	780.8	0.00015	6.9	102222	5285	0.16
Kansas	Kansas Control	11.350	0.133%	750	367,000	782.7	783.2	0.00014	6.8	114821	5309	0.15
Kansas	Kansas Control	11.350	0.100%	1000	388,000	784.7	785.2	0.00013	6.7	125612	5330	0.15
Kansas	Kansas Control	11.350	0.080%	1250	403,000	786.1	786.6	0.00012	6.7	133079	5344	0.15
Kansas	Kansas Control	11.350	0.067%	1500	417,000	787.4	787.8	0.00012	6.6	139930	5357	0.14
Kansas	Kansas Control	11.850	10%	10	121,000	758.8	759.3	0.00017	5.5	25458	2705	0.16
Kansas	Kansas Control	11.850	1%	100	241,000	772.3	772.7	0.00013	6.0	76987	5086	0.15
Kansas	Kansas Control	11.850	0.5%	200	283,000	776.0	776.4	0.00012	6.1	93536	5350	0.14
Kansas	Kansas Control	11.850	0.2%	500	341,000	780.9	781.3	0.00012	6.4	116842	5707	0.15
Kansas	Kansas Control	11.850	0.133%	750	367,000	783.2	783.6	0.00011	6.3	130336	5819	0.14
Kansas	Kansas Control	11.850	0.100%	1000	388,000	785.2	785.6	0.00010	6.2	142037	5914	0.13
Kansas	Kansas Control	11.850	0.080%	1250	403,000	786.6	786.9	0.00010	6.1	150226	5958	0.13
Kansas	Kansas Control	11.850	0.067%	1500	417,000	787.8	788.2	0.00009	6.0	157757	5971	0.13
Kansas	Kansas Control	12.400	10%	10	121,000	759.4	759.7	0.00011	4.4	28837	976	0.13
Kansas	Kansas Control	12.400	1%	100	241,000	772.7	773.1	0.00011	5.4	78170	5725	0.13
Kansas	Kansas Control	12.400	0.5%	200	283,000	776.4	776.7	0.00010	5.4	94527	5790	0.13
Kansas	Kansas Control	12.400	0.2%	500	341,000	781.2	781.6	0.00009	5.5	116522	5875	0.13
Kansas	Kansas Control	12.400	0.133%	750	367,000	783.5	783.8	0.00009	5.5	127055	5937	0.12
Kansas	Kansas Control	12.400	0.100%	1000	388,000	785.5	785.8	0.00009	5.8	137891	5995	0.13
Kansas	Kansas Control	12.400	0.080%	1250	403,000	786.8	787.2	0.00009	5.7	146070	6006	0.12
Kansas	Kansas Control	12.400	0.067%	1500	417,000	788.1	788.4	0.00008	5.6	153581	6016	0.12
Kansas	Kansas Control	12.940	10%	10	121,000	759.7	760.0	0.00012	4.7	32758	1424	0.13
Kansas	Kansas Control	12.940	1%	100	241,000	772.9	773.4	0.00013	5.9	78921	5767	0.14
Kansas	Kansas Control	12.940	0.5%	200	283,000	776.6	777.0	0.00012	6.0	95811	5813	0.14
Kansas	Kansas Control	12.940	0.2%	500	341,000	781.4	781.8	0.00011	6.0	118594	5966	0.14
Kansas	Kansas Control	12.940	0.133%	750	367,000	783.7	784.1	0.00011	6.3	130226	6014	0.14
Kansas	Kansas Control	12.940	0.100%	1000	388,000	785.7	786.1	0.00010	6.2	142065	6031	0.14
Kansas	Kansas Control	12.940	0.080%	1250	403,000	787.0	787.4	0.00010	6.1	150212	6042	0.13
Kansas	Kansas Control	12.940	0.067%	1500	417,000	788.3	788.6	0.00009	6.0	157700	6052	0.13
Kansas	Kansas Control	13.300	10%	10	121,000	759.9	760.2	0.00011	4.5	33697	1412	0.13
Kansas	Kansas Control	13.300	1%	100	241,000	773.2	773.6	0.00011	5.6	81459	6111	0.14
Kansas	Kansas Control	13.300	0.5%	200	283,000	776.9	777.2	0.00010	5.6	100819	6187	0.13
Kansas	Kansas Control	13.300	0.2%	500	341,000	781.7	782.0	0.00010	5.7	126705	6305	0.13
Kansas	Kansas Control	13.300	0.133%	750	367,000	784.0	784.3	0.00009	5.6	141363	6340	0.12
Kansas	Kansas Control	13.300	0.100%	1000	388,000	786.0	786.3	0.00008	5.5	153667	6370	0.12
Kansas	Kansas Control	13.300	0.080%	1250	403,000	787.3	787.6	0.00008	5.4	162164	6390	0.12

Kansas River Existing Conditions Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency		Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
			Percent	Year								
Kansas	Kansas Control	13.300	0.067%	1500	417,000	788.5	788.8	0.00007	5.4	169991	6408	0.12
Kansas	Kansas Control	13.650	10%	10	121,000	760.2	760.4	0.00008	4.1	38749	2752	0.11
Kansas	Kansas Control	13.650	1%	100	241,000	773.6	773.9	0.00008	4.9	97422	5129	0.11
Kansas	Kansas Control	13.650	0.5%	200	283,000	777.2	777.4	0.00008	5.0	116309	5549	0.11
Kansas	Kansas Control	13.650	0.2%	500	341,000	782.0	782.2	0.00007	5.1	142549	5858	0.11
Kansas	Kansas Control	13.650	0.133%	750	367,000	784.3	784.5	0.00007	5.1	155954	6001	0.11
Kansas	Kansas Control	13.650	0.100%	1000	388,000	786.2	786.4	0.00007	5.1	167559	6067	0.11
Kansas	Kansas Control	13.650	0.080%	1250	403,000	787.5	787.8	0.00006	5.1	175626	6107	0.11
Kansas	Kansas Control	13.650	0.067%	1500	417,000	788.7	789.0	0.00006	5.1	183091	6144	0.11
Kansas	Kansas Control	14.250	10%	10	121,000	760.5	760.7	0.00010	3.9	36135	1666	0.12
Kansas	Kansas Control	14.250	1%	100	241,000	773.8	774.1	0.00010	5.0	96601	6213	0.13
Kansas	Kansas Control	14.250	0.5%	200	283,000	777.4	777.7	0.00010	5.2	118601	6394	0.13
Kansas	Kansas Control	14.250	0.2%	500	341,000	782.2	782.5	0.00009	5.4	148258	6485	0.13
Kansas	Kansas Control	14.250	0.133%	750	367,000	784.4	784.8	0.00009	5.4	163028	6525	0.13
Kansas	Kansas Control	14.250	0.100%	1000	388,000	786.4	786.7	0.00009	5.4	175510	6542	0.12
Kansas	Kansas Control	14.250	0.080%	1250	403,000	787.7	788.0	0.00009	5.4	184135	6554	0.12
Kansas	Kansas Control	14.250	0.067%	1500	417,000	788.9	789.2	0.00008	5.4	192083	6565	0.12
Kansas	Kansas Control	14.620	10%	10	121,000	760.7	760.9	0.00006	3.5	38542	1216	0.10
Kansas	Kansas Control	14.620	1%	100	241,000	774.0	774.3	0.00008	5.0	91201	6358	0.12
Kansas	Kansas Control	14.620	0.5%	200	283,000	777.5	777.9	0.00008	5.2	113959	6422	0.12
Kansas	Kansas Control	14.620	0.2%	500	341,000	782.3	782.7	0.00008	5.5	144493	6521	0.12
Kansas	Kansas Control	14.620	0.133%	750	367,000	784.6	785.0	0.00008	5.5	159355	6543	0.12
Kansas	Kansas Control	14.620	0.100%	1000	388,000	786.5	786.9	0.00008	5.5	171802	6562	0.12
Kansas	Kansas Control	14.620	0.080%	1250	403,000	787.8	788.2	0.00008	5.5	180411	6574	0.12
Kansas	Kansas Control	14.620	0.067%	1500	417,000	789.0	789.4	0.00008	5.5	188345	6586	0.12

EXHIBIT A-2.107
Drainage Control Structure Preliminary Screening

Sponsor	Levee Unit	Drainage Control Structure	Levee Station (feet)
Kaw Valley Drainage District	Argentine	Turner Station	60+40
		Con-Agra	145+00
		Santa Fe Drainage Ditch	253+14
	Armourdale	Matoon Creek Basin Storm Sewer	2+41.17
		Osage Ave. Pumping Plant	82+30
		12th Street Sewer System	129+20
		Mill Street Pumping Plant	156+75
		Shawnee Avenue Pumping Plant	230+77
		Splitlog Outfall	311+10
	Fairfax-Jersey Creek	Jersey Creek Outfall	28+71
	Central Industrial District	Ohio Avenue Pump Plant	-5+85
		Turkey Creek Sewer Outfall	124+83
Kansas City, Missouri	East Bottoms	Prospect Avenue Pump Station	93+36
		Milwaukee Pump Station	172+00
		Hawthorn Pump Station	401+00
	Birmingham	Birmingham Pump Plant	434+21
		Southeastern Drainage	288+70
	Central Industrial District	Santa Fe Pump Plant	52+87
Fairfax Drainage District	Fairfax-Jersey Creek	Pump Plant F-1	267+70
North Kansas City	North Kansas City	Rock Creek Pump Plant	388+96

Notes:
Turkey Creek not included as part of initial analysis

EXHIBIT A-2.108
Sources of Data for Drainage Control Structure Interior Stormwater Hydraulic Modeling

Sponsor	Levee Unit	Drainage Control System	Levee Station (feet)	Pumping Rates	Storm Sewer Information		Elevations and Slopes
					Size	Material	
Kaw Valley Drainage District	Argentine	Turner Station	60+40	Reconnaissance Report, PCurve	SS Inventory, SS Layout Map (UG)	SS Inventory, SS Layout Map (UG)	SS Inventory, Drainage Report
		Con-Agra	145+00	NA	SS Layout Map (UG)	SS Layout Map (UG)	USGS or Inferred
		Santa Fe Drainage Ditch	253+14	Reconnaissance Report, PCurve	SS Inventory, SS Layout Map (UG)	SS Inventory, SS Layout Map (UG)	SS Inventory, Drainage Report, SS Layout Map (UG), or Inferred
	Armourdale	Matoon Creek Basin Storm Sewer	2+41.17	NA	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, Drainage Report, or Inferred
		Osage Ave. Pumping Plant	82+30	Reconnaissance Report	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory
		12th Street Sewer System	129+20	Reconnaissance Report, PCurve	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, Drainage Report
		Mill Street Pumping Plant	156+75	Reconnaissance Report, PCurve	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, Drainage Report, or Inferred
		Shawnee Avenue Pumping Plant	230+77	Reconnaissance Report, PCurve	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, Drainage Report, SS Layout Map (UG)
		Splitlog Outfall	311+10	NA	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, SS Layout Map (UG), Drainage Report	SS Inventory, Drainage Report, Reconnaissance Report
	Fairfax-Jersey Creek	Jersey Creek Outfall	28+71	Reconnaissance Report, PCurve	SS Inventory, SS Layout Map (UG), SS Layout Map (FDD), Drainage Report	SS Inventory, SS Layout Map (UG), SS Layout Map (FDD), Drainage Report	SS Inventory, SS Layout Map (FDD), Drainage Report, USGS
	Central Industrial District	Ohio Avenue Pump Plant	-5+85	Reconnaissance Report	SS Layout Map (UG), Drainage Report	SS Layout Map (UG), Drainage Report	SS Inventory, Drainage Report
Kansas City, Missouri	East Bottoms	Prospect Avenue Pump Station	93+36	Reconnaissance Report	Drainage Report	Drainage Report	Drainage Report, SS Layout Map (WSD), USGS
		Milwaukee Pump Station	172+00	Reconnaissance Report	Drainage Report	Drainage Report	Drainage Report
		Hawthorn Pump Station	401+00	Reconnaissance Report	Drainage Report	Drainage Report	Drainage Report
	Birmingham	Birmingham Pump Plant	434+21	Reconnaissance Report	Reconnaissance Report	Reconnaissance Report	USGS
		Southeastern Drainage	288+70	Reconnaissance Report	Reconnaissance Report	Reconnaissance Report	USGS
	Central Industrial District	Santa Fe Pump Plant	52+87	Reconnaissance Report	SS Layout Map (WSD), Drainage Report	SS Layout Map (WSD), Drainage Report	Drainage Report, USGS
Fairfax Drainage District	Fairfax-Jersey Creek	Pump Plant F-1	267+70	Reconnaissance Report, PCurve	SS Inventory, SS Layout Map (FDD), Drainage Report	SS Inventory, SS Layout Map (FDD), Drainage Report	Drainage Report, SS Layout Map (FDD)
North Kansas City	North Kansas City	Rock Creek Pump Plant	388+96		SS Layout Map (NKC)	Inferred	SS Layout Map (NKC)

Notes:

Reconnaissance Report = Reconnaissance Report (KCD, 1999)
PCurve = Pump curve (obtained from Public Works Department, Unified Government, Kansas City, KS.)
Drainage Report = Supplemental Interior Drainage Report (developed by USACE around 1948)
SS Layout Map (UG) = Storm sewer layout maps (obtained from Public Works Department, Unified Government, Kansas City, KS.)
SS Layout Map (WSD) = Storm sewer layout maps (obtained from Water Services Department, Kansas City, MO.)
SS Layout Map (FDD) = Storm sewer layout maps (obtained from Fairfax Drainage District)
SS Layout Map (NKC) = Storm sewer layout maps (obtained from City of North Kansas City, Missouri)
SS Inventory = Storm Sewer System Inventory Surveys (obtained from Public Works Department, Unified Government, Kansas City, KS.)
USGS = USGS 7.5 minute Quadrangle maps
Inferred = Elevations and/or slope was Inferred from known elevations or slopes of nearby pipes or nodes
NA = Not Applicable

EXHIBIT A-2.109
Drainage Control Structure Interior Stormwater Flood Volumes

Levee Unit	Drainage Control System	Levee Station (feet)	Total Flood Volume[1] (ac-ft)	Contained Flood Volume[2] (ac-ft)	Non-Contained Flood Volume[3] (ac-ft)	Land Use[4]	Comments	Critical Designation (Yes/No)
East Bottoms	Hawthorn Pump Station	401+00	449	449	0	U, D	Shallow (<1ft) in developed areas.	Yes
North Kansas City	Rock Creek Pump Plant	388+96	120	120	0	D	Stormwater contained within single area of inundation	Yes
Argentine	Turner Station	60+40	113	87	26	D	Non-contained stormwater will flow to industrial and undeveloped areas	Yes
Argentine	Santa Fe Drainage Ditch	253+14	102	102	0	R, RY	Portions of the area have been subject to past flooding	Yes
Armourdale	Osage Ave. Pumping Plant	82+30	94	0	94	D	Non-contained stormwater will flow to residential and industrial areas and possibly combine with floodwater from Milll Street Pumping Station area	Yes
Birmingham	Birmingham Pump Plant	434+21	87	87	0	U	All flood volume contained within pasture/row crop area	No
Armourdale	12th Street Sewer System	129+20	74	0	74	R, D	Non-contained stormwater will flow to residential and industrial areas and possibly combine with floodwater from Milll Street Pumping Station area	Yes
Armourdale	Shawnee Avenue Pumping Plant	230+77	66	31	35	D, U	Non-contained stormwater will flow to industrial areas	Yes
East Bottoms	Milwaukee Pump Station	172+00	64	64	0	D, U	Shallow (<1ft) in developed areas.	Yes
Armourdale	Mill Street Pumping Plant	156+75	60	57	3	R, D, U	Non-contained stormwater will flow to industrial areas	Yes
Argentine	Con-Agra Pump Plant	145+00	32	10	22	U	Non-contained stormwater will flow to undeveloped areas	No
East Bottoms	Prospect Avenue Pump Station	93+36	28	25	3	R, D	Non-contained stormwater will flow to industrial areas	Yes
Central Industrial District (MO)	Santa Fe Pump Plant	52+87	6	0	6	D	Shallow(<1-ft) street flooding in developed areas.	No
Central Industrial District (KS)	Ohio Avenue Pump Plant	-5+85	7	3	4	U	Non-contained stormwater will flow to undeveloped areas	No
Armourdale	Splitlog Outfall	311+10	3	3	0	U, RY	Stormwater contained within single area of inundation	No

Note:
[1] Volume of floodwater generated nearest the line-of-protection under gate closed/design river-stage conditions
[2] Volume of floodwater contained nearest the line-of-protection
[3] Volume of floodwater that is not contained nearest the line-of-protection
[3] The more prominent land use is listed first
[4] R = Residential (houses & apartments)
[4] D = Developed Areas (office buildings, retail, light industrial, storage yards, warehouses, trucking, and other)
[4] U = Undeveloped Areas (open spaces, agricultural, others)
[4] RY = Rail yards

EXHIBIT A-2.110
Critical Drainage Control Structure Screening

Levee Unit	Drainage Control System	Levee Station (feet)	Total Flood Volume[1] (ac-ft)	Contained Flood Volume[2] (ac-ft)	Non-Contained Flood Volume[3] (ac-ft)	Land Use[4]	Comments	Critical Designation (Yes/No)
East Bottoms	Hawthorn Pump Station	401+00	449	449	0	U, D	Shallow (<1ft) in developed areas.	Yes
North Kansas City	Rock Creek Pump Plant	388+96	120	120	0	D	Stormwater contained within single area of inundation	Yes
Argentine	Turner Station	60+40	113	87	26	D	Non-contained stormwater will flow to industrial and undeveloped areas	Yes
Argentine	Santa Fe Drainage Ditch	253+14	102	102	0	R, RY	Portions of the area have been subject to past flooding	Yes
Armourdale	Osage Ave. Pumping Plant	82+30	94	0	94	D	Non-contained stormwater will flow to residential and industrial areas and possibly combine with floodwater from Milll Street Pumping Station area	Yes
Birmingham	Birmingham Pump Plant	434+21	87	87	0	U	All flood volume contained within pasture/row crop area	No
Armourdale	12th Street Sewer System	129+20	74	0	74	R, D	Non-contained stormwater will flow to residential and industrial areas and possibly combine with floodwater from Milll Street Pumping Station area	Yes
Armourdale	Shawnee Avenue Pumping Plant	230+77	66	31	35	D, U	Non-contained stormwater will flow to industrial areas	Yes
East Bottoms	Milwaukee Pump Station	172+00	64	64	0	D, U	Shallow (<1ft) in developed areas.	Yes
Armourdale	Mill Street Pumping Plant	156+75	60	57	3	R, D, U	Non-contained stormwater will flow to industrial areas	Yes
Argentine	Con-Agra Pump Plant	145+00	32	10	22	U	Non-contained stormwater will flow to undeveloped areas	No
East Bottoms	Prospect Avenue Pump Station	93+36	28	25	3	R, D	Non-contained stormwater will flow to industrial areas	Yes
Central Industrial District (MO)	Santa Fe Pump Plant	52+87	6	0	6	D	Shallow(<1-ft) street flooding in developed areas.	No
Central Industrial District (KS)	Ohio Avenue Pump Plant	-5+85	7	3	4	U	Non-contained stormwater will flow to undeveloped areas	No
Armourdale	Splitlog Outfall	311+10	3	3	0	U, RY	Stormwater contained within single area of inundation	No

Note:
[1] Volume of floodwater generated nearest the line-of-protection under gate closed/design river-stage conditions
[2] Volume of floodwater contained nearest the line-of-protection
[3] Volume of floodwater that is not contained nearest the line-of-protection
[3] The more prominent land use is listed first
[4] R = Residential (houses & apartments)
[4] D = Developed Areas (office buildings, retail, light industrial, storage yards, warehouses, trucking, and other)
[4] U = Undeveloped Areas (open spaces, agricultural, others)
[4] RY = Rail yards

EXHIBIT A-2.111

Ranking of Bridges Based on Kansas River Water Surface Elevation Losses

(1%) 100-Year		
River Mile	Bridge	Loss (ft.)
1.399	I-670 Bridge	0.25
2.531	KC Terminal Bridge	0.25
2.104	CRI&P Bridge	0.16
3.416	7th Street Bridge	0.16
1.619	Missouri Pacific Bridge No. 72	0.15
1.638	Union Pacific Bridge No. 3	0.15
0.500	James Street Bridge	0.13
4.960	18th Street Bridge	0.13
0.815	KC Southern Bridge	0.12
1.112	Central Avenue Bridge	0.12
2.172	Kansas Avenue East Bridge	0.10
4.280	12th Street Bridge	0.08
0.303	I-70 Bridge (eastbound)	0.07
0.256	Missouri Pacific Bridge No. 1	0.06
0.280	I-70 Bridge (westbound)	0.06
7.338	I-635 Bridge (northbound)	0.03
9.498	Kansas Avenue West Bridge	0.03
5.513	Kaw Power Plant Intake Structure	0.03
7.355	I-635 Bridge (southbound)	0.02
5.821	Kansas Avenue Bridge	0.01

(0.5%) 200-Year		
River Mile	Bridge	Loss (ft.)
2.531	KC Terminal Bridge	0.36
1.399	I-670 Bridge	0.29
3.416	7th Street Bridge	0.19
2.104	CRI&P Bridge	0.19
1.619	Missouri Pacific Bridge No. 72	0.18
1.638	Union Pacific Bridge No. 3	0.17
4.960	18th Street Bridge	0.17
2.172	Kansas Avenue East Bridge	0.15
0.815	KC Southern Bridge	0.14
1.112	Central Avenue Bridge	0.13
0.500	James Street Bridge	0.11
4.280	12th Street Bridge	0.10
0.256	Missouri Pacific Bridge No. 1	0.09
0.280	I-70 Bridge (westbound)	0.09
0.303	I-70 Bridge (eastbound)	0.09
5.513	Kaw Power Plant Intake Structure	0.04
9.498	Kansas Avenue West Bridge	0.03
7.355	I-635 Bridge (southbound)	0.03
7.338	I-635 Bridge (northbound)	0.02
5.821	Kansas Avenue Bridge	0.01

(0.2%) 500-Year		
River Mile	Bridge	Loss (ft.)
2.531	KC Terminal Bridge	0.54
1.619	Missouri Pacific Bridge No. 72	0.50
2.172	Kansas Avenue East Bridge	0.38
2.104	CRI&P Bridge	0.33
1.399	I-670 Bridge	0.33
3.416	7th Street Bridge	0.32
4.960	18th Street Bridge	0.23
1.638	Union Pacific Bridge No. 3	0.20
4.280	12th Street Bridge	0.19
0.500	James Street Bridge	0.15
0.280	I-70 Bridge (westbound)	0.14
0.256	Missouri Pacific Bridge No. 1	0.13
0.303	I-70 Bridge (eastbound)	0.12
0.815	KC Southern Bridge	0.12
1.112	Central Avenue Bridge	0.11
5.513	Kaw Power Plant Intake Structure	0.04
5.821	Kansas Avenue Bridge	0.04
5.821	Kansas Avenue Bridge	0.02
7.338	I-635 Bridge (northbound)	0.02
7.355	I-635 Bridge (southbound)	0.02

(0.133%) 750-Year		
River Mile	Bridge	Loss (ft.)
2.172	Kansas Avenue East Bridge	0.83
2.531	KC Terminal Bridge	0.78
1.619	Missouri Pacific Bridge No. 72	0.60
2.104	CRI&P Bridge	0.51
3.416	7th Street Bridge	0.40
1.638	Union Pacific Bridge No. 3	0.32
1.399	I-670 Bridge	0.28
1.112	Central Avenue Bridge	0.27
4.960	18th Street Bridge	0.27
4.280	12th Street Bridge	0.26
0.815	KC Southern Bridge	0.24
0.500	James Street Bridge	0.18
0.280	I-70 Bridge (westbound)	0.16
0.256	Missouri Pacific Bridge No. 1	0.15
0.303	I-70 Bridge (eastbound)	0.14
9.498	Kansas Avenue West Bridge	0.08
5.821	Kansas Avenue Bridge	0.04
5.513	Kaw Power Plant Intake Structure	0.04
7.338	I-635 Bridge (northbound)	0.03
7.355	I-635 Bridge (southbound)	0.03

(0.1%) 1000-Year		
River Mile	Bridge	Loss (ft.)
2.531	KC Terminal Bridge	0.95
2.172	Kansas Avenue East Bridge	0.86
1.619	Missouri Pacific Bridge No. 72	0.80
2.104	CRI&P Bridge	0.67
3.416	7th Street Bridge	0.45
1.638	Union Pacific Bridge No. 3	0.42
1.112	Central Avenue Bridge	0.40
0.815	KC Southern Bridge	0.39
1.399	I-670 Bridge	0.32
4.280	12th Street Bridge	0.32
4.960	18th Street Bridge	0.32
0.500	James Street Bridge	0.20
0.280	I-70 Bridge (westbound)	0.18
0.256	Missouri Pacific Bridge No. 1	0.17
0.303	I-70 Bridge (eastbound)	0.16
9.498	Kansas Avenue West Bridge	0.12
5.821	Kansas Avenue Bridge	0.05
5.513	Kaw Power Plant Intake Structure	0.04
7.338	I-635 Bridge (northbound)	0.03
7.355	I-635 Bridge (southbound)	0.03

(0.08%) 1250-Year		
River Mile	Bridge	Loss (ft.)
2.531	KC Terminal Bridge	1.08
1.619	Missouri Pacific Bridge No. 72	0.89
2.172	Kansas Avenue East Bridge	0.69
2.104	CRI&P Bridge	0.60
1.112	Central Avenue Bridge	0.54
0.815	KC Southern Bridge	0.52
3.416	7th Street Bridge	0.50
1.638	Union Pacific Bridge No. 3	0.42
4.280	12th Street Bridge	0.37
1.399	I-670 Bridge	0.36
4.960	18th Street Bridge	0.36
0.256	Missouri Pacific Bridge No. 1	0.24
0.500	James Street Bridge	0.22
0.280	I-70 Bridge (westbound)	0.20
0.303	I-70 Bridge (eastbound)	0.17
9.498	Kansas Avenue West Bridge	0.15
5.821	Kansas Avenue Bridge	0.06
5.513	Kaw Power Plant Intake Structure	0.05
7.338	I-635 Bridge (northbound)	0.03
7.355	I-635 Bridge (southbound)	0.03

EXHIBIT A-2.112
Missouri River Future Conditions Without Project Water Surface Elevations

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	339.67	10%	10	247,000	714.0	714.8	0.00017	7.3	53,832	5,741	0.25
Lower	Lower Missouri	339.67	1%	100	405,000	720.2	721.0	0.00017	8.4	89,197	5,806	0.26
Lower	Lower Missouri	339.67	0.5%	200	459,000	723.1	723.5	0.00009	6.3	176,197	21,610	0.18
Lower	Lower Missouri	339.67	0.2%	500	537,000	724.8	725.2	0.00009	6.7	194,484	21,855	0.19
Lower	Lower Missouri	339.67	0.133%	750	573,000	722.0	722.7	0.00016	8.4	163,596	21,178	0.25
Lower	Lower Missouri	339.67	0.100%	1000	600,000	722.2	722.9	0.00017	8.7	165,688	21,493	0.26
Lower	Lower Missouri	339.67	0.080%	1250	621,000	722.6	723.3	0.00017	8.8	170,056	21,566	0.26
Lower	Lower Missouri	339.67	0.067%	1500	637,000	722.9	723.6	0.00017	8.8	173,565	21,591	0.26
Lower	Lower Missouri	340.32	10%	10	247,000	714.5	715.5	0.00022	8.1	38,017	3,998	0.28
Lower	Lower Missouri	340.32	1%	100	405,000	720.6	721.8	0.00024	9.7	65,800	4,890	0.31
Lower	Lower Missouri	340.32	0.5%	200	459,000	723.3	723.9	0.00014	7.7	131,224	18,627	0.23
Lower	Lower Missouri	340.32	0.2%	500	537,000	725.0	725.6	0.00014	8.1	146,936	23,188	0.24
Lower	Lower Missouri	340.32	0.133%	750	573,000	722.3	723.5	0.00025	10.2	122,022	18,066	0.31
Lower	Lower Missouri	340.32	0.100%	1000	600,000	722.6	723.8	0.00026	10.5	124,022	18,233	0.32
Lower	Lower Missouri	340.32	0.080%	1250	621,000	722.9	724.2	0.00026	10.6	127,759	18,442	0.32
Lower	Lower Missouri	340.32	0.067%	1500	637,000	723.3	724.5	0.00026	10.7	130,747	18,615	0.32
Lower	Lower Missouri	341.06	10%	10	247,000	715.7	716.3	0.00018	6.5	45,581	4,528	0.25
Lower	Lower Missouri	341.06	1%	100	405,000	722.1	722.6	0.00013	6.6	114,169	14,592	0.22
Lower	Lower Missouri	341.06	0.5%	200	459,000	723.9	724.5	0.00012	6.7	132,980	15,031	0.22
Lower	Lower Missouri	341.06	0.2%	500	537,000	725.6	726.2	0.00013	7.1	150,027	15,121	0.22
Lower	Lower Missouri	341.06	0.133%	750	573,000	723.5	724.4	0.00020	8.5	128,858	15,002	0.28
Lower	Lower Missouri	341.06	0.100%	1000	600,000	723.8	724.7	0.00021	8.8	131,714	15,022	0.28
Lower	Lower Missouri	341.06	0.080%	1250	621,000	724.2	725.1	0.00021	8.9	135,676	15,050	0.29
Lower	Lower Missouri	341.06	0.067%	1500	637,000	724.5	725.4	0.00021	8.9	138,821	15,065	0.29
Lower	Lower Missouri	341.88	10%	10	247,000	716.3	717.5	0.00028	9.0	37,136	6,256	0.32
Lower	Lower Missouri	341.88	1%	100	405,000	722.3	723.6	0.00026	10.0	79,829	12,656	0.32
Lower	Lower Missouri	341.88	0.5%	200	459,000	724.1	725.4	0.00025	10.2	94,404	13,188	0.31
Lower	Lower Missouri	341.88	0.2%	500	537,000	725.8	727.1	0.00026	10.7	108,311	21,651	0.32
Lower	Lower Missouri	341.88	0.133%	750	573,000	723.9	725.9	0.00040	12.8	92,538	13,162	0.40
Lower	Lower Missouri	341.88	0.100%	1000	600,000	724.2	726.3	0.00042	13.2	94,959	13,189	0.41
Lower	Lower Missouri	341.88	0.080%	1250	621,000	724.6	726.7	0.00042	13.3	98,215	13,196	0.41
Lower	Lower Missouri	341.88	0.067%	1500	637,000	724.9	727.0	0.00042	13.4	100,747	13,205	0.41
Lower	Lower Missouri	342.49	10%	10	247,000	717.4	718.1	0.00012	6.6	50,792	7,922	0.21
Lower	Lower Missouri	342.49	1%	100	405,000	723.4	724.2	0.00013	7.7	102,090	12,778	0.23
Lower	Lower Missouri	342.49	0.5%	200	459,000	725.2	726.0	0.00013	7.9	118,253	13,536	0.23
Lower	Lower Missouri	342.49	0.2%	500	537,000	726.9	727.8	0.00014	8.4	133,998	22,643	0.24
Lower	Lower Missouri	342.49	0.133%	750	573,000	725.7	726.8	0.00019	9.6	122,788	13,538	0.28
Lower	Lower Missouri	342.49	0.100%	1000	600,000	726.1	727.3	0.00019	9.8	126,389	13,539	0.28
Lower	Lower Missouri	342.49	0.080%	1250	621,000	726.5	727.7	0.00019	9.9	130,017	22,623	0.28
Lower	Lower Missouri	342.49	0.067%	1500	637,000	726.8	728.0	0.00020	10.0	132,804	22,637	0.28
Lower	Lower Missouri	343.09	10%	10	247,000	717.7	718.6	0.00018	8.0	37,947	3,602	0.26
Lower	Lower Missouri	343.09	1%	100	405,000	723.5	724.9	0.00022	10.0	69,714	10,163	0.30
Lower	Lower Missouri	343.09	0.5%	200	459,000	725.3	726.7	0.00022	10.3	83,277	12,008	0.30
Lower	Lower Missouri	343.09	0.2%	500	537,000	727.0	728.5	0.00024	10.9	96,729	12,178	0.31
Lower	Lower Missouri	343.09	0.133%	750	573,000	725.8	727.8	0.00032	12.4	87,408	12,076	0.36
Lower	Lower Missouri	343.09	0.100%	1000	600,000	726.2	728.3	0.00033	12.8	90,474	12,111	0.37
Lower	Lower Missouri	343.09	0.080%	1250	621,000	726.6	728.7	0.00033	12.9	93,581	12,144	0.37
Lower	Lower Missouri	343.09	0.067%	1500	637,000	726.9	729.1	0.00034	13.1	95,968	12,170	0.37
Lower	Lower Missouri	343.57	10%	10	247,000	718.3	719.1	0.00018	7.4	44,068	7,822	0.25
Lower	Lower Missouri	343.57	1%	100	405,000	724.5	725.5	0.00018	8.5	83,206	9,397	0.26
Lower	Lower Missouri	343.57	0.5%	200	459,000	726.2	727.2	0.00018	8.8	94,397	9,633	0.27
Lower	Lower Missouri	343.57	0.2%	500	537,000	728.0	729.1	0.00019	9.4	105,821	9,788	0.28
Lower	Lower Missouri	343.57	0.133%	750	573,000	727.3	728.6	0.00024	10.4	100,907	9,753	0.31
Lower	Lower Missouri	343.57	0.100%	1000	600,000	727.7	729.1	0.00025	10.7	103,826	9,775	0.32
Lower	Lower Missouri	343.57	0.080%	1250	621,000	728.1	729.5	0.00025	10.8	106,454	9,792	0.32
Lower	Lower Missouri	343.57	0.067%	1500	637,000	728.4	729.9	0.00025	10.9	108,450	9,806	0.32

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	344.14	10%	10	247,000	718.7	719.8	0.00021	8.2	37,620	3,536	0.28
Lower	Lower Missouri	344.14	1%	100	405,000	724.8	726.2	0.00025	10.1	63,301	5,162	0.31
Lower	Lower Missouri	344.14	0.5%	200	459,000	726.5	728.0	0.00026	10.5	71,115	5,436	0.32
Lower	Lower Missouri	344.14	0.2%	500	537,000	728.2	730.0	0.00028	11.4	79,193	5,473	0.34
Lower	Lower Missouri	344.14	0.133%	750	573,000	727.6	729.7	0.00035	12.5	76,084	5,467	0.37
Lower	Lower Missouri	344.14	0.100%	1000	600,000	728.0	730.2	0.00037	12.9	78,156	5,471	0.38
Lower	Lower Missouri	344.14	0.080%	1250	621,000	728.4	730.7	0.00037	13.1	79,997	5,475	0.39
Lower	Lower Missouri	344.14	0.067%	1500	637,000	728.7	731.0	0.00038	13.3	81,393	5,477	0.39
Lower	Lower Missouri	344.74	10%	10	247,000	719.5	720.4	0.00018	7.6	37,685	3,478	0.25
Lower	Lower Missouri	344.74	1%	100	405,000	725.6	726.9	0.00022	9.6	60,992	4,044	0.29
Lower	Lower Missouri	344.74	0.5%	200	459,000	727.3	728.7	0.00023	10.2	67,550	4,064	0.30
Lower	Lower Missouri	344.74	0.2%	500	537,000	729.1	730.7	0.00025	11.1	74,530	4,087	0.32
Lower	Lower Missouri	344.74	0.133%	750	573,000	728.6	730.6	0.00030	12.0	72,879	4,081	0.35
Lower	Lower Missouri	344.74	0.100%	1000	600,000	729.1	731.2	0.00031	12.4	74,752	4,087	0.35
Lower	Lower Missouri	344.74	0.080%	1250	621,000	729.5	731.7	0.00032	12.6	76,356	4,092	0.36
Lower	Lower Missouri	344.74	0.067%	1500	637,000	729.8	732.1	0.00033	12.8	77,568	4,101	0.36
Lower	Lower Missouri	345.67	10%	10	247,000	720.4	721.2	0.00017	7.5	36,284	3,010	0.25
Lower	Lower Missouri	345.67	1%	100	405,000	726.7	727.9	0.00019	9.2	68,511	5,245	0.28
Lower	Lower Missouri	345.67	0.5%	200	459,000	728.5	729.8	0.00020	9.7	76,747	5,285	0.28
Lower	Lower Missouri	345.67	0.2%	500	537,000	730.4	731.9	0.00022	10.5	85,941	5,315	0.30
Lower	Lower Missouri	345.67	0.133%	750	573,000	730.3	732.0	0.00025	11.2	85,302	5,313	0.32
Lower	Lower Missouri	345.67	0.100%	1000	600,000	730.8	732.6	0.00026	11.5	87,920	5,322	0.33
Lower	Lower Missouri	345.67	0.080%	1250	621,000	731.3	733.1	0.00027	11.7	90,089	5,360	0.33
Lower	Lower Missouri	345.67	0.067%	1500	637,000	731.6	733.5	0.00027	11.8	91,726	5,378	0.33
Lower	Lower Missouri	346.54	10%	10	247,000	721.2	721.8	0.00010	6.5	41,027	2,622	0.20
Lower	Lower Missouri	346.54	1%	100	405,000	727.8	728.6	0.00011	7.6	89,392	8,155	0.22
Lower	Lower Missouri	346.54	0.5%	200	459,000	729.6	730.5	0.00011	8.0	99,616	8,180	0.22
Lower	Lower Missouri	346.54	0.2%	500	537,000	731.7	732.7	0.00012	8.6	111,387	8,208	0.23
Lower	Lower Missouri	346.54	0.133%	750	573,000	731.8	732.9	0.00014	9.2	111,838	8,254	0.25
Lower	Lower Missouri	346.54	0.100%	1000	600,000	732.4	733.5	0.00014	9.4	115,291	8,258	0.25
Lower	Lower Missouri	346.54	0.080%	1250	621,000	732.9	734.1	0.00014	9.5	118,094	8,260	0.25
Lower	Lower Missouri	346.54	0.067%	1500	637,000	733.3	734.5	0.00015	9.6	120,206	8,262	0.26
Lower	Lower Missouri	347.38	10%	10	247,000	721.5	722.7	0.00029	8.8	32,235	2,444	0.32
Lower	Lower Missouri	347.38	1%	100	405,000	728.4	729.3	0.00021	8.8	90,175	8,600	0.29
Lower	Lower Missouri	347.38	0.5%	200	459,000	730.2	731.2	0.00019	8.9	103,581	8,622	0.28
Lower	Lower Missouri	347.38	0.2%	500	537,000	732.4	733.3	0.00019	9.3	119,186	8,674	0.28
Lower	Lower Missouri	347.38	0.133%	750	573,000	732.6	733.6	0.00021	9.8	120,425	8,676	0.30
Lower	Lower Missouri	347.38	0.100%	1000	600,000	733.2	734.3	0.00021	9.9	125,132	8,685	0.30
Lower	Lower Missouri	347.38	0.080%	1250	621,000	733.7	734.8	0.00021	10.0	128,923	8,691	0.30
Lower	Lower Missouri	347.38	0.067%	1500	637,000	734.1	735.2	0.00021	10.1	131,778	8,697	0.30
Lower	Lower Missouri	348.25	10%	10	247,000	722.8	723.7	0.00017	7.8	35,708	2,849	0.26
Lower	Lower Missouri	348.25	1%	100	405,000	729.0	730.4	0.00021	9.9	54,728	3,131	0.30
Lower	Lower Missouri	348.25	0.5%	200	459,000	731.1	731.9	0.00014	8.2	119,109	8,705	0.24
Lower	Lower Missouri	348.25	0.2%	500	537,000	733.3	734.1	0.00014	8.6	136,978	8,735	0.24
Lower	Lower Missouri	348.25	0.133%	750	573,000	733.6	734.5	0.00015	9.0	139,287	8,739	0.26
Lower	Lower Missouri	348.25	0.100%	1000	600,000	734.2	735.1	0.00015	9.1	144,704	8,750	0.26
Lower	Lower Missouri	348.25	0.080%	1250	621,000	734.8	735.7	0.00015	9.2	149,034	17,958	0.26
Lower	Lower Missouri	348.25	0.067%	1500	637,000	735.2	736.1	0.00015	9.3	152,296	17,960	0.26
Lower	Lower Missouri	349.2	10%	10	247,000	723.6	724.6	0.00018	8.1	35,329	2,337	0.27
Lower	Lower Missouri	349.2	1%	100	405,000	730.6	731.3	0.00013	7.9	115,418	11,059	0.23
Lower	Lower Missouri	349.2	0.5%	200	459,000	731.8	732.6	0.00014	8.3	126,310	11,195	0.24
Lower	Lower Missouri	349.2	0.2%	500	537,000	734.0	734.8	0.00014	8.7	145,318	11,254	0.24
Lower	Lower Missouri	349.2	0.133%	750	573,000	734.4	735.2	0.00015	9.1	148,415	11,291	0.25
Lower	Lower Missouri	349.2	0.100%	1000	600,000	735.0	735.9	0.00015	9.2	154,189	15,200	0.25
Lower	Lower Missouri	349.2	0.080%	1250	621,000	735.6	736.4	0.00015	9.2	158,783	15,283	0.25
Lower	Lower Missouri	349.2	0.067%	1500	637,000	736.0	736.8	0.00015	9.3	162,238	15,335	0.25

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	349.9	10%	10	247,000	724.3	725.3	0.00018	8.0	33,732	1,722	0.26
Lower	Lower Missouri	349.9	1%	100	405,000	731.0	731.8	0.00015	8.4	105,067	13,741	0.25
Lower	Lower Missouri	349.9	0.5%	200	459,000	732.3	733.2	0.00015	8.8	116,857	13,766	0.26
Lower	Lower Missouri	349.9	0.2%	500	537,000	734.5	735.3	0.00015	9.0	137,022	13,814	0.26
Lower	Lower Missouri	349.9	0.133%	750	573,000	734.8	735.8	0.00016	9.4	140,663	13,839	0.27
Lower	Lower Missouri	349.9	0.100%	1000	600,000	735.5	736.5	0.00016	9.5	146,808	14,305	0.27
Lower	Lower Missouri	349.9	0.080%	1250	621,000	736.0	737.0	0.00016	9.6	151,675	14,306	0.27
Lower	Lower Missouri	349.9	0.067%	1500	637,000	736.4	737.4	0.00016	9.6	155,335	14,307	0.27
Lower	Lower Missouri	350.49	10%	10	247,000	724.9	725.9	0.00019	8.1	31,348	1,365	0.27
Lower	Lower Missouri	350.49	1%	100	405,000	731.3	732.4	0.00018	9.1	84,423	13,828	0.28
Lower	Lower Missouri	350.49	0.5%	200	459,000	732.6	733.8	0.00019	9.6	95,063	13,858	0.29
Lower	Lower Missouri	350.49	0.2%	500	537,000	734.8	736.0	0.00019	9.9	113,006	13,924	0.29
Lower	Lower Missouri	350.49	0.133%	750	573,000	735.2	736.5	0.00020	10.4	116,468	13,958	0.30
Lower	Lower Missouri	350.49	0.100%	1000	600,000	735.8	737.1	0.00020	10.5	121,943	13,978	0.30
Lower	Lower Missouri	350.49	0.080%	1250	621,000	736.4	737.7	0.00020	10.6	126,272	13,982	0.30
Lower	Lower Missouri	350.49	0.067%	1500	637,000	736.8	738.1	0.00020	10.6	129,529	13,985	0.30
Lower	Lower Missouri	351.15	10%	10	247,000	725.6	726.5	0.00015	7.4	40,401	3,625	0.25
Lower	Lower Missouri	351.15	1%	100	405,000	732.1	733.0	0.00015	8.5	94,976	15,265	0.26
Lower	Lower Missouri	351.15	0.5%	200	459,000	733.4	734.4	0.00016	8.9	106,328	15,884	0.26
Lower	Lower Missouri	351.15	0.2%	500	537,000	735.5	736.6	0.00016	9.3	124,778	16,093	0.27
Lower	Lower Missouri	351.15	0.133%	750	573,000	736.0	737.1	0.00017	9.7	128,882	16,112	0.28
Lower	Lower Missouri	351.15	0.100%	1000	600,000	736.7	737.8	0.00017	9.8	134,519	16,118	0.28
Lower	Lower Missouri	351.15	0.080%	1250	621,000	737.2	738.3	0.00017	9.9	138,956	16,120	0.28
Lower	Lower Missouri	351.15	0.067%	1500	637,000	737.6	738.7	0.00017	10.0	142,293	16,121	0.28
Lower	Lower Missouri	351.94	10%	10	247,000	726.3	727.0	0.00013	7.1	42,772	11,019	0.23
Lower	Lower Missouri	351.94	1%	100	405,000	732.6	733.7	0.00015	8.8	69,416	12,791	0.26
Lower	Lower Missouri	351.94	0.5%	200	459,000	733.9	735.1	0.00017	9.5	75,122	13,114	0.27
Lower	Lower Missouri	351.94	0.2%	500	537,000	736.0	737.4	0.00018	10.2	84,190	13,324	0.29
Lower	Lower Missouri	351.94	0.133%	750	573,000	736.5	738.0	0.00020	10.7	86,333	13,337	0.30
Lower	Lower Missouri	351.94	0.100%	1000	600,000	737.1	738.7	0.00020	10.9	89,101	17,183	0.30
Lower	Lower Missouri	351.94	0.080%	1250	621,000	737.6	739.2	0.00021	11.1	91,273	17,227	0.31
Lower	Lower Missouri	351.94	0.067%	1500	637,000	738.0	739.6	0.00021	11.2	92,905	17,238	0.31
Lower	Lower Missouri	352.57	10%	10	247,000	726.6	727.5	0.00013	7.7	33,087	4,422	0.23
Lower	Lower Missouri	352.57	1%	100	405,000	732.7	734.4	0.00019	10.5	44,883	11,276	0.30
Lower	Lower Missouri	352.57	0.5%	200	459,000	734.0	736.0	0.00022	11.5	47,585	11,650	0.32
Lower	Lower Missouri	352.57	0.2%	500	537,000	736.0	738.4	0.00025	12.7	51,830	12,717	0.34
Lower	Lower Missouri	352.57	0.133%	750	573,000	736.4	739.1	0.00027	13.3	52,823	12,813	0.36
Lower	Lower Missouri	352.57	0.100%	1000	600,000	737.0	739.8	0.00029	13.8	54,101	16,644	0.37
Lower	Lower Missouri	352.57	0.080%	1250	621,000	737.5	740.4	0.00029	14.1	55,102	16,743	0.37
Lower	Lower Missouri	352.57	0.067%	1500	637,000	737.8	740.9	0.00030	14.3	55,851	16,830	0.38
Lower	Lower Missouri	352.641*	10%	10	247,000	726.6	727.6	0.00015	8.2	30,627	1,699	0.26
Lower	Lower Missouri	352.641*	1%	100	405,000	732.7	734.6	0.00022	11.1	40,327	2,450	0.32
Lower	Lower Missouri	352.641*	0.5%	200	459,000	733.9	736.2	0.00026	12.1	42,471	4,463	0.34
Lower	Lower Missouri	352.641*	0.2%	500	537,000	735.8	738.6	0.00029	13.4	45,833	8,174	0.37
Lower	Lower Missouri	352.641*	0.133%	750	573,000	736.3	739.3	0.00032	14.1	46,602	8,511	0.39
Lower	Lower Missouri	352.641*	0.100%	1000	600,000	736.9	740.1	0.00033	14.6	47,606	8,788	0.40
Lower	Lower Missouri	352.641*	0.080%	1250	621,000	737.3	740.7	0.00034	14.9	48,390	8,969	0.41
Lower	Lower Missouri	352.641*	0.067%	1500	637,000	737.6	741.1	0.00035	15.1	48,978	9,081	0.41
Lower		352.647	Liberty Bend Bridge									
Lower	Lower Missouri	352.66	10%	10	247,000	726.7	727.7	0.00011	7.7	32,237	1,818	0.24
Lower	Lower Missouri	352.66	1%	100	405,000	732.9	734.6	0.00016	10.6	42,151	2,421	0.30
Lower	Lower Missouri	352.66	0.5%	200	459,000	734.2	736.3	0.00018	11.6	44,354	2,820	0.32
Lower	Lower Missouri	352.66	0.2%	500	537,000	736.2	738.7	0.00021	12.8	47,778	5,486	0.35
Lower	Lower Missouri	352.66	0.133%	750	573,000	736.7	739.5	0.00023	13.5	48,611	6,430	0.37

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	352.66	0.100%	1000	600,000	737.3	740.2	0.00024	13.9	49,641	7,431	0.37
Lower	Lower Missouri	352.66	0.080%	1250	621,000	737.7	740.8	0.00025	14.2	50,445	7,965	0.38
Lower	Lower Missouri	352.66	0.067%	1500	637,000	738.1	741.3	0.00025	14.5	51,048	10,658	0.39
Lower	Lower Missouri	352.74	10%	10	247,000	726.5	727.8	0.00016	9.1	27,566	8,924	0.29
Lower	Lower Missouri	352.74	1%	100	405,000	732.6	734.9	0.00023	12.2	37,811	11,297	0.36
Lower	Lower Missouri	352.74	0.5%	200	459,000	733.9	736.5	0.00026	13.3	40,375	11,478	0.38
Lower	Lower Missouri	352.74	0.2%	500	537,000	735.8	739.0	0.00029	14.6	44,739	11,740	0.41
Lower	Lower Missouri	352.74	0.133%	750	573,000	736.2	739.8	0.00032	15.4	45,786	11,786	0.43
Lower	Lower Missouri	352.74	0.100%	1000	600,000	736.8	740.6	0.00033	15.8	47,173	11,848	0.44
Lower	Lower Missouri	352.74	0.080%	1250	621,000	737.3	741.2	0.00034	16.2	48,271	11,929	0.45
Lower	Lower Missouri	352.74	0.067%	1500	637,000	737.6	741.6	0.00035	16.4	49,102	11,957	0.45
Lower	Lower Missouri	352.8	10%	10	247,000	726.7	727.9	0.00015	8.8	29,874	10,481	0.28
Lower	Lower Missouri	352.8	1%	100	405,000	733.1	735.0	0.00020	11.3	47,397	11,839	0.33
Lower	Lower Missouri	352.8	0.5%	200	459,000	734.5	736.7	0.00022	12.2	51,565	11,883	0.35
Lower	Lower Missouri	352.8	0.2%	500	537,000	736.7	739.2	0.00024	13.2	58,117	12,039	0.37
Lower	Lower Missouri	352.8	0.133%	750	573,000	737.3	740.0	0.00025	13.8	59,865	12,053	0.38
Lower	Lower Missouri	352.8	0.100%	1000	600,000	738.0	740.8	0.00026	14.1	61,899	12,061	0.39
Lower	Lower Missouri	352.8	0.080%	1250	621,000	738.5	741.4	0.00026	14.4	63,491	12,068	0.39
Lower	Lower Missouri	352.8	0.067%	1500	637,000	738.9	741.8	0.00027	14.5	64,690	12,073	0.39
Lower	Lower Missouri	353.15	10%	10	247,000	727.2	728.1	0.00011	7.7	34,859	2,997	0.24
Lower	Lower Missouri	353.15	1%	100	405,000	733.9	735.3	0.00014	9.9	57,500	5,437	0.28
Lower	Lower Missouri	353.15	0.5%	200	459,000	735.4	737.1	0.00015	10.6	63,208	5,489	0.29
Lower	Lower Missouri	353.15	0.2%	500	537,000	737.8	739.6	0.00016	11.4	71,993	5,573	0.31
Lower	Lower Missouri	353.15	0.133%	750	573,000	738.5	740.4	0.00017	11.9	74,597	5,587	0.32
Lower	Lower Missouri	353.15	0.100%	1000	600,000	739.2	741.2	0.00017	12.1	77,348	5,601	0.32
Lower	Lower Missouri	353.15	0.080%	1250	621,000	739.8	741.9	0.00018	12.3	79,493	5,613	0.32
Lower	Lower Missouri	353.15	0.067%	1500	637,000	740.2	742.3	0.00018	12.4	81,109	15,454	0.33
Lower	Lower Missouri	353.45	10%	10	247,000	727.4	728.4	0.00013	8.0	33,889	2,131	0.26
Lower	Lower Missouri	353.45	0	0	405,000	734.1	735.6	0.00017	10.2	52,466	3,202	0.30
Lower	Lower Missouri	353.45	0.5%	200	459,000	735.6	737.4	0.00018	11.0	57,386	3,221	0.32
Lower	Lower Missouri	353.45	0.2%	500	537,000	737.9	739.9	0.00020	11.8	64,935	3,238	0.33
Lower	Lower Missouri	353.45	0.133%	750	573,000	738.6	740.8	0.00021	12.3	67,198	3,243	0.34
Lower	Lower Missouri	353.45	0.100%	1000	600,000	739.4	741.6	0.00021	12.6	69,562	4,792	0.35
Lower	Lower Missouri	353.45	0.080%	1250	621,000	739.9	742.2	0.00021	12.8	71,408	4,808	0.35
Lower	Lower Missouri	353.45	0.067%	1500	637,000	740.4	742.7	0.00022	12.9	72,793	4,811	0.35
Lower	Lower Missouri	353.82	10%	10	247,000	727.6	728.6	0.00012	8.0	32,475	1,842	0.25
Lower	Lower Missouri	353.82	1%	100	405,000	734.3	736.0	0.00016	10.4	48,244	2,423	0.30
Lower	Lower Missouri	353.82	0.5%	200	459,000	735.9	737.7	0.00017	11.2	51,963	2,432	0.31
Lower	Lower Missouri	353.82	0.2%	500	537,000	738.2	740.4	0.00019	12.2	57,603	2,446	0.33
Lower	Lower Missouri	353.82	0.133%	750	573,000	738.9	741.3	0.00020	12.8	59,315	2,451	0.35
Lower	Lower Missouri	353.82	0.100%	1000	600,000	739.6	742.1	0.00021	13.1	61,073	2,455	0.35
Lower	Lower Missouri	353.82	0.080%	1250	621,000	740.2	742.7	0.00021	13.3	62,443	2,459	0.35
Lower	Lower Missouri	353.82	0.067%	1500	637,000	740.6	743.2	0.00022	13.5	63,471	3,181	0.36
Lower	Lower Missouri	354.2	10%	10	247,000	727.9	728.9	0.00012	7.7	37,073	3,099	0.25
Lower	Lower Missouri	354.2	1%	100	405,000	735.0	736.3	0.00014	9.4	63,438	3,877	0.27
Lower	Lower Missouri	354.2	0.5%	200	459,000	736.7	738.1	0.00014	9.9	70,031	3,915	0.28
Lower	Lower Missouri	354.2	0.2%	500	537,000	739.3	740.8	0.00015	10.6	79,999	3,946	0.29
Lower	Lower Missouri	354.2	0.133%	750	573,000	740.1	741.7	0.00015	10.9	83,252	3,956	0.30
Lower	Lower Missouri	354.2	0.100%	1000	600,000	740.9	742.5	0.00016	11.1	86,410	3,966	0.30
Lower	Lower Missouri	354.2	0.080%	1250	621,000	741.5	743.2	0.00016	11.3	88,869	3,973	0.30
Lower	Lower Missouri	354.2	0.067%	1500	637,000	742.0	743.7	0.00016	11.4	90,718	3,979	0.31
Lower	Lower Missouri	354.62	10%	10	247,000	728.5	729.1	0.00008	6.5	49,430	3,680	0.21
Lower	Lower Missouri	354.62	1%	100	405,000	735.8	736.6	0.00009	7.8	81,283	4,525	0.22
Lower	Lower Missouri	354.62	0.5%	200	459,000	737.5	738.4	0.00009	8.2	89,296	4,603	0.23
Lower	Lower Missouri	354.62	0.2%	500	537,000	740.1	741.1	0.00010	8.7	101,294	4,621	0.24

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	354.62	0.133%	750	573,000	741.0	742.0	0.00010	9.0	105,341	4,623	0.24
Lower	Lower Missouri	354.62	0.100%	1000	600,000	741.8	742.9	0.00010	9.2	109,125	4,625	0.24
Lower	Lower Missouri	354.62	0.080%	1250	621,000	742.4	743.5	0.00010	9.3	112,060	4,627	0.25
Lower	Lower Missouri	354.62	0.067%	1500	637,000	742.9	744.0	0.00010	9.4	114,262	4,628	0.25
Lower	Lower Missouri	355.01	10%	10	247,000	728.3	729.5	0.00020	9.0	33,055	3,628	0.31
Lower	Lower Missouri	355.01	1%	100	405,000	735.7	737.0	0.00018	9.9	62,946	4,332	0.31
Lower	Lower Missouri	355.01	0.5%	200	459,000	737.4	738.8	0.00018	10.3	70,732	4,440	0.31
Lower	Lower Missouri	355.01	0.2%	500	537,000	740.1	741.5	0.00017	10.6	82,562	4,582	0.31
Lower	Lower Missouri	355.01	0.133%	750	573,000	741.0	742.4	0.00018	10.9	86,664	4,700	0.32
Lower	Lower Missouri	355.01	0.100%	1000	600,000	741.8	743.3	0.00017	11.0	90,563	4,706	0.31
Lower	Lower Missouri	355.01	0.080%	1250	621,000	742.4	743.9	0.00017	11.1	93,588	4,711	0.31
Lower	Lower Missouri	355.01	0.067%	1500	637,000	742.9	744.4	0.00017	11.2	95,855	4,722	0.31
Lower	Lower Missouri	355.4	10%	10	247,000	728.8	729.9	0.00014	8.4	32,716	4,407	0.27
Lower	Lower Missouri	355.4	1%	100	405,000	736.0	737.3	0.00015	9.9	63,086	6,396	0.29
Lower	Lower Missouri	355.4	0.5%	200	459,000	737.7	739.2	0.00016	10.4	72,389	6,606	0.30
Lower	Lower Missouri	355.4	0.2%	500	537,000	740.3	741.8	0.00016	10.7	86,591	6,627	0.30
Lower	Lower Missouri	355.4	0.133%	750	573,000	741.2	742.8	0.00016	11.0	91,421	6,638	0.30
Lower	Lower Missouri	355.4	0.100%	1000	600,000	742.1	743.6	0.00016	11.1	95,900	6,640	0.30
Lower	Lower Missouri	355.4	0.080%	1250	621,000	742.7	744.3	0.00016	11.2	99,371	6,641	0.30
Lower	Lower Missouri	355.4	0.067%	1500	637,000	743.2	744.7	0.00016	11.2	101,976	6,642	0.30
Lower	Lower Missouri	355.76	10%	10	247,000	729.4	730.1	0.00010	6.8	39,125	3,819	0.22
Lower	Lower Missouri	355.76	1%	100	405,000	736.7	737.6	0.00011	8.2	72,554	6,654	0.24
Lower	Lower Missouri	355.76	0.5%	200	459,000	738.5	739.5	0.00011	8.6	82,967	6,871	0.25
Lower	Lower Missouri	355.76	0.2%	500	537,000	741.1	742.1	0.00011	8.9	98,480	7,077	0.25
Lower	Lower Missouri	355.76	0.133%	750	573,000	742.0	743.1	0.00011	9.2	103,951	7,087	0.25
Lower	Lower Missouri	355.76	0.100%	1000	600,000	742.8	743.9	0.00011	9.3	108,898	7,096	0.25
Lower	Lower Missouri	355.76	0.080%	1250	621,000	743.5	744.5	0.00011	9.3	112,731	7,104	0.25
Lower	Lower Missouri	355.76	0.067%	1500	637,000	743.9	745.0	0.00011	9.4	115,609	7,112	0.25
Lower	Lower Missouri	356.1	10%	10	247,000	729.5	730.4	0.00012	7.4	34,292	3,373	0.25
Lower	Lower Missouri	356.1	1%	100	405,000	736.8	737.8	0.00012	8.8	69,832	7,431	0.26
Lower	Lower Missouri	356.1	0.5%	200	459,000	738.6	739.7	0.00012	9.2	80,860	7,522	0.26
Lower	Lower Missouri	356.1	0.2%	500	537,000	741.2	742.4	0.00012	9.4	96,825	7,563	0.26
Lower	Lower Missouri	356.1	0.133%	750	573,000	742.1	743.3	0.00012	9.7	102,428	7,580	0.27
Lower	Lower Missouri	356.1	0.100%	1000	600,000	742.9	744.1	0.00012	9.7	107,476	7,633	0.27
Lower	Lower Missouri	356.1	0.080%	1250	621,000	743.6	744.8	0.00012	9.8	111,385	7,712	0.27
Lower	Lower Missouri	356.1	0.067%	1500	637,000	744.1	745.3	0.00012	9.9	114,336	7,728	0.27
Lower	Lower Missouri	356.43	10%	10	247,000	729.6	730.7	0.00015	8.4	29,512	2,793	0.28
Lower	Lower Missouri	356.43	1%	100	405,000	736.8	738.2	0.00016	9.9	64,046	7,154	0.29
Lower	Lower Missouri	356.43	0.5%	200	459,000	738.6	740.0	0.00016	10.2	74,560	7,254	0.30
Lower	Lower Missouri	356.43	0.2%	500	537,000	741.3	742.7	0.00015	10.4	89,763	7,552	0.29
Lower	Lower Missouri	356.43	0.133%	750	573,000	742.2	743.6	0.00015	10.6	95,104	7,667	0.30
Lower	Lower Missouri	356.43	0.100%	1000	600,000	743.0	744.4	0.00015	10.7	99,897	7,735	0.30
Lower	Lower Missouri	356.43	0.080%	1250	621,000	743.7	745.1	0.00015	10.8	103,609	7,773	0.30
Lower	Lower Missouri	356.43	0.067%	1500	637,000	744.2	745.5	0.00015	10.8	106,394	7,807	0.29
Lower	Lower Missouri	356.77	10%	10	247,000	730.0	730.9	0.00013	7.8	32,570	2,821	0.26
Lower	Lower Missouri	356.77	1%	100	405,000	737.2	738.4	0.00014	9.3	65,379	7,022	0.28
Lower	Lower Missouri	356.77	0.5%	200	459,000	739.0	740.3	0.00014	9.6	76,797	7,212	0.28
Lower	Lower Missouri	356.77	0.2%	500	537,000	741.6	742.9	0.00014	9.9	93,422	7,485	0.28
Lower	Lower Missouri	356.77	0.133%	750	573,000	742.6	743.9	0.00014	10.1	99,342	7,655	0.28
Lower	Lower Missouri	356.77	0.100%	1000	600,000	743.4	744.7	0.00014	10.1	104,600	7,925	0.28
Lower	Lower Missouri	356.77	0.080%	1250	621,000	744.0	745.3	0.00013	10.2	108,669	7,937	0.28
Lower	Lower Missouri	356.77	0.067%	1500	637,000	744.5	745.8	0.00013	10.2	111,726	7,952	0.28
Lower	Lower Missouri	357.06	10%	10	247,000	730.1	731.2	0.00016	8.8	33,177	2,909	0.29
Lower	Lower Missouri	357.06	1%	100	405,000	737.3	738.7	0.00016	10.2	67,603	6,574	0.30
Lower	Lower Missouri	357.06	0.5%	200	459,000	739.2	740.6	0.00016	10.5	78,338	6,661	0.30

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	357.06	0.2%	500	537,000	741.8	743.2	0.00016	10.8	93,550	6,698	0.30
Lower	Lower Missouri	357.06	0.133%	750	573,000	742.7	744.1	0.00016	11.0	98,970	6,708	0.30
Lower	Lower Missouri	357.06	0.100%	1000	600,000	743.5	745.0	0.00016	11.1	103,764	6,716	0.30
Lower	Lower Missouri	357.06	0.080%	1250	621,000	744.1	745.6	0.00015	11.1	107,472	6,722	0.30
Lower	Lower Missouri	357.06	0.067%	1500	637,000	744.6	746.1	0.00015	11.2	110,255	6,727	0.30
Lower	Lower Missouri	357.3	10%	10	247,000	730.3	731.4	0.00017	8.8	34,739	2,558	0.29
Lower	Lower Missouri	357.3	1%	100	405,000	737.6	738.9	0.00018	10.1	70,177	6,271	0.31
Lower	Lower Missouri	357.3	0.5%	200	459,000	739.4	740.8	0.00018	10.4	81,655	6,335	0.31
Lower	Lower Missouri	357.3	0.2%	500	537,000	742.0	743.4	0.00017	10.7	98,120	6,355	0.31
Lower	Lower Missouri	357.3	0.133%	750	573,000	742.9	744.3	0.00017	10.9	104,034	6,362	0.31
Lower	Lower Missouri	357.3	0.100%	1000	600,000	743.7	745.2	0.00017	10.9	109,233	6,368	0.31
Lower	Lower Missouri	357.3	0.080%	1250	621,000	744.4	745.8	0.00017	11.0	113,255	6,373	0.31
Lower	Lower Missouri	357.3	0.067%	1500	637,000	744.8	746.3	0.00016	11.0	116,276	6,377	0.31
Lower	Lower Missouri	357.63	10%	10	245,000	730.9	731.7	0.00012	7.5	40,241	2,890	0.25
Lower	Lower Missouri	357.63	1%	100	401,000	738.3	739.3	0.00014	8.6	75,922	6,360	0.27
Lower	Lower Missouri	357.63	0.5%	200	454,000	740.1	741.1	0.00014	9.0	87,386	6,404	0.28
Lower	Lower Missouri	357.63	0.2%	500	530,000	742.6	743.7	0.00014	9.2	103,809	6,425	0.27
Lower	Lower Missouri	357.63	0.133%	750	565,000	743.5	744.7	0.00014	9.4	109,816	6,433	0.28
Lower	Lower Missouri	357.63	0.100%	1000	590,000	744.4	745.5	0.00013	9.5	115,039	6,443	0.27
Lower	Lower Missouri	357.63	0.080%	1250	610,000	745.0	746.1	0.00013	9.5	119,064	6,445	0.27
Lower	Lower Missouri	357.63	0.067%	1500	625,000	745.5	746.6	0.00013	9.6	122,094	6,449	0.27
Lower	Lower Missouri	357.94	10%	10	245,000	731.1	731.9	0.00013	7.5	36,539	1,564	0.24
Lower	Lower Missouri	357.94	1%	100	401,000	738.3	739.6	0.00016	9.4	59,188	4,460	0.28
Lower	Lower Missouri	357.94	0.5%	200	454,000	740.1	741.5	0.00016	9.9	67,583	4,855	0.29
Lower	Lower Missouri	357.94	0.2%	500	530,000	742.6	744.1	0.00017	10.5	79,693	4,872	0.29
Lower	Lower Missouri	357.94	0.133%	750	565,000	743.5	745.0	0.00017	10.8	84,127	4,878	0.30
Lower	Lower Missouri	357.94	0.100%	1000	590,000	744.3	745.9	0.00017	10.9	87,997	4,883	0.30
Lower	Lower Missouri	357.94	0.080%	1250	610,000	744.9	746.5	0.00017	11.0	90,981	4,887	0.30
Lower	Lower Missouri	357.94	0.067%	1500	625,000	745.3	747.0	0.00017	11.1	93,231	4,890	0.30
Lower	Lower Missouri	358.26	10%	10	245,000	731.2	732.2	0.00016	8.3	29,782	1,195	0.27
Lower	Lower Missouri	358.26	1%	100	401,000	738.3	740.0	0.00020	10.7	46,250	3,311	0.31
Lower	Lower Missouri	358.26	0.5%	200	454,000	740.0	741.9	0.00021	11.4	51,941	3,327	0.33
Lower	Lower Missouri	358.26	0.2%	500	530,000	742.4	744.6	0.00022	12.2	59,979	3,349	0.34
Lower	Lower Missouri	358.26	0.133%	750	565,000	743.3	745.6	0.00023	12.6	62,908	3,357	0.35
Lower	Lower Missouri	358.26	0.100%	1000	590,000	744.1	746.4	0.00023	12.8	65,478	3,364	0.35
Lower	Lower Missouri	358.26	0.080%	1250	610,000	744.6	747.1	0.00024	13.0	67,459	3,370	0.35
Lower	Lower Missouri	358.26	0.067%	1500	625,000	745.1	747.6	0.00024	13.1	68,954	3,374	0.35
Lower	Lower Missouri	358.57	10%	10	245,000	731.7	732.5	0.00010	7.0	37,039	1,817	0.22
Lower	Lower Missouri	358.57	1%	100	401,000	739.1	740.3	0.00013	8.9	53,966	2,536	0.26
Lower	Lower Missouri	358.57	0.5%	200	454,000	740.9	742.3	0.00014	9.6	58,499	2,569	0.27
Lower	Lower Missouri	358.57	0.2%	500	530,000	743.4	744.9	0.00015	10.4	64,816	2,585	0.28
Lower	Lower Missouri	358.57	0.133%	750	565,000	744.3	746.0	0.00016	10.8	67,161	2,591	0.29
Lower	Lower Missouri	358.57	0.100%	1000	590,000	745.0	746.8	0.00016	11.0	69,147	2,596	0.30
Lower	Lower Missouri	358.57	0.080%	1250	610,000	745.6	747.5	0.00017	11.2	70,678	2,600	0.30
Lower	Lower Missouri	358.57	0.067%	1500	625,000	746.1	747.9	0.00017	11.3	71,829	2,603	0.30
Lower	Lower Missouri	358.91	10%	10	245,000	731.9	732.7	0.00015	7.4	33,676	1,779	0.25
Lower	Lower Missouri	358.91	1%	100	401,000	739.3	740.6	0.00017	9.3	50,636	2,436	0.28
Lower	Lower Missouri	358.91	0.5%	200	454,000	741.1	742.6	0.00018	10.0	55,002	2,448	0.29
Lower	Lower Missouri	358.91	0.2%	500	530,000	743.6	745.3	0.00019	10.8	61,063	2,466	0.30
Lower	Lower Missouri	358.91	0.133%	750	565,000	744.5	746.3	0.00020	11.2	63,324	2,473	0.31
Lower	Lower Missouri	358.91	0.100%	1000	590,000	745.3	747.2	0.00020	11.4	65,229	2,478	0.31
Lower	Lower Missouri	358.91	0.080%	1250	610,000	745.8	747.8	0.00021	11.6	66,698	2,483	0.32
Lower	Lower Missouri	358.91	0.067%	1500	625,000	746.3	748.3	0.00021	11.7	67,802	2,486	0.32
Lower	Lower Missouri	359.26	10%	10	245,000	732.0	733.1	0.00020	8.5	29,520	1,523	0.29
Lower	Lower Missouri	359.26	1%	100	401,000	739.4	741.1	0.00022	10.5	47,061	2,550	0.32

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	359.26	0.5%	200	454,000	741.2	743.1	0.00023	11.2	51,666	2,590	0.33
Lower	Lower Missouri	359.26	0.2%	500	530,000	743.7	745.8	0.00025	12.0	58,137	2,645	0.34
Lower	Lower Missouri	359.26	0.133%	750	565,000	744.6	746.9	0.00026	12.5	60,568	2,657	0.35
Lower	Lower Missouri	359.26	0.100%	1000	590,000	745.4	747.7	0.00026	12.7	62,621	2,663	0.35
Lower	Lower Missouri	359.26	0.080%	1250	610,000	746.0	748.4	0.00026	12.9	64,205	2,667	0.35
Lower	Lower Missouri	359.26	0.067%	1500	625,000	746.4	748.9	0.00026	13.0	65,395	2,671	0.36
Lower	Lower Missouri	359.318*	10%	10	245,000	732.1	733.2	0.00018	8.4	29,550	1,569	0.28
Lower	Lower Missouri	359.318*	1%	100	401,000	739.5	741.2	0.00021	10.6	46,975	2,606	0.31
Lower	Lower Missouri	359.318*	0.5%	200	454,000	741.3	743.2	0.00023	11.3	51,650	2,609	0.32
Lower	Lower Missouri	359.318*	0.2%	500	530,000	743.8	745.9	0.00024	12.1	58,101	2,611	0.34
Lower	Lower Missouri	359.318*	0.133%	750	565,000	744.7	747.0	0.00025	12.6	60,510	2,612	0.35
Lower	Lower Missouri	359.318*	0.100%	1000	590,000	745.5	747.8	0.00025	12.8	62,524	2,613	0.35
Lower	Lower Missouri	359.318*	0.080%	1250	610,000	746.1	748.5	0.00026	13.0	64,075	2,614	0.35
Lower	Lower Missouri	359.318*	0.067%	1500	625,000	746.5	749.0	0.00026	13.2	65,239	2,614	0.35
Lower		359.324	Turman Lift Bridge									
Lower	Lower Missouri	359.33	10%	10	245,000	732.2	733.3	0.00017	8.3	30,024	1,755	0.27
Lower	Lower Missouri	359.33	1%	100	401,000	739.8	741.4	0.00020	10.4	47,749	2,522	0.30
Lower	Lower Missouri	359.33	0.5%	200	454,000	741.6	743.4	0.00021	11.1	52,431	2,537	0.32
Lower	Lower Missouri	359.33	0.2%	500	530,000	744.2	746.3	0.00023	12.0	58,938	2,539	0.33
Lower	Lower Missouri	359.33	0.133%	750	565,000	745.1	747.4	0.00024	12.4	61,405	2,540	0.34
Lower	Lower Missouri	359.33	0.100%	1000	590,000	745.9	748.2	0.00024	12.6	63,448	2,541	0.34
Lower	Lower Missouri	359.33	0.080%	1250	610,000	746.6	748.9	0.00024	12.8	65,026	2,542	0.34
Lower	Lower Missouri	359.33	0.067%	1500	625,000	747.0	749.4	0.00024	13.0	66,210	2,542	0.35
Lower	Lower Missouri	359.39	10%	10	245,000	732.3	733.3	0.00018	8.4	29,535	1,294	0.28
Lower	Lower Missouri	359.39	1%	100	401,000	739.8	741.5	0.00021	10.6	44,889	2,580	0.31
Lower	Lower Missouri	359.39	0.5%	200	454,000	741.6	743.5	0.00023	11.2	49,684	2,600	0.32
Lower	Lower Missouri	359.39	0.2%	500	530,000	744.2	746.3	0.00024	12.1	56,399	2,629	0.34
Lower	Lower Missouri	359.39	0.133%	750	565,000	745.2	747.4	0.00025	12.5	58,968	2,640	0.34
Lower	Lower Missouri	359.39	0.100%	1000	590,000	746.0	748.3	0.00025	12.7	61,101	2,649	0.35
Lower	Lower Missouri	359.39	0.080%	1250	610,000	746.6	749.0	0.00025	12.9	62,754	2,656	0.35
Lower	Lower Missouri	359.39	0.067%	1500	625,000	747.1	749.5	0.00025	13.0	63,997	2,661	0.35
Lower	Lower Missouri	359.55	10%	10	245,000	732.3	733.6	0.00028	9.3	26,700	1,199	0.32
Lower	Lower Missouri	359.55	1%	100	401,000	739.8	741.8	0.00030	11.5	41,089	2,415	0.35
Lower	Lower Missouri	359.55	0.5%	200	454,000	741.6	743.8	0.00031	12.2	45,611	2,474	0.36
Lower	Lower Missouri	359.55	0.2%	500	530,000	744.2	746.7	0.00033	13.0	52,064	2,556	0.37
Lower	Lower Missouri	359.55	0.133%	750	565,000	745.2	747.8	0.00034	13.4	54,568	2,587	0.38
Lower	Lower Missouri	359.55	0.100%	1000	590,000	746.0	748.7	0.00034	13.7	56,664	2,613	0.38
Lower	Lower Missouri	359.55	0.080%	1250	610,000	746.6	749.4	0.00034	13.9	58,298	2,632	0.39
Lower	Lower Missouri	359.55	0.067%	1500	625,000	747.1	749.9	0.00034	14.0	59,532	2,647	0.39
Lower	Lower Missouri	359.85	10%	10	245,000	732.9	734.0	0.00017	8.1	30,259	1,026	0.26
Lower	Lower Missouri	359.85	1%	100	401,000	740.5	742.2	0.00021	10.5	43,858	2,377	0.30
Lower	Lower Missouri	359.85	0.5%	200	454,000	742.4	744.3	0.00023	11.2	48,395	2,460	0.31
Lower	Lower Missouri	359.85	0.2%	500	530,000	745.0	747.1	0.00024	12.1	54,839	2,537	0.33
Lower	Lower Missouri	359.85	0.133%	750	565,000	745.9	748.3	0.00025	12.5	57,370	2,567	0.33
Lower	Lower Missouri	359.85	0.100%	1000	590,000	746.7	749.1	0.00026	12.7	59,445	2,591	0.34
Lower	Lower Missouri	359.85	0.080%	1250	610,000	747.4	749.8	0.00026	12.9	61,064	2,609	0.34
Lower	Lower Missouri	359.85	0.067%	1500	625,000	747.8	750.3	0.00026	13.1	62,284	2,623	0.34
Lower	Lower Missouri	360.14	10%	10	245,000	733.4	734.2	0.00014	7.4	33,362	1,104	0.23
Lower	Lower Missouri	360.14	1%	100	401,000	741.1	742.5	0.00018	9.5	48,563	2,505	0.27
Lower	Lower Missouri	360.14	0.5%	200	454,000	743.1	744.6	0.00019	10.2	53,441	2,539	0.28
Lower	Lower Missouri	360.14	0.2%	500	530,000	745.7	747.5	0.00020	11.0	60,224	2,586	0.29
Lower	Lower Missouri	360.14	0.133%	750	565,000	746.7	748.7	0.00021	11.4	62,895	2,607	0.30
Lower	Lower Missouri	360.14	0.100%	1000	590,000	747.6	749.6	0.00022	11.6	65,043	2,624	0.30
Lower	Lower Missouri	360.14	0.080%	1250	610,000	748.2	750.2	0.00022	11.8	66,715	2,638	0.31
Lower	Lower Missouri	360.14	0.067%	1500	625,000	748.7	750.8	0.00022	11.9	67,971	2,648	0.31

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	360.223*	10%	10	245,000	733.4	734.3	0.00015	7.8	31,318	996	0.25
Lower	Lower Missouri	360.223*	1%	100	401,000	741.1	742.6	0.00019	10.0	47,564	2,578	0.28
Lower	Lower Missouri	360.223*	0.5%	200	454,000	743.1	744.8	0.00020	10.6	52,637	2,656	0.29
Lower	Lower Missouri	360.223*	0.2%	500	530,000	745.7	747.6	0.00021	11.4	59,731	2,670	0.30
Lower	Lower Missouri	360.223*	0.133%	750	565,000	746.8	748.8	0.00022	11.8	62,502	2,675	0.31
Lower	Lower Missouri	360.223*	0.100%	1000	590,000	747.6	749.7	0.00022	12.0	64,718	2,678	0.31
Lower	Lower Missouri	360.223*	0.080%	1250	610,000	748.2	750.4	0.00022	12.2	66,436	2,680	0.32
Lower	Lower Missouri	360.223*	0.067%	1500	625,000	748.7	750.9	0.00022	12.3	67,721	2,682	0.32
Lower		360.229	I-435 Bridge									
Lower	Lower Missouri	360.25	10%	10	245,000	733.5	734.4	0.00014	7.4	32,953	984	0.23
Lower	Lower Missouri	360.25	1%	100	401,000	741.3	742.7	0.00017	9.6	49,947	2,604	0.26
Lower	Lower Missouri	360.25	0.5%	200	454,000	743.3	744.8	0.00019	10.3	55,049	2,635	0.28
Lower	Lower Missouri	360.25	0.2%	500	530,000	745.9	747.7	0.00020	11.1	62,065	2,657	0.29
Lower	Lower Missouri	360.25	0.133%	750	565,000	746.9	748.9	0.00021	11.5	64,816	2,667	0.30
Lower	Lower Missouri	360.25	0.100%	1000	590,000	747.8	749.8	0.00021	11.7	67,011	2,672	0.30
Lower	Lower Missouri	360.25	0.080%	1250	610,000	748.4	750.5	0.00022	11.9	68,712	2,676	0.30
Lower	Lower Missouri	360.25	0.067%	1500	625,000	748.9	751.0	0.00022	12.1	69,984	2,679	0.30
Lower	Lower Missouri	360.29	10%	10	245,000	733.5	734.4	0.00017	7.9	31,021	1,091	0.25
Lower	Lower Missouri	360.29	1%	100	401,000	741.2	742.8	0.00020	10.1	47,434	2,581	0.28
Lower	Lower Missouri	360.29	0.5%	200	454,000	743.2	744.9	0.00022	10.8	52,449	2,597	0.30
Lower	Lower Missouri	360.29	0.2%	500	530,000	745.8	747.8	0.00023	11.6	59,350	2,618	0.31
Lower	Lower Missouri	360.29	0.133%	750	565,000	746.8	749.0	0.00024	12.0	62,051	2,627	0.32
Lower	Lower Missouri	360.29	0.100%	1000	590,000	747.7	749.9	0.00024	12.3	64,209	2,633	0.32
Lower	Lower Missouri	360.29	0.080%	1250	610,000	748.3	750.5	0.00025	12.5	65,883	2,638	0.32
Lower	Lower Missouri	360.29	0.067%	1500	625,000	748.8	751.1	0.00025	12.6	67,136	2,642	0.32
Lower	Lower Missouri	360.61	10%	10	245,000	733.7	734.7	0.00018	8.1	30,271	977	0.26
Lower	Lower Missouri	360.61	1%	100	401,000	741.5	743.2	0.00022	10.4	44,270	2,806	0.30
Lower	Lower Missouri	360.61	0.5%	200	454,000	743.5	745.3	0.00024	11.1	49,835	2,894	0.31
Lower	Lower Missouri	360.61	0.2%	500	530,000	746.1	748.2	0.00025	11.9	57,631	2,943	0.32
Lower	Lower Missouri	360.61	0.133%	750	565,000	747.2	749.4	0.00026	12.3	60,718	2,961	0.33
Lower	Lower Missouri	360.61	0.100%	1000	590,000	748.0	750.3	0.00026	12.5	63,177	2,976	0.33
Lower	Lower Missouri	360.61	0.080%	1250	610,000	748.6	751.0	0.00026	12.7	65,091	2,987	0.33
Lower	Lower Missouri	360.61	0.067%	1500	625,000	749.1	751.5	0.00027	12.9	66,525	2,995	0.33
Lower	Lower Missouri	360.91	10%	10	245,000	734.0	735.0	0.00018	8.1	30,384	1,159	0.26
Lower	Lower Missouri	360.91	1%	100	401,000	741.9	743.5	0.00022	10.4	42,694	2,425	0.30
Lower	Lower Missouri	360.91	0.5%	200	454,000	743.8	745.7	0.00024	11.1	47,763	2,670	0.31
Lower	Lower Missouri	360.91	0.2%	500	530,000	746.5	748.6	0.00025	11.9	55,181	2,864	0.32
Lower	Lower Missouri	360.91	0.133%	750	565,000	747.6	749.8	0.00026	12.3	58,230	2,924	0.33
Lower	Lower Missouri	360.91	0.100%	1000	590,000	748.4	750.7	0.00027	12.6	60,675	2,971	0.33
Lower	Lower Missouri	360.91	0.080%	1250	610,000	749.0	751.4	0.00027	12.8	62,597	3,007	0.33
Lower	Lower Missouri	360.91	0.067%	1500	625,000	749.5	752.0	0.00027	12.9	64,048	3,035	0.34
Lower	Lower Missouri	361.23	10%	10	245,000	734.4	735.4	0.00021	8.0	31,115	1,232	0.27
Lower	Lower Missouri	361.23	1%	100	401,000	742.4	743.9	0.00024	10.0	47,213	2,371	0.29
Lower	Lower Missouri	361.23	0.5%	200	454,000	744.5	746.1	0.00025	10.6	52,076	2,413	0.30
Lower	Lower Missouri	361.23	0.2%	500	530,000	747.2	749.1	0.00026	11.4	58,871	2,579	0.31
Lower	Lower Missouri	361.23	0.133%	750	565,000	748.3	750.3	0.00027	11.7	61,700	2,628	0.32
Lower	Lower Missouri	361.23	0.100%	1000	590,000	749.1	751.2	0.00027	11.9	63,934	2,667	0.32
Lower	Lower Missouri	361.23	0.080%	1250	610,000	749.8	751.9	0.00027	12.1	65,689	2,697	0.32
Lower	Lower Missouri	361.23	0.067%	1500	625,000	750.3	752.4	0.00028	12.3	67,037	3,033	0.33
Lower	Lower Missouri	361.54	10%	10	245,000	734.8	735.7	0.00016	7.6	32,480	1,126	0.24
Lower	Lower Missouri	361.54	1%	100	401,000	742.8	744.3	0.00020	9.7	46,914	2,311	0.27
Lower	Lower Missouri	361.54	0.5%	200	454,000	744.9	746.5	0.00021	10.4	51,650	2,345	0.28
Lower	Lower Missouri	361.54	0.2%	500	530,000	747.6	749.5	0.00023	11.2	58,262	2,527	0.30
Lower	Lower Missouri	361.54	0.133%	750	565,000	748.7	750.7	0.00024	11.6	61,082	2,640	0.30

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	361.54	0.100%	1000	590,000	749.6	751.6	0.00024	11.8	63,327	2,686	0.31
Lower	Lower Missouri	361.54	0.080%	1250	610,000	750.2	752.3	0.00024	12.0	65,111	2,760	0.31
Lower	Lower Missouri	361.54	0.067%	1500	625,000	750.7	752.9	0.00025	12.2	66,470	2,791	0.31
Lower	Lower Missouri	361.84	10%	10	245,000	735.0	735.9	0.00017	7.7	31,786	1,102	0.24
Lower	Lower Missouri	361.84	1%	100	401,000	743.1	744.6	0.00021	9.9	46,175	2,316	0.28
Lower	Lower Missouri	361.84	0.5%	200	454,000	745.2	746.9	0.00022	10.6	50,983	2,382	0.29
Lower	Lower Missouri	361.84	0.2%	500	530,000	747.9	749.9	0.00024	11.4	57,742	2,505	0.30
Lower	Lower Missouri	361.84	0.133%	750	565,000	749.0	751.1	0.00024	11.8	60,537	2,569	0.31
Lower	Lower Missouri	361.84	0.100%	1000	590,000	749.9	752.0	0.00025	12.1	62,726	2,590	0.31
Lower	Lower Missouri	361.84	0.080%	1250	610,000	750.5	752.7	0.00025	12.2	64,432	2,602	0.31
Lower	Lower Missouri	361.84	0.067%	1500	625,000	751.0	753.3	0.00025	12.4	65,716	2,610	0.31
Lower	Lower Missouri	362.17	10%	10	245,000	735.5	736.2	0.00014	6.8	40,176	2,301	0.22
Lower	Lower Missouri	362.17	1%	100	401,000	744.0	745.0	0.00015	8.4	59,841	2,357	0.24
Lower	Lower Missouri	362.17	0.5%	200	454,000	746.1	747.2	0.00016	8.9	64,912	2,372	0.24
Lower	Lower Missouri	362.17	0.2%	500	530,000	749.0	750.3	0.00017	9.6	71,787	2,394	0.25
Lower	Lower Missouri	362.17	0.133%	750	565,000	750.1	751.5	0.00017	9.9	74,567	2,410	0.26
Lower	Lower Missouri	362.17	0.100%	1000	590,000	751.0	752.5	0.00017	10.1	76,690	2,426	0.26
Lower	Lower Missouri	362.17	0.080%	1250	610,000	751.7	753.2	0.00018	10.2	78,344	2,438	0.26
Lower	Lower Missouri	362.17	0.067%	1500	625,000	752.2	753.7	0.00018	10.4	79,584	2,456	0.26
Lower	Lower Missouri	362.234*	10%	10	245,000	735.5	736.3	0.00017	7.5	34,297	1,565	0.24
Lower	Lower Missouri	362.234*	1%	100	401,000	743.8	745.1	0.00019	9.3	52,634	2,437	0.26
Lower	Lower Missouri	362.234*	0.5%	200	454,000	746.0	747.4	0.00020	9.9	57,840	2,447	0.27
Lower	Lower Missouri	362.234*	0.2%	500	530,000	748.8	750.5	0.00021	10.6	64,872	2,456	0.28
Lower	Lower Missouri	362.234*	0.133%	750	565,000	750.0	751.7	0.00021	10.9	67,700	2,459	0.29
Lower	Lower Missouri	362.234*	0.100%	1000	590,000	750.9	752.6	0.00021	11.1	69,851	2,468	0.29
Lower	Lower Missouri	362.234*	0.080%	1250	610,000	751.5	753.4	0.00022	11.3	71,523	2,477	0.29
Lower	Lower Missouri	362.234*	0.067%	1500	625,000	752.0	753.9	0.00022	11.4	72,777	2,479	0.29
Lower		362.24	Choteau Bridge									
Lower	Lower Missouri	362.25	10%	10	245,000	735.5	736.4	0.00018	7.6	33,609	1,329	0.24
Lower	Lower Missouri	362.25	1%	100	401,000	743.9	745.2	0.00021	9.5	51,279	2,414	0.27
Lower	Lower Missouri	362.25	0.5%	200	454,000	746.0	747.5	0.00022	10.1	56,489	2,428	0.27
Lower	Lower Missouri	362.25	0.2%	500	530,000	748.9	750.6	0.00023	10.8	63,570	2,447	0.28
Lower	Lower Missouri	362.25	0.133%	750	565,000	750.1	751.9	0.00023	11.1	66,435	2,455	0.29
Lower	Lower Missouri	362.25	0.100%	1000	590,000	751.0	752.8	0.00024	11.3	68,616	2,462	0.29
Lower	Lower Missouri	362.25	0.080%	1250	610,000	751.7	753.6	0.00024	11.5	70,315	2,476	0.29
Lower	Lower Missouri	362.25	0.067%	1500	625,000	752.2	754.1	0.00024	11.6	71,586	2,483	0.30
Lower	Lower Missouri	362.27	10%	10	245,000	735.5	736.4	0.00018	7.6	33,916	1,361	0.24
Lower	Lower Missouri	362.27	1%	100	401,000	743.9	745.2	0.00021	9.5	51,376	2,388	0.26
Lower	Lower Missouri	362.27	0.5%	200	454,000	746.1	747.5	0.00022	10.1	56,536	2,412	0.27
Lower	Lower Missouri	362.27	0.2%	500	530,000	749.0	750.6	0.00023	10.8	63,582	2,444	0.28
Lower	Lower Missouri	362.27	0.133%	750	565,000	750.1	751.9	0.00023	11.1	66,449	2,462	0.29
Lower	Lower Missouri	362.27	0.100%	1000	590,000	751.0	752.9	0.00024	11.3	68,641	2,482	0.29
Lower	Lower Missouri	362.27	0.080%	1250	610,000	751.7	753.6	0.00024	11.5	70,353	2,497	0.29
Lower	Lower Missouri	362.27	0.067%	1500	625,000	752.2	754.1	0.00024	11.6	71,634	2,507	0.30
Lower	Lower Missouri	362.54	10%	10	245,000	736.0	736.7	0.00016	6.8	36,944	1,634	0.22
Lower	Lower Missouri	362.54	1%	100	401,000	744.5	745.5	0.00017	8.4	55,280	3,137	0.24
Lower	Lower Missouri	362.54	0.5%	200	454,000	746.7	747.8	0.00018	8.9	61,056	3,163	0.25
Lower	Lower Missouri	362.54	0.2%	500	530,000	749.6	751.0	0.00019	9.5	68,895	3,199	0.25
Lower	Lower Missouri	362.54	0.133%	750	565,000	750.8	752.2	0.00019	9.8	72,085	3,222	0.26
Lower	Lower Missouri	362.54	0.100%	1000	590,000	751.7	753.2	0.00019	10.0	74,496	3,243	0.26
Lower	Lower Missouri	362.54	0.080%	1250	610,000	752.4	753.9	0.00019	10.1	76,370	3,259	0.26
Lower	Lower Missouri	362.54	0.067%	1500	625,000	753.0	754.5	0.00019	10.2	77,774	3,272	0.26
Lower	Lower Missouri	362.85	10%	10	245,000	736.3	736.9	0.00015	6.2	39,682	1,685	0.21
Lower	Lower Missouri	362.85	1%	100	401,000	744.9	745.8	0.00015	7.5	59,539	3,287	0.22

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	362.85	0.5%	200	454,000	747.2	748.1	0.00016	8.0	65,528	4,085	0.23
Lower	Lower Missouri	362.85	0.2%	500	530,000	750.2	751.2	0.00016	8.5	73,709	4,682	0.23
Lower	Lower Missouri	362.85	0.133%	750	565,000	751.4	752.5	0.00016	8.7	77,089	4,760	0.24
Lower	Lower Missouri	362.85	0.100%	1000	590,000	752.3	753.5	0.00016	8.9	79,656	4,811	0.24
Lower	Lower Missouri	362.85	0.080%	1250	610,000	753.0	754.2	0.00017	9.0	81,666	4,855	0.24
Lower	Lower Missouri	362.85	0.067%	1500	625,000	753.5	754.8	0.00017	9.1	83,178	4,892	0.24
Lower	Lower Missouri	363.14	10%	10	245,000	736.5	737.2	0.00015	6.8	36,770	2,168	0.22
Lower	Lower Missouri	363.14	1%	100	401,000	745.1	746.1	0.00017	8.3	57,465	5,122	0.24
Lower	Lower Missouri	363.14	0.5%	200	454,000	747.3	748.4	0.00018	8.7	63,185	5,410	0.24
Lower	Lower Missouri	363.14	0.2%	500	530,000	750.3	751.6	0.00018	9.3	70,945	5,820	0.25
Lower	Lower Missouri	363.14	0.133%	750	565,000	751.5	752.8	0.00019	9.6	74,125	5,849	0.26
Lower	Lower Missouri	363.14	0.100%	1000	590,000	752.4	753.8	0.00019	9.8	76,511	5,899	0.26
Lower	Lower Missouri	363.14	0.080%	1250	610,000	753.1	754.5	0.00019	9.9	78,364	5,989	0.26
Lower	Lower Missouri	363.14	0.067%	1500	625,000	753.7	755.1	0.00019	10.0	79,750	6,037	0.26
Lower	Lower Missouri	363.43	10%	10	245,000	736.4	737.7	0.00035	9.1	27,288	1,304	0.31
Lower	Lower Missouri	363.43	1%	100	401,000	744.9	746.7	0.00036	11.0	42,443	2,032	0.33
Lower	Lower Missouri	363.43	0.5%	200	454,000	747.1	749.1	0.00036	11.6	46,907	2,046	0.34
Lower	Lower Missouri	363.43	0.2%	500	530,000	750.0	752.2	0.00037	12.3	52,966	2,066	0.34
Lower	Lower Missouri	363.43	0.133%	750	565,000	751.2	753.5	0.00038	12.7	55,441	2,074	0.35
Lower	Lower Missouri	363.43	0.100%	1000	590,000	752.1	754.5	0.00038	12.9	57,305	2,081	0.35
Lower	Lower Missouri	363.43	0.080%	1250	610,000	752.8	755.3	0.00038	13.0	58,755	2,085	0.35
Lower	Lower Missouri	363.43	0.067%	1500	625,000	753.3	755.8	0.00038	13.2	59,842	2,089	0.35
Lower	Lower Missouri	363.73	10%	10	245,000	737.2	738.2	0.00020	7.7	32,624	1,394	0.24
Lower	Lower Missouri	363.73	1%	100	401,000	745.8	747.2	0.00023	9.7	46,433	1,706	0.27
Lower	Lower Missouri	363.73	0.5%	200	454,000	748.0	749.6	0.00024	10.3	50,206	1,720	0.28
Lower	Lower Missouri	363.73	0.2%	500	530,000	750.9	752.8	0.00026	11.2	55,306	1,738	0.29
Lower	Lower Missouri	363.73	0.133%	750	565,000	752.1	754.1	0.00027	11.5	57,400	1,745	0.30
Lower	Lower Missouri	363.73	0.100%	1000	590,000	753.0	755.1	0.00027	11.8	58,964	1,751	0.30
Lower	Lower Missouri	363.73	0.080%	1250	610,000	753.7	755.8	0.00027	12.0	60,180	1,755	0.30
Lower	Lower Missouri	363.73	0.067%	1500	625,000	754.2	756.4	0.00028	12.1	61,090	1,758	0.31
Lower	Lower Missouri	364.05	10%	10	245,000	737.6	738.5	0.00020	7.7	32,975	1,282	0.24
Lower	Lower Missouri	364.05	1%	100	401,000	746.2	747.6	0.00023	9.7	45,788	1,566	0.27
Lower	Lower Missouri	364.05	0.5%	200	454,000	748.4	750.0	0.00025	10.3	49,276	1,581	0.28
Lower	Lower Missouri	364.05	0.2%	500	530,000	751.4	753.2	0.00026	11.2	54,000	1,602	0.29
Lower	Lower Missouri	364.05	0.133%	750	565,000	752.6	754.6	0.00027	11.5	55,947	1,610	0.30
Lower	Lower Missouri	364.05	0.100%	1000	590,000	753.5	755.5	0.00028	11.8	57,397	1,617	0.30
Lower	Lower Missouri	364.05	0.080%	1250	610,000	754.2	756.3	0.00028	12.0	58,526	1,621	0.31
Lower	Lower Missouri	364.05	0.067%	1500	625,000	754.7	756.9	0.00028	12.1	59,370	1,625	0.31
Lower	Lower Missouri	364.34	10%	10	245,000	737.9	738.8	0.00017	7.4	34,482	1,297	0.22
Lower	Lower Missouri	364.34	1%	100	401,000	746.6	747.9	0.00021	9.4	46,424	1,432	0.26
Lower	Lower Missouri	364.34	0.5%	200	454,000	748.8	750.4	0.00022	10.1	49,637	1,447	0.27
Lower	Lower Missouri	364.34	0.2%	500	530,000	751.8	753.6	0.00024	11.0	53,972	1,459	0.28
Lower	Lower Missouri	364.34	0.133%	750	565,000	753.0	755.0	0.00025	11.4	55,756	1,463	0.29
Lower	Lower Missouri	364.34	0.100%	1000	590,000	753.9	756.0	0.00025	11.6	57,075	1,466	0.29
Lower	Lower Missouri	364.34	0.080%	1250	610,000	754.6	756.7	0.00026	11.9	58,101	1,469	0.29
Lower	Lower Missouri	364.34	0.067%	1500	625,000	755.1	757.3	0.00026	12.0	58,867	1,471	0.30
Lower	Lower Missouri	364.65	10%	10	245,000	738.2	739.1	0.00018	7.5	33,529	1,341	0.23
Lower	Lower Missouri	364.65	1%	100	401,000	746.9	748.3	0.00021	9.6	45,484	1,406	0.26
Lower	Lower Missouri	364.65	0.5%	200	454,000	749.1	750.7	0.00023	10.2	48,668	1,422	0.27
Lower	Lower Missouri	364.65	0.2%	500	530,000	752.2	754.0	0.00025	11.1	53,013	1,472	0.29
Lower	Lower Missouri	364.65	0.133%	750	565,000	753.4	755.4	0.00025	11.5	54,837	1,483	0.29
Lower	Lower Missouri	364.65	0.100%	1000	590,000	754.3	756.4	0.00026	11.8	56,189	1,492	0.30
Lower	Lower Missouri	364.65	0.080%	1250	610,000	755.0	757.2	0.00026	12.0	57,244	1,498	0.30
Lower	Lower Missouri	364.65	0.067%	1500	625,000	755.5	757.7	0.00027	12.1	58,033	1,503	0.30
Lower	Lower Missouri	364.730*	10%	10	245,000	738.2	739.2	0.00020	7.7	32,520	1,354	0.24

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	364.730*	1%	100	401,000	747.0	748.4	0.00023	9.7	44,566	1,411	0.27
Lower	Lower Missouri	364.730*	0.5%	200	454,000	749.2	750.8	0.00024	10.4	47,775	1,435	0.28
Lower	Lower Missouri	364.730*	0.2%	500	530,000	752.2	754.1	0.00026	11.3	52,142	1,459	0.29
Lower	Lower Missouri	364.730*	0.133%	750	565,000	753.5	755.5	0.00027	11.6	53,952	1,468	0.30
Lower	Lower Missouri	364.730*	0.100%	1000	590,000	754.4	756.5	0.00027	11.9	55,293	1,474	0.30
Lower	Lower Missouri	364.730*	0.080%	1250	610,000	755.1	757.3	0.00028	12.1	56,338	1,479	0.31
Lower	Lower Missouri	364.730*	0.067%	1500	625,000	755.6	757.9	0.00028	12.3	57,119	1,491	0.31
Lower		364.734	Paseo Bridge									
Lower	Lower Missouri	364.75	10%	10	245,000	738.3	739.2	0.00022	7.8	32,304	1,355	0.25
Lower	Lower Missouri	364.75	1%	100	401,000	747.0	748.5	0.00025	9.8	44,403	1,413	0.27
Lower	Lower Missouri	364.75	0.5%	200	454,000	749.3	750.9	0.00027	10.4	47,625	1,428	0.28
Lower	Lower Missouri	364.75	0.2%	500	530,000	752.3	754.2	0.00028	11.3	51,996	1,462	0.30
Lower	Lower Missouri	364.75	0.133%	750	565,000	753.6	755.6	0.00029	11.7	53,820	1,471	0.30
Lower	Lower Missouri	364.75	0.100%	1000	590,000	754.5	756.6	0.00030	11.9	55,171	1,478	0.31
Lower	Lower Missouri	364.75	0.080%	1250	610,000	755.2	757.4	0.00030	12.1	56,224	1,483	0.31
Lower	Lower Missouri	364.75	0.067%	1500	625,000	755.7	758.0	0.00031	12.3	57,010	1,488	0.31
Lower	Lower Missouri	364.78	10%	10	245,000	738.3	739.3	0.00025	8.1	30,959	1,229	0.26
Lower	Lower Missouri	364.78	1%	100	401,000	747.0	748.6	0.00028	10.1	42,598	1,396	0.29
Lower	Lower Missouri	364.78	0.5%	200	454,000	749.3	751.0	0.00029	10.8	45,777	1,412	0.30
Lower	Lower Missouri	364.78	0.2%	500	530,000	752.3	754.3	0.00031	11.6	50,089	1,443	0.31
Lower	Lower Missouri	364.78	0.133%	750	565,000	753.5	755.7	0.00032	12.0	51,886	1,453	0.31
Lower	Lower Missouri	364.78	0.100%	1000	590,000	754.4	756.7	0.00033	12.3	53,218	1,460	0.32
Lower	Lower Missouri	364.78	0.080%	1250	610,000	755.1	757.5	0.00033	12.5	54,255	1,465	0.32
Lower	Lower Missouri	364.78	0.067%	1500	625,000	755.7	758.1	0.00033	12.6	55,031	1,469	0.32
Lower	Lower Missouri	365.1	10%	10	245,000	738.8	739.7	0.00019	7.5	33,314	1,274	0.23
Lower	Lower Missouri	365.1	1%	100	401,000	747.6	749.0	0.00023	9.5	45,271	1,396	0.26
Lower	Lower Missouri	365.1	0.5%	200	454,000	749.9	751.5	0.00024	10.1	48,506	1,411	0.27
Lower	Lower Missouri	365.1	0.2%	500	530,000	753.0	754.8	0.00026	11.0	52,899	1,452	0.28
Lower	Lower Missouri	365.1	0.133%	750	565,000	754.3	756.2	0.00027	11.4	54,758	1,478	0.29
Lower	Lower Missouri	365.1	0.100%	1000	590,000	755.2	757.2	0.00028	11.6	56,137	1,486	0.29
Lower	Lower Missouri	365.1	0.080%	1250	610,000	755.9	758.0	0.00028	11.8	57,213	1,492	0.30
Lower	Lower Missouri	365.1	0.067%	1500	625,000	756.5	758.6	0.00028	12.0	58,017	1,497	0.30
Lower	Lower Missouri	365.43	10%	10	245,000	739.1	740.0	0.00023	7.9	32,231	1,335	0.25
Lower	Lower Missouri	365.43	1%	100	401,000	748.0	749.4	0.00026	9.8	44,367	1,396	0.27
Lower	Lower Missouri	365.43	0.5%	200	454,000	750.3	751.9	0.00027	10.4	47,633	1,412	0.28
Lower	Lower Missouri	365.43	0.2%	500	530,000	753.4	755.3	0.00029	11.3	52,080	1,456	0.30
Lower	Lower Missouri	365.43	0.133%	750	565,000	754.7	756.7	0.00029	11.7	53,959	1,474	0.30
Lower	Lower Missouri	365.43	0.100%	1000	590,000	755.6	757.8	0.00030	11.9	55,348	1,485	0.31
Lower	Lower Missouri	365.43	0.080%	1250	610,000	756.4	758.5	0.00030	12.1	56,434	1,493	0.31
Lower	Lower Missouri	365.43	0.067%	1500	625,000	756.9	759.1	0.00031	12.3	57,248	1,508	0.31
Lower	Lower Missouri	365.521*	10%	10	245,000	739.4	740.2	0.00019	7.1	35,071	1,403	0.22
Lower	Lower Missouri	365.521*	1%	100	401,000	748.4	749.6	0.00021	8.9	47,925	1,458	0.25
Lower	Lower Missouri	365.521*	0.5%	200	454,000	750.7	752.1	0.00022	9.5	51,392	1,473	0.26
Lower	Lower Missouri	365.521*	0.2%	500	530,000	753.9	755.5	0.00023	10.3	56,091	1,508	0.27
Lower	Lower Missouri	365.521*	0.133%	750	565,000	755.2	756.9	0.00024	10.6	58,081	1,530	0.27
Lower	Lower Missouri	365.521*	0.100%	1000	590,000	756.2	757.9	0.00024	10.8	59,551	1,548	0.28
Lower	Lower Missouri	365.521*	0.080%	1250	610,000	756.9	758.7	0.00024	11.0	60,705	1,564	0.28
Lower	Lower Missouri	365.521*	0.067%	1500	625,000	757.4	759.3	0.00025	11.2	61,573	1,581	0.28
Lower		365.53	Heart of America Bridge									
Lower	Lower Missouri	365.56	10%	10	245,000	739.5	740.2	0.00017	6.9	36,340	1,430	0.21
Lower	Lower Missouri	365.56	1%	100	401,000	748.5	749.7	0.00019	8.6	49,492	1,484	0.24
Lower	Lower Missouri	365.56	0.5%	200	454,000	750.9	752.2	0.00020	9.2	53,043	1,498	0.25
Lower	Lower Missouri	365.56	0.2%	500	530,000	754.1	755.6	0.00021	9.9	57,851	1,528	0.26
Lower	Lower Missouri	365.56	0.133%	750	565,000	755.4	757.0	0.00022	10.2	59,884	1,552	0.26

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower	Lower Missouri	365.56	0.100%	1000	590,000	756.4	758.0	0.00022	10.5	61,387	1,569	0.26
Lower	Lower Missouri	365.56	0.080%	1250	610,000	757.1	758.8	0.00023	10.6	62,565	1,588	0.27
Lower	Lower Missouri	365.56	0.067%	1500	625,000	757.7	759.4	0.00023	10.8	63,454	1,599	0.27
Lower		365.57	ASB Bridge									
Lower	Lower Missouri	365.6	10%	10	245,000	739.7	740.3	0.00013	6.3	39,275	1,327	0.19
Lower	Lower Missouri	365.6	1%	100	401,000	748.7	749.7	0.00016	8.1	51,683	1,398	0.21
Lower	Lower Missouri	365.6	0.5%	200	454,000	751.1	752.3	0.00017	8.7	55,038	1,411	0.22
Lower	Lower Missouri	365.6	0.2%	500	530,000	754.3	755.7	0.00019	9.5	59,574	1,442	0.24
Lower	Lower Missouri	365.6	0.133%	750	565,000	755.6	757.1	0.00020	9.8	61,503	1,470	0.24
Lower	Lower Missouri	365.6	0.100%	1000	590,000	756.6	758.1	0.00020	10.0	62,927	1,482	0.24
Lower	Lower Missouri	365.6	0.080%	1250	610,000	757.3	758.9	0.00020	10.2	64,042	1,491	0.25
Lower	Lower Missouri	365.6	0.067%	1500	625,000	757.9	759.5	0.00021	10.3	64,876	1,498	0.25
Lower	Lower Missouri	365.84	10%	10	245,000	739.8	740.5	0.00020	7.1	35,196	1,365	0.22
Lower	Lower Missouri	365.84	1%	100	401,000	748.8	750.0	0.00022	8.9	48,071	1,467	0.25
Lower	Lower Missouri	365.84	0.5%	200	454,000	751.2	752.6	0.00023	9.4	51,629	1,553	0.25
Lower	Lower Missouri	365.84	0.2%	500	530,000	754.4	756.0	0.00024	10.2	56,643	1,568	0.26
Lower	Lower Missouri	365.84	0.133%	750	565,000	755.8	757.4	0.00025	10.5	58,735	1,572	0.27
Lower	Lower Missouri	365.84	0.100%	1000	590,000	756.7	758.5	0.00025	10.7	60,262	1,575	0.27
Lower	Lower Missouri	365.84	0.080%	1250	610,000	757.5	759.3	0.00026	10.9	61,450	1,582	0.27
Lower	Lower Missouri	365.84	0.067%	1500	625,000	758.1	759.9	0.00026	11.0	62,340	1,587	0.28
Lower	Lower Missouri	366.06	10%	10	245,000	739.9	740.9	0.00026	8.1	31,392	1,350	0.25
Lower	Lower Missouri	366.06	1%	100	401,000	748.9	750.4	0.00028	10.0	43,894	1,416	0.28
Lower	Lower Missouri	366.06	0.5%	200	454,000	751.3	753.0	0.00029	10.6	47,290	1,424	0.29
Lower	Lower Missouri	366.06	0.2%	500	530,000	754.5	756.4	0.00031	11.4	51,856	1,434	0.30
Lower	Lower Missouri	366.06	0.133%	750	565,000	755.8	757.9	0.00032	11.8	53,761	1,439	0.30
Lower	Lower Missouri	366.06	0.100%	1000	590,000	756.8	758.9	0.00032	12.0	55,150	1,442	0.31
Lower	Lower Missouri	366.06	0.080%	1250	610,000	757.5	759.7	0.00032	12.2	56,233	1,445	0.31
Lower	Lower Missouri	366.06	0.067%	1500	625,000	758.1	760.4	0.00033	12.4	57,040	1,446	0.31
Lower	Lower Missouri	366.121*	10%	10	245,000	739.9	741.0	0.00028	8.4	30,335	1,350	0.27
Lower	Lower Missouri	366.121*	1%	100	401,000	749.0	750.5	0.00030	10.3	42,886	1,432	0.29
Lower	Lower Missouri	366.121*	0.5%	200	454,000	751.3	753.1	0.00031	10.9	46,324	1,440	0.30
Lower	Lower Missouri	366.121*	0.2%	500	530,000	754.5	756.6	0.00033	11.7	50,946	1,451	0.31
Lower	Lower Missouri	366.121*	0.133%	750	565,000	755.9	758.0	0.00034	12.1	52,876	1,456	0.31
Lower	Lower Missouri	366.121*	0.100%	1000	590,000	756.8	759.1	0.00034	12.3	54,283	1,459	0.32
Lower	Lower Missouri	366.121*	0.080%	1250	610,000	757.6	759.9	0.00034	12.5	55,380	1,461	0.32
Lower	Lower Missouri	366.121*	0.067%	1500	625,000	758.1	760.5	0.00035	12.7	56,197	1,464	0.32
Lower		366.124	Hannibal Bridge									
Lower	Lower Missouri	366.14	10%	10	245,000	740.0	741.2	0.00029	8.5	30,155	1,357	0.27
Lower	Lower Missouri	366.14	1%	100	401,000	749.1	750.7	0.00031	10.4	42,762	1,441	0.29
Lower	Lower Missouri	366.14	0.5%	200	454,000	751.5	753.3	0.00032	11.1	46,233	1,450	0.30
Lower	Lower Missouri	366.14	0.2%	500	530,000	754.7	756.8	0.00034	11.9	50,899	1,461	0.31
Lower	Lower Missouri	366.14	0.133%	750	565,000	756.0	758.3	0.00035	12.3	52,848	1,465	0.32
Lower	Lower Missouri	366.14	0.100%	1000	590,000	757.0	759.3	0.00035	12.5	54,266	1,469	0.32
Lower	Lower Missouri	366.14	0.080%	1250	610,000	757.8	760.2	0.00035	12.7	55,461	1,471	0.32
Lower	Lower Missouri	366.14	0.067%	1500	625,000	758.4	760.8	0.00035	12.8	56,341	1,474	0.32
Lower	Lower Missouri	366.180*	10%	10	245,000	740.1	741.2	0.00033	8.8	29,156	1,351	0.29
Lower	Lower Missouri	366.180*	1%	100	401,000	749.1	750.8	0.00034	10.7	41,966	1,462	0.30
Lower	Lower Missouri	366.180*	0.5%	200	454,000	751.5	753.4	0.00035	11.3	45,493	1,467	0.31
Lower	Lower Missouri	366.180*	0.2%	500	530,000	754.7	756.9	0.00036	12.1	50,206	1,467	0.32
Lower	Lower Missouri	366.180*	0.133%	750	565,000	756.1	758.4	0.00037	12.5	52,165	1,467	0.33
Lower	Lower Missouri	366.180*	0.100%	1000	590,000	757.0	759.4	0.00038	12.7	53,585	1,467	0.33
Lower	Lower Missouri	366.180*	0.080%	1250	610,000	757.9	760.3	0.00038	12.9	54,780	1,467	0.33
Lower	Lower Missouri	366.180*	0.067%	1500	625,000	758.5	760.9	0.00038	13.0	55,658	1,467	0.33

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Lower		366.183	Broadway Bridge									
Lower	Lower Missouri	366.2	10%	10	245,000	740.3	741.3	0.00028	8.1	31,592	1,362	0.26
Lower	Lower Missouri	366.2	1%	100	401,000	749.4	750.9	0.00030	9.9	44,528	1,445	0.28
Lower	Lower Missouri	366.2	0.5%	200	454,000	751.9	753.5	0.00031	10.5	48,083	1,469	0.28
Lower	Lower Missouri	366.2	0.2%	500	530,000	755.1	757.0	0.00033	11.3	52,848	1,469	0.29
Lower	Lower Missouri	366.2	0.133%	750	565,000	756.5	758.5	0.00033	11.7	54,832	1,469	0.30
Lower	Lower Missouri	366.2	0.100%	1000	590,000	757.4	759.5	0.00034	11.9	56,268	1,469	0.30
Lower	Lower Missouri	366.2	0.080%	1250	610,000	758.3	760.4	0.00034	12.1	57,473	1,469	0.30
Lower	Lower Missouri	366.2	0.067%	1500	625,000	758.9	761.1	0.00034	12.2	58,359	1,469	0.31
Lower	Lower Missouri	366.23	10%	10	245,000	740.5	741.4	0.00025	7.7	33,139	1,392	0.24
Lower	Lower Missouri	366.23	1%	100	401,000	749.6	751.0	0.00027	9.4	46,195	1,448	0.26
Lower	Lower Missouri	366.23	0.5%	200	454,000	752.1	753.6	0.00028	10.0	49,774	1,469	0.27
Lower	Lower Missouri	366.23	0.2%	500	530,000	755.3	757.1	0.00030	10.8	54,568	1,469	0.28
Lower	Lower Missouri	366.23	0.133%	750	565,000	756.7	758.5	0.00030	11.1	56,568	1,469	0.28
Lower	Lower Missouri	366.23	0.100%	1000	590,000	757.7	759.6	0.00031	11.3	58,014	1,469	0.29
Lower	Lower Missouri	366.23	0.080%	1250	610,000	758.5	760.5	0.00031	11.5	59,225	1,469	0.29
Lower	Lower Missouri	366.23	0.067%	1500	625,000	759.1	761.1	0.00031	11.6	60,116	16,798	0.29
Lower	Lower Missouri	366.48	10%	10	245,000	740.9	741.7	0.00020	7.1	37,812	1,580	0.22
Lower	Lower Missouri	366.48	1%	100	401,000	750.2	751.3	0.00022	8.7	52,814	1,666	0.24
Lower	Lower Missouri	366.48	0.5%	200	454,000	752.7	753.9	0.00023	9.2	56,979	1,675	0.24
Lower	Lower Missouri	366.48	0.2%	500	530,000	756.0	757.5	0.00024	9.8	62,575	1,686	0.25
Lower	Lower Missouri	366.48	0.133%	750	565,000	757.4	758.9	0.00024	10.1	64,928	1,690	0.26
Lower	Lower Missouri	366.48	0.100%	1000	590,000	758.4	760.0	0.00024	10.4	66,630	1,694	0.26
Lower	Lower Missouri	366.48	0.080%	1250	610,000	759.3	760.9	0.00025	10.5	68,052	1,696	0.26
Lower	Lower Missouri	366.48	0.067%	1500	625,000	759.9	761.5	0.00025	10.6	69,101	2,279	0.26
Lower	Lower Missouri	366.75	10%	10	245,000	741.3	742.0	0.00016	6.5	41,665	1,890	0.20
Lower	Lower Missouri	366.75	1%	100	401,000	750.7	751.6	0.00017	7.9	59,769	1,972	0.21
Lower	Lower Missouri	366.75	0.5%	200	454,000	753.2	754.2	0.00018	8.4	64,780	1,981	0.22
Lower	Lower Missouri	366.75	0.2%	500	530,000	756.6	757.8	0.00018	9.0	71,515	1,992	0.22
Lower	Lower Missouri	366.75	0.133%	750	565,000	758.1	759.3	0.00019	9.2	74,353	1,996	0.23
Lower	Lower Missouri	366.75	0.100%	1000	590,000	759.1	760.3	0.00019	9.4	76,403	2,000	0.23
Lower	Lower Missouri	366.75	0.080%	1250	610,000	759.9	761.2	0.00019	9.5	78,109	2,441	0.23
Lower	Lower Missouri	366.75	0.067%	1500	625,000	760.6	761.9	0.00019	9.6	79,367	2,443	0.23
Lower	Lower Missouri	367.04	10%	10	245,000	741.5	742.3	0.00020	7.2	37,461	1,974	0.22
Lower	Lower Missouri	367.04	1%	100	401,000	750.9	751.9	0.00021	8.5	57,769	2,204	0.23
Lower	Lower Missouri	367.04	0.5%	200	454,000	753.4	754.6	0.00021	8.9	63,564	2,364	0.23
Lower	Lower Missouri	367.04	0.2%	500	530,000	756.9	758.1	0.00021	9.4	71,862	2,459	0.24
Lower	Lower Missouri	367.04	0.133%	750	565,000	758.3	759.6	0.00021	9.6	75,393	2,463	0.24
Lower	Lower Missouri	367.04	0.100%	1000	590,000	759.3	760.6	0.00021	9.8	77,942	2,467	0.24
Lower	Lower Missouri	367.04	0.080%	1250	610,000	760.2	761.5	0.00021	9.9	80,061	3,023	0.24
Lower	Lower Missouri	367.04	0.067%	1500	625,000	760.8	762.2	0.00021	10.0	81,623	3,025	0.24
Upper	Lower Missouri	367.57	10%	10	168,000	741.8	742.3	0.00013	5.2	34,898	2,071	0.18
Upper	Lower Missouri	367.57	1%	100	261,000	751.5	751.9	0.00010	5.6	58,570	2,531	0.18
Upper	Lower Missouri	367.57	0.5%	200	295,000	754.1	754.6	0.00010	5.8	65,201	2,573	0.18
Upper	Lower Missouri	367.57	0.2%	500	348,000	757.6	758.1	0.00010	6.2	74,283	2,660	0.18
Upper	Lower Missouri	367.57	0.133%	750	374,000	759.0	759.6	0.00010	6.4	78,206	2,723	0.19
Upper	Lower Missouri	367.57	0.100%	1000	390,000	760.1	760.6	0.00010	6.4	81,122	2,797	0.19
Upper	Lower Missouri	367.57	0.080%	1250	403,000	760.9	761.5	0.00010	6.5	83,575	3,953	0.19
Upper	Lower Missouri	367.57	0.067%	1500	414,000	761.6	762.2	0.00010	6.5	85,381	19,376	0.19
Upper	Lower Missouri	367.89	10%	10	168,000	741.9	742.6	0.00017	6.3	27,613	1,579	0.20
Upper	Lower Missouri	367.89	1%	100	261,000	751.5	752.2	0.00015	7.0	45,227	1,928	0.20
Upper	Lower Missouri	367.89	0.5%	200	295,000	754.1	754.8	0.00015	7.3	50,238	1,950	0.20
Upper	Lower Missouri	367.89	0.2%	500	348,000	757.5	758.4	0.00015	7.8	57,004	1,979	0.20
Upper	Lower Missouri	367.89	0.133%	750	374,000	759.0	759.9	0.00016	8.0	59,873	1,991	0.21
Upper	Lower Missouri	367.89	0.100%	1000	390,000	760.0	760.9	0.00016	8.1	61,963	1,999	0.21

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	367.89	0.080%	1250	403,000	760.9	761.8	0.00016	8.2	63,698	3,727	0.21
Upper	Lower Missouri	367.89	0.067%	1500	414,000	761.5	762.5	0.00016	8.3	64,973	3,755	0.21
Upper	Lower Missouri	368.19	10%	10	168,000	742.2	742.9	0.00020	6.5	26,987	1,364	0.21
Upper	Lower Missouri	368.19	1%	100	261,000	751.7	752.5	0.00017	7.3	42,159	1,702	0.21
Upper	Lower Missouri	368.19	0.5%	200	295,000	754.3	755.1	0.00017	7.6	46,591	1,739	0.21
Upper	Lower Missouri	368.19	0.2%	500	348,000	757.7	758.6	0.00017	8.1	52,650	1,787	0.21
Upper	Lower Missouri	368.19	0.133%	750	374,000	759.2	760.1	0.00018	8.3	55,247	1,808	0.22
Upper	Lower Missouri	368.19	0.100%	1000	390,000	760.2	761.2	0.00018	8.5	57,151	1,835	0.22
Upper	Lower Missouri	368.19	0.080%	1250	403,000	761.1	762.1	0.00018	8.5	58,736	4,152	0.22
Upper	Lower Missouri	368.19	0.067%	1500	414,000	761.7	762.7	0.00018	8.6	59,899	17,862	0.22
Upper	Lower Missouri	368.48	10%	10	168,000	742.6	743.1	0.00013	5.7	31,321	1,587	0.18
Upper	Lower Missouri	368.48	1%	100	261,000	752.1	752.7	0.00012	6.5	46,607	1,650	0.18
Upper	Lower Missouri	368.48	0.5%	200	295,000	754.7	755.3	0.00012	6.9	50,883	1,667	0.18
Upper	Lower Missouri	368.48	0.2%	500	348,000	758.1	758.9	0.00013	7.4	56,672	1,693	0.19
Upper	Lower Missouri	368.48	0.133%	750	374,000	759.6	760.4	0.00013	7.7	59,142	1,708	0.19
Upper	Lower Missouri	368.48	0.100%	1000	390,000	760.6	761.5	0.00014	7.8	60,927	1,742	0.19
Upper	Lower Missouri	368.48	0.080%	1250	403,000	761.5	762.3	0.00014	7.9	62,428	1,752	0.19
Upper	Lower Missouri	368.48	0.067%	1500	414,000	762.1	763.0	0.00014	8.0	63,539	5,220	0.20
Upper	Lower Missouri	368.73	10%	10	168,000	742.9	743.3	0.00010	5.2	33,786	1,583	0.16
Upper	Lower Missouri	368.73	1%	100	261,000	752.3	752.9	0.00010	6.1	49,049	1,651	0.16
Upper	Lower Missouri	368.73	0.5%	200	295,000	754.9	755.5	0.00010	6.4	53,339	1,669	0.17
Upper	Lower Missouri	368.73	0.2%	500	348,000	758.4	759.1	0.00011	6.9	59,163	1,694	0.17
Upper	Lower Missouri	368.73	0.133%	750	374,000	759.8	760.6	0.00011	7.2	61,651	1,705	0.18
Upper	Lower Missouri	368.73	0.100%	1000	390,000	760.9	761.6	0.00012	7.3	63,439	1,729	0.18
Upper	Lower Missouri	368.73	0.080%	1250	403,000	761.7	762.5	0.00012	7.4	64,931	1,739	0.18
Upper	Lower Missouri	368.73	0.067%	1500	414,000	762.4	763.2	0.00012	7.5	66,037	17,114	0.18
Upper	Lower Missouri	369.05	10%	10	168,000	743.0	743.5	0.00016	5.9	29,269	1,444	0.19
Upper	Lower Missouri	369.05	1%	100	261,000	752.4	753.1	0.00014	6.7	44,019	1,606	0.19
Upper	Lower Missouri	369.05	0.5%	200	295,000	755.0	755.7	0.00014	7.0	48,196	1,625	0.19
Upper	Lower Missouri	369.05	0.2%	500	348,000	758.5	759.3	0.00015	7.6	53,923	1,691	0.20
Upper	Lower Missouri	369.05	0.133%	750	374,000	759.9	760.8	0.00015	7.8	56,416	1,703	0.20
Upper	Lower Missouri	369.05	0.100%	1000	390,000	761.0	761.9	0.00015	7.9	58,201	1,707	0.20
Upper	Lower Missouri	369.05	0.080%	1250	403,000	761.8	762.8	0.00015	8.0	59,672	11,291	0.20
Upper	Lower Missouri	369.05	0.067%	1500	414,000	762.5	763.4	0.00015	8.1	60,764	17,162	0.20
Upper	Lower Missouri	369.38	10%	10	168,000	743.3	743.8	0.00017	6.1	28,778	1,459	0.20
Upper	Lower Missouri	369.38	1%	100	261,000	752.7	753.4	0.00015	6.8	45,086	1,798	0.19
Upper	Lower Missouri	369.38	0.5%	200	295,000	755.3	756.0	0.00015	7.1	49,768	1,815	0.20
Upper	Lower Missouri	369.38	0.2%	500	348,000	758.7	759.6	0.00015	7.6	56,134	1,839	0.20
Upper	Lower Missouri	369.38	0.133%	750	374,000	760.2	761.1	0.00015	7.9	58,859	1,849	0.20
Upper	Lower Missouri	369.38	0.100%	1000	390,000	761.3	762.2	0.00015	8.0	60,804	1,867	0.20
Upper	Lower Missouri	369.38	0.080%	1250	403,000	762.1	763.1	0.00015	8.1	62,418	1,875	0.20
Upper	Lower Missouri	369.38	0.067%	1500	414,000	762.8	763.7	0.00015	8.2	63,618	8,471	0.21
Upper	Upper Missouri	369.66	10%	10	192,000	743.6	744.3	0.00020	6.8	31,236	1,689	0.22
Upper	Lower Missouri	369.66	1%	100	261,000	752.9	753.6	0.00014	6.7	47,531	1,785	0.19
Upper	Lower Missouri	369.66	0.5%	200	295,000	755.5	756.2	0.00014	7.0	52,184	1,803	0.19
Upper	Lower Missouri	369.66	0.2%	500	348,000	759.0	759.8	0.00014	7.5	58,526	1,828	0.19
Upper	Lower Missouri	369.66	0.133%	750	374,000	760.5	761.3	0.00014	7.8	61,247	1,839	0.20
Upper	Lower Missouri	369.66	0.100%	1000	390,000	761.5	762.4	0.00014	7.9	63,185	1,864	0.20
Upper	Lower Missouri	369.66	0.080%	1250	403,000	762.4	763.3	0.00014	8.0	64,809	7,745	0.20
Upper	Lower Missouri	369.66	0.067%	1500	414,000	763.0	763.9	0.00014	8.1	66,042	7,748	0.20
Upper	Upper Missouri	369.96	10%	10	192,000	743.8	744.7	0.00029	7.8	28,230	1,645	0.26
Upper	Lower Missouri	369.96	1%	100	261,000	753.1	753.9	0.00018	7.5	43,630	1,688	0.21
Upper	Lower Missouri	369.96	0.5%	200	295,000	755.7	756.5	0.00018	7.8	48,021	1,700	0.22
Upper	Lower Missouri	369.96	0.2%	500	348,000	759.2	760.1	0.00018	8.2	53,988	1,717	0.22
Upper	Lower Missouri	369.96	0.133%	750	374,000	760.6	761.6	0.00019	8.5	56,544	1,723	0.22

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	369.96	0.100%	1000	390,000	761.7	762.7	0.00018	8.6	58,355	1,732	0.22
Upper	Lower Missouri	369.96	0.080%	1250	403,000	762.5	763.6	0.00018	8.7	59,851	1,785	0.22
Upper	Lower Missouri	369.96	0.067%	1500	414,000	763.2	764.2	0.00018	8.8	60,999	6,190	0.22
Upper	Upper Missouri	370.26	10%	10	192,000	744.4	745.2	0.00027	7.3	29,970	1,675	0.25
Upper	Upper Missouri	370.26	1%	100	287,000	753.5	754.3	0.00020	7.7	45,415	1,726	0.22
Upper	Lower Missouri	370.26	0.5%	200	295,000	756.1	756.8	0.00017	7.3	49,884	1,739	0.21
Upper	Lower Missouri	370.26	0.2%	500	348,000	759.6	760.4	0.00017	7.7	56,016	1,756	0.21
Upper	Lower Missouri	370.26	0.133%	750	374,000	761.1	761.9	0.00017	7.9	58,653	1,763	0.21
Upper	Lower Missouri	370.26	0.100%	1000	390,000	762.1	763.0	0.00017	8.0	60,508	1,769	0.21
Upper	Lower Missouri	370.26	0.080%	1250	403,000	763.0	763.9	0.00017	8.1	62,029	1,780	0.21
Upper	Lower Missouri	370.26	0.067%	1500	414,000	763.6	764.5	0.00017	8.2	63,179	1,787	0.21
Upper	Upper Missouri	370.54	10%	10	192,000	744.9	745.5	0.00020	6.6	32,272	1,642	0.21
Upper	Upper Missouri	370.54	1%	100	287,000	753.8	754.6	0.00016	7.2	48,083	1,934	0.20
Upper	Lower Missouri	370.54	0.5%	200	295,000	756.3	757.0	0.00014	6.8	53,036	1,982	0.19
Upper	Lower Missouri	370.54	0.2%	500	348,000	759.9	760.6	0.00014	7.2	60,053	2,007	0.19
Upper	Lower Missouri	370.54	0.133%	750	374,000	761.4	762.1	0.00014	7.5	63,086	2,018	0.19
Upper	Lower Missouri	370.54	0.100%	1000	390,000	762.4	763.2	0.00014	7.6	65,213	2,025	0.19
Upper	Lower Missouri	370.54	0.080%	1250	403,000	763.3	764.1	0.00014	7.6	66,967	3,458	0.19
Upper	Lower Missouri	370.54	0.067%	1500	414,000	763.9	764.7	0.00014	7.7	68,294	3,505	0.19
Upper	Upper Missouri	370.83	10%	10	192,000	745.3	745.8	0.00017	6.2	40,099	2,963	0.20
Upper	Upper Missouri	370.83	1%	100	287,000	754.3	754.8	0.00012	6.4	64,209	3,141	0.18
Upper	Lower Missouri	370.83	0.5%	200	295,000	756.7	757.2	0.00010	6.0	70,978	3,221	0.16
Upper	Lower Missouri	370.83	0.2%	500	348,000	760.3	760.8	0.00010	6.3	80,839	3,248	0.16
Upper	Lower Missouri	370.83	0.133%	750	374,000	761.8	762.3	0.00010	6.4	85,095	3,259	0.17
Upper	Lower Missouri	370.83	0.100%	1000	390,000	762.9	763.4	0.00010	6.5	88,055	3,272	0.17
Upper	Lower Missouri	370.83	0.080%	1250	403,000	763.8	764.3	0.00010	6.5	90,486	3,274	0.16
Upper	Lower Missouri	370.83	0.067%	1500	414,000	764.4	764.9	0.00010	6.6	92,319	11,848	0.17
Upper	Upper Missouri	371.14	10%	10	192,000	745.5	746.1	0.00016	6.5	38,791	3,429	0.20
Upper	Upper Missouri	371.14	1%	100	287,000	754.4	755.0	0.00013	6.6	63,438	3,735	0.18
Upper	Lower Missouri	371.14	0.5%	200	295,000	756.9	757.4	0.00010	6.2	70,342	3,761	0.16
Upper	Lower Missouri	371.14	0.2%	500	348,000	760.4	760.9	0.00010	6.5	80,510	3,802	0.16
Upper	Lower Missouri	371.14	0.133%	750	374,000	762.0	762.5	0.00010	6.7	84,900	3,813	0.17
Upper	Lower Missouri	371.14	0.100%	1000	390,000	763.0	763.6	0.00010	6.7	87,946	3,825	0.17
Upper	Lower Missouri	371.14	0.080%	1250	403,000	763.9	764.4	0.00010	6.8	90,448	3,831	0.17
Upper	Lower Missouri	371.14	0.067%	1500	414,000	764.6	765.1	0.00010	6.8	92,337	3,833	0.17
Upper	Upper Missouri	371.47	10%	10	192,000	745.9	746.4	0.00018	6.2	40,202	3,762	0.20
Upper	Upper Missouri	371.47	1%	100	287,000	754.8	755.2	0.00012	6.0	68,553	4,172	0.17
Upper	Lower Missouri	371.47	0.5%	200	295,000	757.1	757.5	0.00010	5.6	76,234	4,203	0.16
Upper	Lower Missouri	371.47	0.2%	500	348,000	760.7	761.1	0.00009	5.8	87,780	4,352	0.16
Upper	Lower Missouri	371.47	0.133%	750	374,000	762.3	762.7	0.00009	6.0	92,769	4,361	0.16
Upper	Lower Missouri	371.47	0.100%	1000	390,000	763.3	763.7	0.00009	6.0	96,218	4,367	0.16
Upper	Lower Missouri	371.47	0.080%	1250	403,000	764.2	764.6	0.00009	6.0	99,048	4,380	0.16
Upper	Lower Missouri	371.47	0.067%	1500	414,000	764.8	765.3	0.00009	6.1	101,189	4,381	0.16
Upper	Upper Missouri	371.83	10%	10	192,000	746.1	746.8	0.00016	6.5	35,952	2,774	0.20
Upper	Upper Missouri	371.83	1%	100	287,000	754.9	755.5	0.00013	6.7	65,977	3,825	0.18
Upper	Lower Missouri	371.83	0.5%	200	295,000	757.3	757.8	0.00010	6.2	75,031	3,852	0.16
Upper	Lower Missouri	371.83	0.2%	500	348,000	760.8	761.3	0.00010	6.4	88,863	3,892	0.16
Upper	Lower Missouri	371.83	0.133%	750	374,000	762.4	762.9	0.00010	6.5	94,877	3,911	0.16
Upper	Lower Missouri	371.83	0.100%	1000	390,000	763.4	763.9	0.00009	6.5	99,039	3,924	0.16
Upper	Lower Missouri	371.83	0.080%	1250	403,000	764.3	764.8	0.00009	6.5	102,454	3,941	0.16
Upper	Lower Missouri	371.83	0.067%	1500	414,000	765.0	765.4	0.00009	6.6	105,048	3,947	0.16
Upper	Upper Missouri	372.13	10%	10	192,000	746.4	747.1	0.00022	6.9	34,744	2,929	0.22
Upper	Upper Missouri	372.13	1%	100	287,000	755.2	755.7	0.00014	6.6	68,520	4,188	0.19
Upper	Lower Missouri	372.13	0.5%	200	295,000	757.5	757.9	0.00011	6.1	78,251	4,201	0.17
Upper	Lower Missouri	372.13	0.2%	500	348,000	761.1	761.5	0.00010	6.2	93,311	4,223	0.16

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	372.13	0.133%	750	374,000	762.6	763.0	0.00010	6.2	99,831	4,264	0.16
Upper	Lower Missouri	372.13	0.100%	1000	390,000	763.7	764.1	0.00010	6.2	104,383	4,304	0.16
Upper	Lower Missouri	372.13	0.080%	1250	403,000	764.5	764.9	0.00009	6.2	108,123	4,309	0.16
Upper	Lower Missouri	372.13	0.067%	1500	414,000	765.2	765.6	0.00009	6.3	110,958	4,309	0.16
Upper	Upper Missouri	372.47	10%	10	192,000	746.9	747.4	0.00015	6.0	36,812	1,848	0.19
Upper	Upper Missouri	372.47	1%	100	287,000	755.4	756.0	0.00013	6.7	52,918	1,930	0.18
Upper	Upper Missouri	372.47	0.5%	200	316,000	757.6	758.3	0.00013	6.9	57,287	1,944	0.18
Upper	Lower Missouri	372.47	0.2%	500	348,000	761.1	761.8	0.00012	6.8	64,173	1,967	0.18
Upper	Lower Missouri	372.47	0.133%	750	374,000	762.7	763.3	0.00012	7.0	67,177	1,979	0.18
Upper	Lower Missouri	372.47	0.100%	1000	390,000	763.7	764.4	0.00012	7.1	69,256	1,990	0.18
Upper	Lower Missouri	372.47	0.080%	1250	403,000	764.6	765.3	0.00012	7.2	70,963	1,993	0.18
Upper	Lower Missouri	372.47	0.067%	1500	414,000	765.2	765.9	0.00012	7.3	72,258	1,995	0.18
Upper	Upper Missouri	372.562*	10%	10	192,000	746.9	747.5	0.00018	6.3	33,164	1,574	0.21
Upper	Upper Missouri	372.562*	1%	100	287,000	755.4	756.1	0.00016	7.0	47,017	1,677	0.20
Upper	Upper Missouri	372.562*	0.5%	200	316,000	757.6	758.4	0.00016	7.2	50,806	1,691	0.20
Upper	Lower Missouri	372.562*	0.2%	500	348,000	761.2	761.9	0.00014	7.2	56,795	1,728	0.19
Upper	Lower Missouri	372.562*	0.133%	750	374,000	762.7	763.5	0.00014	7.4	59,432	1,738	0.20
Upper	Lower Missouri	372.562*	0.100%	1000	390,000	763.7	764.5	0.00014	7.5	61,250	1,741	0.20
Upper	Lower Missouri	372.562*	0.080%	1250	403,000	764.6	765.4	0.00014	7.6	62,740	1,744	0.20
Upper	Lower Missouri	372.562*	0.067%	1500	414,000	765.2	766.1	0.00014	7.7	63,872	1,746	0.20
Upper		372.567	Bridge (northbound)									
Upper	Upper Missouri	372.577*	10%	10	192,000	747.0	747.6	0.00019	6.4	32,955	1,621	0.21
Upper	Upper Missouri	372.577*	1%	100	287,000	755.4	756.2	0.00017	7.0	47,178	1,719	0.20
Upper	Upper Missouri	372.577*	0.5%	200	316,000	757.7	758.4	0.00016	7.2	51,067	1,732	0.20
Upper	Lower Missouri	372.577*	0.2%	500	348,000	761.2	761.9	0.00014	7.2	57,186	1,753	0.19
Upper	Lower Missouri	372.577*	0.133%	750	374,000	762.7	763.5	0.00014	7.4	59,864	1,762	0.20
Upper	Lower Missouri	372.577*	0.100%	1000	390,000	763.8	764.6	0.00014	7.5	61,710	1,768	0.20
Upper	Lower Missouri	372.577*	0.080%	1250	403,000	764.6	765.4	0.00014	7.6	63,224	1,774	0.20
Upper	Lower Missouri	372.577*	0.067%	1500	414,000	765.3	766.1	0.00014	7.7	64,377	1,776	0.20
Upper	Upper Missouri	372.58	10%	10	192,000	747.0	747.6	0.00020	6.4	32,825	1,628	0.21
Upper	Upper Missouri	372.58	1%	100	287,000	755.4	756.2	0.00017	7.0	47,101	1,725	0.20
Upper	Upper Missouri	372.58	0.5%	200	316,000	757.7	758.4	0.00016	7.2	51,004	1,738	0.20
Upper	Lower Missouri	372.58	0.2%	500	348,000	761.2	761.9	0.00014	7.2	57,145	1,759	0.19
Upper	Lower Missouri	372.58	0.133%	750	374,000	762.7	763.5	0.00014	7.4	59,832	1,767	0.20
Upper	Lower Missouri	372.58	0.100%	1000	390,000	763.8	764.6	0.00014	7.5	61,687	1,781	0.20
Upper	Lower Missouri	372.58	0.080%	1250	403,000	764.6	765.4	0.00014	7.6	63,216	1,793	0.20
Upper	Lower Missouri	372.58	0.067%	1500	414,000	765.3	766.1	0.00014	7.7	64,380	1,796	0.20
Upper	Upper Missouri	372.584*	10%	10	192,000	747.0	747.6	0.00020	6.4	32,552	1,610	0.21
Upper	Upper Missouri	372.584*	1%	100	287,000	755.4	756.2	0.00017	7.1	46,646	1,709	0.21
Upper	Upper Missouri	372.584*	0.5%	200	316,000	757.7	758.5	0.00017	7.3	50,512	1,723	0.21
Upper	Lower Missouri	372.584*	0.2%	500	348,000	761.2	761.9	0.00015	7.2	56,600	1,745	0.20
Upper	Lower Missouri	372.584*	0.133%	750	374,000	762.7	763.5	0.00015	7.4	59,267	1,754	0.20
Upper	Lower Missouri	372.584*	0.100%	1000	390,000	763.8	764.6	0.00015	7.5	61,102	1,757	0.20
Upper	Lower Missouri	372.584*	0.080%	1250	403,000	764.6	765.4	0.00015	7.6	62,607	1,760	0.20
Upper	Lower Missouri	372.584*	0.067%	1500	414,000	765.3	766.1	0.00015	7.7	63,750	1,762	0.20
Upper		372.585	Bridge (southbound)									
Upper	Upper Missouri	372.597*	10%	10	192,000	747.0	747.7	0.00019	6.4	32,670	1,559	0.21
Upper	Upper Missouri	372.597*	1%	100	287,000	755.5	756.2	0.00017	7.0	46,267	1,637	0.20
Upper	Upper Missouri	372.597*	0.5%	200	316,000	757.8	758.5	0.00016	7.2	49,967	1,656	0.20
Upper	Lower Missouri	372.597*	0.2%	500	348,000	761.3	762.0	0.00014	7.2	55,851	1,695	0.19
Upper	Lower Missouri	372.597*	0.133%	750	374,000	762.8	763.6	0.00015	7.4	58,438	1,699	0.20
Upper	Lower Missouri	372.597*	0.100%	1000	390,000	763.8	764.6	0.00015	7.6	60,215	1,703	0.20
Upper	Lower Missouri	372.597*	0.080%	1250	403,000	764.7	765.5	0.00015	7.6	61,671	1,705	0.20
Upper	Lower Missouri	372.597*	0.067%	1500	414,000	765.3	766.2	0.00015	7.7	62,778	1,707	0.20

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Upper Missouri	372.61	10%	10	192,000	747.1	747.7	0.00016	6.0	35,576	1,830	0.19
Upper	Upper Missouri	372.61	1%	100	287,000	755.6	756.3	0.00014	6.6	51,598	1,919	0.19
Upper	Upper Missouri	372.61	0.5%	200	316,000	757.9	758.6	0.00014	6.8	55,958	1,933	0.19
Upper	Lower Missouri	372.61	0.2%	500	348,000	761.4	762.0	0.00012	6.7	62,776	1,955	0.18
Upper	Lower Missouri	372.61	0.133%	750	374,000	762.9	763.6	0.00012	6.9	65,792	1,972	0.18
Upper	Lower Missouri	372.61	0.100%	1000	390,000	764.0	764.7	0.00012	7.0	67,870	1,989	0.18
Upper	Lower Missouri	372.61	0.080%	1250	403,000	764.9	765.6	0.00012	7.1	69,582	1,993	0.18
Upper	Lower Missouri	372.61	0.067%	1500	414,000	765.5	766.2	0.00012	7.2	70,886	1,995	0.18
Upper	Upper Missouri	372.86	10%	10	192,000	747.3	747.9	0.00016	6.1	35,837	1,961	0.19
Upper	Upper Missouri	372.86	1%	100	287,000	755.8	756.5	0.00014	6.8	52,912	2,048	0.19
Upper	Upper Missouri	372.86	0.5%	200	316,000	758.1	758.7	0.00014	7.0	57,556	2,062	0.19
Upper	Lower Missouri	372.86	0.2%	500	348,000	761.6	762.2	0.00012	6.9	64,792	2,085	0.18
Upper	Lower Missouri	372.86	0.133%	750	374,000	763.1	763.8	0.00012	7.1	68,007	2,095	0.18
Upper	Lower Missouri	372.86	0.100%	1000	390,000	764.1	764.9	0.00012	7.2	70,215	2,114	0.18
Upper	Lower Missouri	372.86	0.080%	1250	403,000	765.0	765.7	0.00012	7.3	72,035	2,120	0.18
Upper	Lower Missouri	372.86	0.067%	1500	414,000	765.7	766.4	0.00012	7.4	73,422	2,122	0.18
Upper	Upper Missouri	373.15	10%	10	192,000	747.6	748.1	0.00015	5.9	37,608	1,897	0.19
Upper	Upper Missouri	373.15	1%	100	287,000	756.1	756.7	0.00013	6.6	53,947	1,967	0.18
Upper	Upper Missouri	373.15	0.5%	200	316,000	758.3	759.0	0.00013	6.7	58,394	1,983	0.18
Upper	Lower Missouri	373.15	0.2%	500	348,000	761.8	762.4	0.00012	6.7	65,291	2,007	0.18
Upper	Lower Missouri	373.15	0.133%	750	374,000	763.3	764.0	0.00012	6.9	68,392	2,022	0.18
Upper	Lower Missouri	373.15	0.100%	1000	390,000	764.4	765.0	0.00012	7.0	70,519	2,029	0.18
Upper	Lower Missouri	373.15	0.080%	1250	403,000	765.2	765.9	0.00012	7.1	72,262	2,032	0.18
Upper	Lower Missouri	373.15	0.067%	1500	414,000	765.9	766.6	0.00012	7.2	73,592	2,034	0.18
Upper	Upper Missouri	373.46	10%	10	192,000	747.9	748.4	0.00011	5.3	42,062	1,907	0.16
Upper	Upper Missouri	373.46	1%	100	287,000	756.4	756.9	0.00010	6.0	58,311	1,946	0.16
Upper	Upper Missouri	373.46	0.5%	200	316,000	758.6	759.1	0.00010	6.2	62,695	1,954	0.16
Upper	Lower Missouri	373.46	0.2%	500	348,000	762.0	762.6	0.00009	6.2	69,415	1,966	0.16
Upper	Lower Missouri	373.46	0.133%	750	374,000	763.6	764.1	0.00010	6.4	72,457	1,971	0.16
Upper	Lower Missouri	373.46	0.100%	1000	390,000	764.6	765.2	0.00010	6.5	74,527	1,974	0.16
Upper	Lower Missouri	373.46	0.080%	1250	403,000	765.5	766.1	0.00010	6.6	76,222	1,977	0.16
Upper	Lower Missouri	373.46	0.067%	1500	414,000	766.1	766.8	0.00010	6.7	77,517	3,479	0.16
Upper	Upper Missouri	373.79	10%	10	192,000	748.0	748.7	0.00019	6.4	33,949	1,884	0.21
Upper	Upper Missouri	373.79	1%	100	287,000	756.4	757.2	0.00016	7.0	50,211	1,971	0.20
Upper	Upper Missouri	373.79	0.5%	200	316,000	758.7	759.4	0.00016	7.2	54,654	1,986	0.20
Upper	Lower Missouri	373.79	0.2%	500	348,000	762.1	762.8	0.00014	7.2	61,487	2,011	0.19
Upper	Lower Missouri	373.79	0.133%	750	374,000	763.7	764.4	0.00014	7.4	64,605	2,021	0.19
Upper	Lower Missouri	373.79	0.100%	1000	390,000	764.7	765.5	0.00014	7.5	66,730	2,029	0.19
Upper	Lower Missouri	373.79	0.080%	1250	403,000	765.6	766.3	0.00014	7.5	68,473	2,035	0.20
Upper	Lower Missouri	373.79	0.067%	1500	414,000	766.2	767.0	0.00014	7.6	69,807	2,040	0.20
Upper	Upper Missouri	374.02	10%	10	192,000	748.2	749.0	0.00021	7.0	31,457	1,741	0.22
Upper	Upper Missouri	374.02	1%	100	287,000	756.6	757.4	0.00019	7.8	46,629	1,863	0.22
Upper	Upper Missouri	374.02	0.5%	200	316,000	758.8	759.7	0.00019	8.0	50,811	1,880	0.22
Upper	Lower Missouri	374.02	0.2%	500	348,000	762.2	763.1	0.00017	8.0	57,320	1,927	0.21
Upper	Lower Missouri	374.02	0.133%	750	374,000	763.7	764.7	0.00017	8.2	60,303	1,935	0.21
Upper	Lower Missouri	374.02	0.100%	1000	390,000	764.8	765.7	0.00017	8.3	62,331	1,940	0.21
Upper	Lower Missouri	374.02	0.080%	1250	403,000	765.6	766.6	0.00017	8.4	63,994	1,945	0.21
Upper	Lower Missouri	374.02	0.067%	1500	414,000	766.3	767.3	0.00017	8.5	65,266	1,948	0.21
Upper	Upper Missouri	374.081*	10%	10	192,000	748.2	749.1	0.00026	7.7	26,656	1,260	0.25
Upper	Upper Missouri	374.081*	1%	100	287,000	756.5	757.6	0.00025	8.7	37,631	1,372	0.25
Upper	Upper Missouri	374.081*	0.5%	200	316,000	758.7	759.9	0.00024	9.0	40,704	1,396	0.25
Upper	Lower Missouri	374.081*	0.2%	500	348,000	762.1	763.3	0.00022	9.0	45,459	1,415	0.24
Upper	Lower Missouri	374.081*	0.133%	750	374,000	763.6	764.9	0.00022	9.3	47,633	1,423	0.24
Upper	Lower Missouri	374.081*	0.100%	1000	390,000	764.7	766.0	0.00022	9.5	49,114	1,428	0.24
Upper	Lower Missouri	374.081*	0.080%	1250	403,000	765.5	766.9	0.00022	9.6	50,330	1,433	0.25

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	374.081*	0.067%	1500	414,000	766.2	767.5	0.00022	9.7	51,260	1,436	0.25
Upper		374.087	I-635 Bridge									
Upper	Upper Missouri	374.11	10%	10	192,000	748.3	749.3	0.00029	8.0	25,757	1,248	0.26
Upper	Upper Missouri	374.11	1%	100	287,000	756.6	757.8	0.00027	9.0	36,672	1,351	0.26
Upper	Upper Missouri	374.11	0.5%	200	316,000	758.8	760.1	0.00026	9.3	39,686	1,361	0.26
Upper	Lower Missouri	374.11	0.2%	500	348,000	762.2	763.4	0.00024	9.3	44,338	1,414	0.25
Upper	Lower Missouri	374.11	0.133%	750	374,000	763.7	765.1	0.00024	9.6	46,515	1,421	0.25
Upper	Lower Missouri	374.11	0.100%	1000	390,000	764.8	766.1	0.00024	9.7	47,998	1,427	0.25
Upper	Lower Missouri	374.11	0.080%	1250	403,000	765.6	767.0	0.00024	9.8	49,214	1,431	0.25
Upper	Lower Missouri	374.11	0.067%	1500	414,000	766.3	767.7	0.00024	9.9	50,145	1,434	0.25
Upper	Upper Missouri	374.14	10%	10	192,000	748.3	749.3	0.00029	8.0	27,775	1,753	0.26
Upper	Upper Missouri	374.14	1%	100	287,000	756.8	757.9	0.00024	8.7	43,063	1,839	0.25
Upper	Upper Missouri	374.14	0.5%	200	316,000	759.1	760.2	0.00023	8.9	47,261	1,862	0.25
Upper	Lower Missouri	374.14	0.2%	500	348,000	762.5	763.5	0.00021	8.8	53,745	1,933	0.23
Upper	Lower Missouri	374.14	0.133%	750	374,000	764.1	765.2	0.00021	9.0	56,798	1,941	0.24
Upper	Lower Missouri	374.14	0.100%	1000	390,000	765.1	766.2	0.00021	9.1	58,867	1,946	0.24
Upper	Lower Missouri	374.14	0.080%	1250	403,000	766.0	767.1	0.00020	9.2	60,562	1,951	0.24
Upper	Lower Missouri	374.14	0.067%	1500	414,000	766.7	767.8	0.00020	9.3	61,862	1,954	0.24
Upper	Upper Missouri	374.43	10%	10	192,000	749.0	749.8	0.00023	7.3	33,533	1,925	0.23
Upper	Upper Missouri	374.43	1%	100	287,000	757.4	758.3	0.00019	7.9	50,065	1,992	0.22
Upper	Upper Missouri	374.43	0.5%	200	316,000	759.7	760.6	0.00019	8.1	54,583	2,002	0.22
Upper	Lower Missouri	374.43	0.2%	500	348,000	763.1	763.9	0.00017	8.0	61,347	2,017	0.21
Upper	Lower Missouri	374.43	0.133%	750	374,000	764.6	765.5	0.00017	8.2	64,551	2,025	0.21
Upper	Lower Missouri	374.43	0.100%	1000	390,000	765.7	766.6	0.00017	8.3	66,707	2,030	0.21
Upper	Lower Missouri	374.43	0.080%	1250	403,000	766.6	767.5	0.00017	8.4	68,471	2,036	0.21
Upper	Lower Missouri	374.43	0.067%	1500	414,000	767.2	768.2	0.00017	8.5	69,832	2,048	0.21
Upper	Upper Missouri	374.76	10%	10	192,000	749.6	750.1	0.00017	6.1	43,671	2,919	0.20
Upper	Upper Missouri	374.76	1%	100	287,000	758.1	758.6	0.00013	6.4	68,775	3,017	0.18
Upper	Upper Missouri	374.76	0.5%	200	316,000	760.3	760.8	0.00012	6.4	75,652	3,030	0.18
Upper	Lower Missouri	374.76	0.2%	500	348,000	763.7	764.1	0.00011	6.3	85,787	3,048	0.17
Upper	Lower Missouri	374.76	0.133%	750	374,000	765.3	765.8	0.00011	6.5	90,700	3,056	0.17
Upper	Lower Missouri	374.76	0.100%	1000	390,000	766.3	766.8	0.00010	6.5	93,985	3,062	0.17
Upper	Lower Missouri	374.76	0.080%	1250	403,000	767.2	767.7	0.00010	6.6	96,668	3,067	0.17
Upper	Lower Missouri	374.76	0.067%	1500	414,000	767.9	768.4	0.00010	6.6	98,744	3,071	0.17
Upper	Upper Missouri	375.07	10%	10	192,000	750.0	750.4	0.00012	5.2	59,834	5,172	0.17
Upper	Upper Missouri	375.07	1%	100	287,000	758.5	758.8	0.00008	4.9	104,188	5,289	0.14
Upper	Upper Missouri	375.07	0.5%	200	316,000	760.8	761.0	0.00007	4.9	116,254	5,304	0.14
Upper	Lower Missouri	375.07	0.2%	500	348,000	764.1	764.3	0.00006	4.7	133,877	5,346	0.13
Upper	Lower Missouri	375.07	0.133%	750	374,000	765.7	765.9	0.00006	4.8	142,572	5,373	0.12
Upper	Lower Missouri	375.07	0.100%	1000	390,000	766.8	767.0	0.00006	4.8	148,376	5,389	0.12
Upper	Lower Missouri	375.07	0.080%	1250	403,000	767.7	767.9	0.00006	4.8	153,114	5,400	0.12
Upper	Lower Missouri	375.07	0.067%	1500	414,000	768.3	768.6	0.00006	4.8	156,792	5,407	0.12
Upper	Upper Missouri	375.33	10%	10	192,000	750.2	750.5	0.00012	5.4	65,227	6,006	0.17
Upper	Upper Missouri	375.33	1%	100	287,000	758.6	758.9	0.00007	4.9	116,462	6,117	0.14
Upper	Upper Missouri	375.33	0.5%	200	316,000	760.9	761.1	0.00007	4.8	130,383	6,132	0.13
Upper	Lower Missouri	375.33	0.2%	500	348,000	764.2	764.4	0.00005	4.6	150,643	6,159	0.12
Upper	Lower Missouri	375.33	0.133%	750	374,000	765.8	766.0	0.00005	4.6	160,668	6,203	0.12
Upper	Lower Missouri	375.33	0.100%	1000	390,000	766.9	767.1	0.00005	4.6	167,356	6,210	0.12
Upper	Lower Missouri	375.33	0.080%	1250	403,000	767.8	767.9	0.00005	4.6	172,814	6,215	0.12
Upper	Lower Missouri	375.33	0.067%	1500	414,000	768.4	768.6	0.00005	4.7	177,044	6,218	0.12
Upper	Upper Missouri	375.71	10%	10	192,000	750.5	750.8	0.00015	5.3	70,218	7,540	0.18
Upper	Upper Missouri	375.71	1%	100	287,000	758.8	759.0	0.00007	4.4	135,349	8,009	0.13
Upper	Upper Missouri	375.71	0.5%	200	316,000	761.1	761.2	0.00006	4.2	153,496	8,059	0.12
Upper	Lower Missouri	375.71	0.2%	500	348,000	764.4	764.5	0.00005	4.0	179,917	8,116	0.11

Missouri River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	Profile Frequency Percent	Profile Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Upper	Lower Missouri	375.71	0.133%	750	374,000	766.0	766.1	0.00004	4.0	193,081	8,136	0.11
Upper	Lower Missouri	375.71	0.100%	1000	390,000	767.0	767.2	0.00004	3.9	201,841	8,165	0.11
Upper	Lower Missouri	375.71	0.080%	1250	403,000	767.9	768.0	0.00004	3.9	209,002	8,189	0.10
Upper	Lower Missouri	375.71	0.067%	1500	414,000	768.6	768.7	0.00004	3.9	214,570	8,207	0.10
Upper	Upper Missouri	376.11	10%	10	192,000	750.7	751.1	0.00012	5.1	74,534	8,536	0.16
Upper	Upper Missouri	376.11	1%	100	287,000	759.0	759.1	0.00006	4.3	147,155	9,003	0.12
Upper	Upper Missouri	376.11	0.5%	200	316,000	761.2	761.3	0.00005	4.1	167,357	9,019	0.11
Upper	Lower Missouri	376.11	0.2%	500	348,000	764.4	764.6	0.00004	3.9	196,740	9,106	0.10
Upper	Lower Missouri	376.11	0.133%	750	374,000	766.1	766.2	0.00004	3.8	211,464	9,112	0.10
Upper	Lower Missouri	376.11	0.100%	1000	390,000	767.1	767.2	0.00004	3.8	221,233	9,117	0.10
Upper	Lower Missouri	376.11	0.080%	1250	403,000	768.0	768.1	0.00003	3.8	229,199	9,120	0.10
Upper	Lower Missouri	376.11	0.067%	1500	414,000	768.7	768.8	0.00003	3.8	235,383	9,123	0.10
Upper	Upper Missouri	376.77	10%	10	192,000	751.1	751.4	0.00010	4.9	77,113	8,478	0.15
Upper	Upper Missouri	376.77	1%	100	287,000	759.1	759.3	0.00006	4.2	145,656	8,641	0.12
Upper	Upper Missouri	376.77	0.5%	200	316,000	761.4	761.5	0.00005	4.1	164,886	8,705	0.11
Upper	Lower Missouri	376.77	0.2%	500	348,000	764.6	764.7	0.00004	3.8	192,858	8,722	0.10
Upper	Lower Missouri	376.77	0.133%	750	374,000	766.2	766.3	0.00004	3.8	206,898	8,731	0.10
Upper	Lower Missouri	376.77	0.100%	1000	390,000	767.2	767.4	0.00004	3.8	216,213	8,737	0.10
Upper	Lower Missouri	376.77	0.080%	1250	403,000	768.1	768.2	0.00003	3.8	223,811	8,741	0.10
Upper	Lower Missouri	376.77	0.067%	1500	414,000	768.8	768.9	0.00003	3.8	229,716	8,745	0.10
Upper	Upper Missouri	377.43	10%	10	192,000	751.5	751.8	0.00009	4.4	87,200	8,964	0.14
Upper	Upper Missouri	377.43	1%	100	287,000	759.4	759.5	0.00005	3.9	158,786	9,443	0.11
Upper	Upper Missouri	377.43	0.5%	200	316,000	761.5	761.7	0.00004	3.8	179,489	9,513	0.11
Upper	Lower Missouri	377.43	0.2%	500	348,000	764.7	764.8	0.00004	3.5	209,624	9,586	0.10
Upper	Lower Missouri	377.43	0.133%	750	374,000	766.3	766.4	0.00003	3.5	224,902	9,623	0.09
Upper	Lower Missouri	377.43	0.100%	1000	390,000	767.4	767.5	0.00003	3.5	235,034	9,637	0.09
Upper	Lower Missouri	377.43	0.080%	1250	403,000	768.2	768.3	0.00003	3.5	243,304	9,696	0.09
Upper	Lower Missouri	377.43	0.067%	1500	414,000	768.9	769.0	0.00003	3.5	249,762	9,711	0.09
Upper	Upper Missouri	378.26	10%	10	192,000	751.9	752.3	0.00014	5.5	67,006	9,133	0.18
Upper	Upper Missouri	378.26	1%	100	287,000	759.5	759.8	0.00008	5.0	121,147	10,102	0.14
Upper	Upper Missouri	378.26	0.5%	200	316,000	761.7	761.9	0.00007	4.9	136,840	10,208	0.14
Upper	Lower Missouri	378.26	0.2%	500	348,000	764.8	765.0	0.00006	4.7	159,673	10,307	0.13
Upper	Lower Missouri	378.26	0.133%	750	374,000	766.4	766.6	0.00006	4.7	171,310	10,360	0.12
Upper	Lower Missouri	378.26	0.100%	1000	390,000	767.5	767.7	0.00006	4.6	179,047	10,406	0.12
Upper	Lower Missouri	378.26	0.080%	1250	403,000	768.4	768.5	0.00005	4.6	185,370	10,428	0.12
Upper	Lower Missouri	378.26	0.067%	1500	414,000	769.0	769.2	0.00005	4.6	190,293	10,464	0.12
Upper	Upper Missouri	378.85	10%	10	192,000	752.3	752.8	0.00017	5.9	60,237	7,098	0.20
Upper	Upper Missouri	378.85	1%	100	287,000	759.8	760.0	0.00008	4.7	137,522	10,266	0.14
Upper	Upper Missouri	378.85	0.5%	200	316,000	762.0	762.1	0.00007	4.6	155,759	10,316	0.13
Upper	Lower Missouri	378.85	0.2%	500	348,000	765.1	765.2	0.00005	4.3	182,230	10,424	0.12
Upper	Lower Missouri	378.85	0.133%	750	374,000	766.6	766.8	0.00005	4.3	195,876	10,461	0.12
Upper	Lower Missouri	378.85	0.100%	1000	390,000	767.7	767.8	0.00005	4.3	204,921	10,506	0.11
Upper	Lower Missouri	378.85	0.080%	1250	403,000	768.5	768.7	0.00005	4.2	212,306	10,533	0.11
Upper	Lower Missouri	378.85	0.067%	1500	414,000	769.2	769.3	0.00005	4.2	218,065	10,548	0.11
Upper	Upper Missouri	379.53	10%	10	192,000	752.8	753.6	0.00026	7.2	31,955	2,119	0.24
Upper	Upper Missouri	379.53	1%	100	287,000	760.1	760.3	0.00006	4.1	165,110	10,273	0.12
Upper	Upper Missouri	379.53	0.5%	200	316,000	762.2	762.4	0.00005	4.0	186,651	10,283	0.12
Upper	Lower Missouri	379.53	0.2%	500	348,000	765.3	765.4	0.00004	3.7	217,873	10,297	0.10
Upper	Lower Missouri	379.53	0.133%	750	374,000	766.8	766.9	0.00004	3.7	234,074	10,304	0.10
Upper	Lower Missouri	379.53	0.100%	1000	390,000	767.9	768.0	0.00004	3.7	244,794	10,309	0.10
Upper	Lower Missouri	379.53	0.080%	1250	403,000	768.7	768.8	0.00004	3.6	253,547	10,312	0.10
Upper	Lower Missouri	379.53	0.067%	1500	414,000	769.4	769.5	0.00004	3.6	260,380	10,315	0.10

***denotes interpolated cross-section**

EXHIBIT A-2.113
Kansas River Future Conditions Without Project Water Surface Elevations

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	0.010	10%	10	121,000	742.4	742.9	0.00026	5.9	20554	812	0.21
Kansas	Missouri Control	0.010	1%	100	192,000	751.2	751.9	0.00025	6.8	28949	1044	0.23
Kansas	Missouri Control	0.010	0.5%	200	237,000	753.6	754.6	0.00030	7.8	31516	1090	0.25
Kansas	Missouri Control	0.010	0.2%	500	308,000	756.8	758.1	0.00037	9.3	35030	1151	0.29
Kansas	Missouri Control	0.010	0.133%	750	343,000	758.0	759.6	0.00041	10.0	36553	1275	0.30
Kansas	Missouri Control	0.010	0.100%	1000	369,000	758.9	760.6	0.00044	10.5	37744	1333	0.31
Kansas	Missouri Control	0.010	0.080%	1250	391,000	759.7	761.5	0.00046	10.9	38765	1381	0.32
Kansas	Missouri Control	0.010	0.067%	1500	407,000	760.2	762.2	0.00048	11.2	39539	1434	0.33
Kansas	Kansas Control	0.140	10%	10	121,000	742.5	743.1	0.00028	6.2	19438	737	0.21
Kansas	Missouri Control	0.140	1%	100	192,000	751.3	752.1	0.00027	7.4	26174	803	0.22
Kansas	Missouri Control	0.140	0.5%	200	237,000	753.7	754.8	0.00033	8.5	28127	820	0.25
Kansas	Missouri Control	0.140	0.2%	500	308,000	756.8	758.4	0.00043	10.2	30785	924	0.28
Kansas	Missouri Control	0.140	0.133%	750	343,000	758.1	760.0	0.00048	11.0	31991	1009	0.30
Kansas	Missouri Control	0.140	0.100%	1000	369,000	759.0	761.1	0.00051	11.5	32910	1025	0.31
Kansas	Missouri Control	0.140	0.080%	1250	391,000	759.8	762.0	0.00054	12.0	33677	1038	0.32
Kansas	Missouri Control	0.140	0.067%	1500	407,000	760.3	762.6	0.00056	12.3	34244	1044	0.33
Kansas	Kansas Control	0.220	10%	10	121,000	742.6	743.3	0.00039	7.0	17193	697	0.25
Kansas	Missouri Control	0.220	1%	100	192,000	751.3	752.3	0.00036	8.2	23730	786	0.25
Kansas	Missouri Control	0.220	0.5%	200	237,000	753.7	755.1	0.00043	9.4	25633	803	0.28
Kansas	Missouri Control	0.220	0.2%	500	308,000	756.8	758.7	0.00055	11.2	28163	826	0.32
Kansas	Missouri Control	0.220	0.133%	750	343,000	758.1	760.3	0.00061	12.1	29210	836	0.34
Kansas	Missouri Control	0.220	0.100%	1000	369,000	758.9	761.4	0.00065	12.7	29959	843	0.35
Kansas	Missouri Control	0.220	0.080%	1250	391,000	759.7	762.4	0.00069	13.2	30592	920	0.36
Kansas	Missouri Control	0.220	0.067%	1500	407,000	760.2	763.1	0.00072	13.6	31094	991	0.37
Kansas	Kansas Control	0.253	10%	10	121,000	742.6	743.4	0.00043	7.4	16385	667	0.26
Kansas	Missouri Control	0.253	1%	100	192,000	751.3	752.4	0.00040	8.6	22639	758	0.26
Kansas	Missouri Control	0.253	0.5%	200	237,000	753.7	755.2	0.00048	9.9	24469	775	0.29
Kansas	Missouri Control	0.253	0.2%	500	308,000	756.8	758.9	0.00061	11.8	26898	797	0.33
Kansas	Missouri Control	0.253	0.133%	750	343,000	758.0	760.5	0.00067	12.7	27902	806	0.35
Kansas	Missouri Control	0.253	0.100%	1000	369,000	758.9	761.6	0.00072	13.3	28632	834	0.37
Kansas	Missouri Control	0.253	0.080%	1250	391,000	759.6	762.6	0.00076	13.8	29239	836	0.38
Kansas	Missouri Control	0.253	0.067%	1500	407,000	760.2	763.3	0.00079	14.2	29688	836	0.39
Kansas	Kansas Control	0.256	Missouri Pacific Bridge No. 1									
Kansas	Kansas Control	0.259	10%	10	121,000	742.6	743.5	0.00044	7.4	16272	667	0.27
Kansas	Missouri Control	0.259	1%	100	192,000	751.4	752.5	0.00041	8.6	22562	764	0.27
Kansas	Missouri Control	0.259	0.5%	200	237,000	753.8	755.3	0.00048	9.9	24422	781	0.29
Kansas	Missouri Control	0.259	0.2%	500	308,000	756.9	759.0	0.00061	11.8	26904	806	0.34
Kansas	Missouri Control	0.259	0.133%	750	343,000	758.2	760.6	0.00068	12.7	27937	814	0.36
Kansas	Missouri Control	0.259	0.100%	1000	369,000	759.1	761.8	0.00072	13.3	28674	817	0.37
Kansas	Missouri Control	0.259	0.080%	1250	391,000	759.9	762.8	0.00076	13.8	29323	820	0.38
Kansas	Missouri Control	0.259	0.067%	1500	407,000	760.5	763.5	0.00078	14.2	29811	5634	0.39
Kansas	Kansas Control	0.274	10%	10	121,000	742.9	743.6	0.00039	6.6	18245	810	0.25
Kansas	Missouri Control	0.274	1%	100	192,000	751.7	752.6	0.00033	7.5	25742	886	0.24
Kansas	Missouri Control	0.274	0.5%	200	237,000	754.3	755.4	0.00038	8.6	28009	903	0.26
Kansas	Missouri Control	0.274	0.2%	500	308,000	757.6	759.2	0.00047	10.1	31072	926	0.29
Kansas	Missouri Control	0.274	0.133%	750	343,000	759.0	760.8	0.00051	10.9	32384	965	0.31
Kansas	Missouri Control	0.274	0.100%	1000	369,000	760.0	762.0	0.00054	11.4	33362	1005	0.32
Kansas	Missouri Control	0.274	0.080%	1250	391,000	760.9	763.0	0.00057	11.8	34258	5880	0.33
Kansas	Missouri Control	0.274	0.067%	1500	407,000	761.5	763.8	0.00058	12.1	34946	6010	0.33
Kansas	Kansas Control	0.280	I-70 Bridge (westbound)									
Kansas	Kansas Control	0.286	10%	10	121,000	743.0	743.7	0.00039	6.7	18182	808	0.25
Kansas	Missouri Control	0.286	1%	100	192,000	751.8	752.7	0.00034	7.5	25689	886	0.24
Kansas	Missouri Control	0.286	0.5%	200	237,000	754.4	755.5	0.00040	8.5	27978	903	0.26
Kansas	Missouri Control	0.286	0.2%	500	308,000	757.8	759.3	0.00048	10.0	31082	927	0.29
Kansas	Missouri Control	0.286	0.133%	750	343,000	759.2	761.0	0.00052	10.7	32418	961	0.31
Kansas	Missouri Control	0.286	0.100%	1000	369,000	760.2	762.1	0.00055	11.2	33406	1011	0.32

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	0.286	0.080%	1250	391,000	761.1	763.2	0.00057	11.6	34303	5876	0.33
Kansas	Missouri Control	0.286	0.067%	1500	407,000	761.7	763.9	0.00059	11.8	34974	5993	0.33
Kansas	Kansas Control	0.297	10%	10	121,000	743.0	743.7	0.00040	6.7	18067	801	0.25
Kansas	Missouri Control	0.297	1%	100	192,000	751.8	752.7	0.00035	7.5	25528	881	0.24
Kansas	Missouri Control	0.297	0.5%	200	237,000	754.4	755.5	0.00040	8.6	27807	899	0.27
Kansas	Missouri Control	0.297	0.2%	500	308,000	757.8	759.3	0.00049	10.1	30899	923	0.30
Kansas	Missouri Control	0.297	0.133%	750	343,000	759.2	761.0	0.00053	10.8	32230	956	0.31
Kansas	Missouri Control	0.297	0.100%	1000	369,000	760.2	762.2	0.00056	11.3	33213	1005	0.32
Kansas	Missouri Control	0.297	0.080%	1250	391,000	761.1	763.2	0.00058	11.7	34105	5868	0.33
Kansas	Missouri Control	0.297	0.067%	1500	407,000	761.8	764.0	0.00059	11.9	34772	5984	0.33
Kansas	Kansas Control	0.303	I-70 Bridge (eastbound)									
Kansas	Kansas Control	0.309	10%	10	121,000	743.1	743.8	0.00040	6.8	17931	786	0.25
Kansas	Missouri Control	0.309	1%	100	192,000	751.9	752.8	0.00035	7.6	25261	865	0.24
Kansas	Missouri Control	0.309	0.5%	200	237,000	754.5	755.6	0.00041	8.7	27519	887	0.27
Kansas	Missouri Control	0.309	0.2%	500	308,000	757.9	759.5	0.00049	10.2	30629	924	0.30
Kansas	Missouri Control	0.309	0.133%	750	343,000	759.3	761.2	0.00053	10.9	31982	958	0.31
Kansas	Missouri Control	0.309	0.100%	1000	369,000	760.4	762.4	0.00056	11.4	32981	994	0.32
Kansas	Missouri Control	0.309	0.080%	1250	391,000	761.3	763.4	0.00058	11.8	33874	5874	0.33
Kansas	Missouri Control	0.309	0.067%	1500	407,000	761.9	764.2	0.00060	12.0	34543	5991	0.34
Kansas	Kansas Control	0.440	10%	10	121,000	743.2	744.1	0.00050	7.4	16376	742	0.28
Kansas	Kansas Control	0.440	1%	100	241,000	752.0	753.7	0.00066	10.5	23229	817	0.33
Kansas	Missouri Control	0.440	0.5%	200	237,000	754.6	756.0	0.00049	9.5	25331	837	0.29
Kansas	Missouri Control	0.440	0.2%	500	308,000	758.0	759.9	0.00059	11.1	28242	865	0.33
Kansas	Missouri Control	0.440	0.133%	750	343,000	759.4	761.6	0.00064	11.9	29515	904	0.34
Kansas	Missouri Control	0.440	0.100%	1000	369,000	760.4	762.8	0.00068	12.5	30447	5279	0.35
Kansas	Missouri Control	0.440	0.080%	1250	391,000	761.3	763.9	0.00070	12.9	31265	5468	0.36
Kansas	Missouri Control	0.440	0.067%	1500	407,000	762.0	764.7	0.00072	13.2	31877	5609	0.37
Kansas	Kansas Control	0.496	10%	10	121,000	743.5	744.2	0.00041	6.7	17981	804	0.25
Kansas	Kansas Control	0.496	1%	100	241,000	752.5	753.9	0.00052	9.5	25628	889	0.30
Kansas	Missouri Control	0.496	0.5%	200	237,000	754.9	756.1	0.00039	8.7	27809	909	0.26
Kansas	Missouri Control	0.496	0.2%	500	308,000	758.5	760.1	0.00047	10.1	31077	928	0.29
Kansas	Missouri Control	0.496	0.133%	750	343,000	760.0	761.8	0.00051	10.8	32590	966	0.31
Kansas	Missouri Control	0.496	0.100%	1000	369,000	761.1	763.1	0.00054	11.3	33631	5557	0.32
Kansas	Missouri Control	0.496	0.080%	1250	391,000	762.0	764.1	0.00056	11.7	34536	5735	0.32
Kansas	Missouri Control	0.496	0.067%	1500	407,000	762.7	764.9	0.00057	12.0	35209	5867	0.33
Kansas	Kansas Control	0.500	James Street Bridge									
Kansas	Kansas Control	0.504	10%	10	121,000	743.6	744.3	0.00040	6.7	18047	798	0.25
Kansas	Kansas Control	0.504	1%	100	241,000	752.7	754.0	0.00052	9.5	25676	877	0.30
Kansas	Missouri Control	0.504	0.5%	200	237,000	755.1	756.2	0.00039	8.6	27805	896	0.26
Kansas	Missouri Control	0.504	0.2%	500	308,000	758.6	760.2	0.00047	10.1	31094	951	0.29
Kansas	Missouri Control	0.504	0.133%	750	343,000	760.2	762.0	0.00050	10.8	32559	956	0.31
Kansas	Missouri Control	0.504	0.100%	1000	369,000	761.3	763.2	0.00053	11.3	33609	5595	0.31
Kansas	Missouri Control	0.504	0.080%	1250	391,000	762.2	764.3	0.00055	11.7	34522	5777	0.32
Kansas	Missouri Control	0.504	0.067%	1500	407,000	763.0	765.1	0.00056	11.9	35216	5915	0.33
Kansas	Kansas Control	0.640	10%	10	121,000	743.8	744.6	0.00032	7.2	17468	692	0.23
Kansas	Kansas Control	0.640	1%	100	241,000	752.9	754.6	0.00050	10.7	24040	759	0.30
Kansas	Missouri Control	0.640	0.5%	200	237,000	755.2	756.7	0.00040	9.8	25811	774	0.27
Kansas	Missouri Control	0.640	0.2%	500	308,000	758.8	760.8	0.00050	11.7	28623	799	0.31
Kansas	Missouri Control	0.640	0.133%	750	343,000	760.3	762.6	0.00055	12.5	29845	818	0.33
Kansas	Missouri Control	0.640	0.100%	1000	369,000	761.4	764.0	0.00059	13.2	30992	5806	0.34
Kansas	Missouri Control	0.640	0.080%	1250	391,000	762.3	765.1	0.00061	13.6	31967	5989	0.35
Kansas	Missouri Control	0.640	0.067%	1500	407,000	763.0	765.9	0.00063	13.9	32709	6128	0.35
Kansas	Kansas Control	0.812	10%	10	121,000	744.0	745.0	0.00039	8.0	15838	657	0.26
Kansas	Kansas Control	0.812	1%	100	241,000	753.1	755.2	0.00060	11.9	22119	723	0.34
Kansas	Kansas Control	0.812	0.5%	200	283,000	755.3	757.9	0.00068	13.1	23765	737	0.36

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	0.812	0.2%	500	308,000	758.9	761.4	0.00060	13.0	26439	751	0.34
Kansas	Missouri Control	0.812	0.133%	750	343,000	760.5	763.3	0.00066	13.9	27586	756	0.36
Kansas	Missouri Control	0.812	0.100%	1000	369,000	761.5	764.7	0.00070	14.6	28411	6068	0.37
Kansas	Missouri Control	0.812	0.080%	1250	391,000	762.5	765.8	0.00073	15.1	29128	6232	0.38
Kansas	Missouri Control	0.812	0.067%	1500	407,000	763.2	766.7	0.00075	15.5	29670	6357	0.39
Kansas	Kansas Control	0.815	KC Southern Bridge									
Kansas	Kansas Control	0.817	10%	10	121,000	744.1	745.1	0.00040	8.0	15821	656	0.26
Kansas	Kansas Control	0.817	1%	100	241,000	753.2	755.3	0.00062	11.9	22129	722	0.33
Kansas	Kansas Control	0.817	0.5%	200	283,000	755.5	758.0	0.00070	13.1	23786	736	0.36
Kansas	Missouri Control	0.817	0.2%	500	308,000	759.0	761.5	0.00061	13.0	26442	751	0.34
Kansas	Missouri Control	0.817	0.133%	750	343,000	760.7	763.5	0.00067	13.9	27692	760	0.36
Kansas	Missouri Control	0.817	0.100%	1000	369,000	761.9	765.0	0.00070	14.5	28619	1471	0.37
Kansas	Missouri Control	0.817	0.080%	1250	391,000	763.0	766.3	0.00073	15.0	29427	6321	0.38
Kansas	Missouri Control	0.817	0.067%	1500	407,000	763.8	767.2	0.00074	15.3	30045	6464	0.38
Kansas	Kansas Control	1.106	10%	10	121,000	744.6	745.6	0.00039	8.0	15751	643	0.25
Kansas	Kansas Control	1.106	1%	100	241,000	754.1	756.2	0.00060	11.9	22111	695	0.33
Kansas	Kansas Control	1.106	0.5%	200	283,000	756.5	759.0	0.00067	13.1	23781	703	0.35
Kansas	Missouri Control	1.106	0.2%	500	308,000	759.9	762.4	0.00060	13.1	26211	715	0.34
Kansas	Missouri Control	1.106	0.133%	750	343,000	761.6	764.5	0.00066	14.0	27454	720	0.36
Kansas	Missouri Control	1.106	0.100%	1000	369,000	762.9	766.0	0.00069	14.6	28368	7011	0.37
Kansas	Missouri Control	1.106	0.080%	1250	391,000	764.0	767.3	0.00072	15.1	29159	7210	0.37
Kansas	Missouri Control	1.106	0.067%	1500	407,000	764.8	768.3	0.00073	15.4	29759	7359	0.38
Kansas	Kansas Control	1.112	Central Avenue Bridge									
Kansas	Kansas Control	1.117	10%	10	121,000	744.7	745.7	0.00038	8.0	15818	643	0.25
Kansas	Kansas Control	1.117	1%	100	241,000	754.2	756.3	0.00059	11.9	22201	694	0.33
Kansas	Kansas Control	1.117	0.5%	200	283,000	756.6	759.2	0.00066	13.0	23878	702	0.35
Kansas	Missouri Control	1.117	0.2%	500	308,000	760.0	762.5	0.00060	13.0	26287	713	0.34
Kansas	Missouri Control	1.117	0.133%	750	343,000	761.9	764.8	0.00064	13.9	27645	5398	0.35
Kansas	Missouri Control	1.117	0.100%	1000	369,000	763.3	766.4	0.00067	14.5	28650	7147	0.36
Kansas	Missouri Control	1.117	0.080%	1250	391,000	764.6	767.8	0.00069	14.9	29539	7381	0.37
Kansas	Missouri Control	1.117	0.067%	1500	407,000	765.5	768.9	0.00070	15.2	30221	7549	0.37
Kansas	Kansas Control	1.270	10%	10	121,000	745.2	746.0	0.00037	7.1	17043	648	0.24
Kansas	Kansas Control	1.270	1%	100	241,000	755.2	756.8	0.00051	10.3	23820	709	0.30
Kansas	Kansas Control	1.270	0.5%	200	283,000	757.7	759.7	0.00056	11.3	25652	719	0.32
Kansas	Kansas Control	1.270	0.2%	500	341,000	761.1	763.5	0.00061	12.5	28087	731	0.34
Kansas	Missouri Control	1.270	0.133%	750	343,000	763.1	765.3	0.00053	12.0	29535	6424	0.32
Kansas	Missouri Control	1.270	0.100%	1000	369,000	764.5	766.9	0.00055	12.5	30626	6624	0.32
Kansas	Missouri Control	1.270	0.080%	1250	391,000	765.8	768.4	0.00056	12.8	31574	6798	0.33
Kansas	Missouri Control	1.270	0.067%	1500	407,000	766.8	769.4	0.00057	13.1	32292	6929	0.33
Kansas	Kansas Control	1.385	10%	10	121,000	745.4	746.3	0.00041	7.4	16412	626	0.25
Kansas	Kansas Control	1.385	1%	100	241,000	755.4	757.1	0.00055	10.6	22925	674	0.31
Kansas	Kansas Control	1.385	0.5%	200	283,000	758.0	760.1	0.00060	11.6	24676	683	0.33
Kansas	Kansas Control	1.385	0.2%	500	341,000	761.3	763.9	0.00066	12.9	27000	695	0.35
Kansas	Missouri Control	1.385	0.133%	750	343,000	763.3	765.6	0.00057	12.4	28350	6028	0.33
Kansas	Missouri Control	1.385	0.100%	1000	369,000	764.8	767.3	0.00059	12.9	29390	6267	0.34
Kansas	Missouri Control	1.385	0.080%	1250	391,000	766.1	768.8	0.00060	13.2	30292	6498	0.34
Kansas	Missouri Control	1.385	0.067%	1500	407,000	767.0	769.8	0.00061	13.5	30975	6651	0.34
Kansas	Kansas Control	1.399	I-670 Bridge									
Kansas	Kansas Control	1.413	10%	10	121,000	745.6	746.4	0.00040	7.4	16419	624	0.25
Kansas	Kansas Control	1.413	1%	100	241,000	755.6	757.4	0.00054	10.6	22993	674	0.31
Kansas	Kansas Control	1.413	0.5%	200	283,000	758.3	760.3	0.00059	11.6	24770	684	0.33
Kansas	Kansas Control	1.413	0.2%	500	341,000	761.7	764.2	0.00065	12.8	27128	695	0.35
Kansas	Missouri Control	1.413	0.133%	750	343,000	763.6	765.9	0.00057	12.3	28447	6080	0.33
Kansas	Missouri Control	1.413	0.100%	1000	369,000	765.1	767.6	0.00058	12.8	29512	6346	0.33
Kansas	Missouri Control	1.413	0.080%	1250	391,000	766.4	769.1	0.00059	13.2	30448	6592	0.34

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	1.413	0.067%	1500	407,000	767.4	770.2	0.00060	13.4	31163	6741	0.34
Kansas	Kansas Control	1.614	10%	10	121,000	745.6	746.5	0.00042	7.6	15944	597	0.26
Kansas	Kansas Control	1.614	1%	100	241,000	755.7	757.5	0.00059	10.8	22377	669	0.32
Kansas	Kansas Control	1.614	0.5%	200	283,000	758.3	760.5	0.00064	11.8	24144	679	0.34
Kansas	Kansas Control	1.614	0.2%	500	341,000	761.7	764.4	0.00070	13.1	26487	691	0.36
Kansas	Missouri Control	1.614	0.133%	750	343,000	763.6	766.1	0.00061	12.6	27794	6111	0.34
Kansas	Missouri Control	1.614	0.100%	1000	369,000	765.1	767.8	0.00062	13.1	28869	6315	0.34
Kansas	Missouri Control	1.614	0.080%	1250	391,000	766.5	769.3	0.00063	13.4	29814	6493	0.35
Kansas	Missouri Control	1.614	0.067%	1500	407,000	767.5	770.4	0.00064	13.7	30535	6629	0.35
Kansas	Kansas Control	1.619	Missouri Pacific Bridge No. 72									
Kansas	Kansas Control	1.624	10%	10	121,000	745.7	746.6	0.00042	7.6	15993	598	0.26
Kansas	Kansas Control	1.624	1%	100	241,000	755.8	757.7	0.00058	10.8	22477	670	0.32
Kansas	Kansas Control	1.624	0.5%	200	283,000	758.5	760.7	0.00063	11.8	24265	679	0.34
Kansas	Kansas Control	1.624	0.2%	500	341,000	762.2	764.8	0.00067	12.9	26827	692	0.35
Kansas	Missouri Control	1.624	0.133%	750	343,000	764.2	766.6	0.00058	12.4	28202	6191	0.33
Kansas	Missouri Control	1.624	0.100%	1000	369,000	765.9	768.5	0.00059	12.8	29402	6420	0.33
Kansas	Missouri Control	1.624	0.080%	1250	391,000	767.4	770.0	0.00059	13.2	30403	6612	0.34
Kansas	Missouri Control	1.624	0.067%	1500	407,000	768.4	771.2	0.00060	13.4	31115	6778	0.34
Kansas	Kansas Control	1.634	10%	10	121,000	745.7	746.6	0.00042	7.6	15943	594	0.26
Kansas	Kansas Control	1.634	1%	100	241,000	755.9	757.7	0.00059	10.8	22405	670	0.32
Kansas	Kansas Control	1.634	0.5%	200	283,000	758.5	760.7	0.00064	11.8	24199	681	0.34
Kansas	Kansas Control	1.634	0.2%	500	341,000	762.3	764.9	0.00067	12.9	26769	694	0.35
Kansas	Missouri Control	1.634	0.133%	750	343,000	764.2	766.6	0.00058	12.4	28145	6131	0.33
Kansas	Missouri Control	1.634	0.100%	1000	369,000	766.0	768.5	0.00059	12.8	29349	6351	0.33
Kansas	Missouri Control	1.634	0.080%	1250	391,000	767.4	770.1	0.00060	13.2	30353	6535	0.34
Kansas	Missouri Control	1.634	0.067%	1500	407,000	768.4	771.2	0.00060	13.4	31067	6668	0.34
Kansas	Kansas Control	1.638	Union Pacific Bridge No. 3									
Kansas	Kansas Control	1.643	10%	10	121,000	745.8	746.7	0.00042	7.6	15993	595	0.26
Kansas	Kansas Control	1.643	1%	100	241,000	756.0	757.8	0.00058	10.8	22507	670	0.32
Kansas	Kansas Control	1.643	0.5%	200	283,000	758.7	760.8	0.00063	11.8	24314	680	0.33
Kansas	Kansas Control	1.643	0.2%	500	341,000	762.5	765.0	0.00066	12.9	26895	693	0.35
Kansas	Missouri Control	1.643	0.133%	750	343,000	764.6	766.9	0.00057	12.3	28351	6171	0.33
Kansas	Missouri Control	1.643	0.100%	1000	369,000	766.4	768.9	0.00057	12.7	29625	6405	0.33
Kansas	Missouri Control	1.643	0.080%	1250	391,000	767.8	770.5	0.00058	13.1	30629	6590	0.33
Kansas	Missouri Control	1.643	0.067%	1500	407,000	768.9	771.6	0.00058	13.3	31343	6724	0.34
Kansas	Kansas Control	2.016	10%	10	121,000	746.6	747.4	0.00035	7.5	16259	585	0.24
Kansas	Kansas Control	2.016	1%	100	241,000	757.1	758.9	0.00051	11.0	22801	663	0.30
Kansas	Kansas Control	2.016	0.5%	200	283,000	759.8	762.0	0.00056	12.0	24659	684	0.32
Kansas	Kansas Control	2.016	0.2%	500	341,000	763.6	766.3	0.00060	13.2	27327	712	0.34
Kansas	Kansas Control	2.016	0.133%	750	367,000	765.6	768.4	0.00061	13.6	28743	6505	0.34
Kansas	Kansas Control	2.016	0.100%	1000	388,000	767.4	770.3	0.00060	13.9	30048	6802	0.34
Kansas	Missouri Control	2.016	0.080%	1250	391,000	768.9	771.6	0.00055	13.5	31110	7036	0.33
Kansas	Missouri Control	2.016	0.067%	1500	407,000	769.9	772.7	0.00055	13.8	31862	7196	0.33
Kansas	Kansas Control	2.097	10%	10	121,000	746.7	747.6	0.00038	7.6	16013	586	0.25
Kansas	Kansas Control	2.097	1%	100	241,000	757.3	759.1	0.00051	10.9	22677	673	0.31
Kansas	Kansas Control	2.097	0.5%	200	283,000	760.1	762.3	0.00056	11.9	24593	696	0.33
Kansas	Kansas Control	2.097	0.2%	500	341,000	764.0	766.6	0.00060	13.1	27340	5104	0.34
Kansas	Kansas Control	2.097	0.133%	750	367,000	766.0	768.7	0.00060	13.4	28772	5271	0.34
Kansas	Kansas Control	2.097	0.100%	1000	388,000	767.7	770.6	0.00059	13.6	30078	6093	0.34
Kansas	Missouri Control	2.097	0.080%	1250	391,000	769.2	771.9	0.00054	13.3	31120	6727	0.33
Kansas	Missouri Control	2.097	0.067%	1500	407,000	770.2	773.0	0.00054	13.6	31879	7095	0.33
Kansas	Kansas Control	2.104	CRI&P Bridge									
Kansas	Kansas Control	2.111	10%	10	121,000	746.8	747.7	0.00037	7.5	16081	589	0.25
Kansas	Kansas Control	2.111	1%	100	241,000	757.5	759.3	0.00049	10.8	22840	679	0.31

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	2.111	0.5%	200	283,000	760.3	762.5	0.00053	11.8	24790	702	0.32
Kansas	Kansas Control	2.111	0.2%	500	341,000	764.3	766.9	0.00056	12.9	27663	5121	0.34
Kansas	Kansas Control	2.111	0.133%	750	367,000	766.5	769.1	0.00056	13.3	29234	5466	0.34
Kansas	Kansas Control	2.111	0.100%	1000	388,000	768.4	771.1	0.00054	13.4	30669	6355	0.33
Kansas	Missouri Control	2.111	0.080%	1250	391,000	769.8	772.4	0.00050	13.1	31667	6978	0.32
Kansas	Missouri Control	2.111	0.067%	1500	407,000	770.8	773.5	0.00050	13.4	32435	7093	0.33
Kansas	Kansas Control	2.165	10%	10	121,000	747.0	747.8	0.00038	7.1	16997	692	0.25
Kansas	Kansas Control	2.165	1%	100	241,000	758.0	759.5	0.00045	9.8	25253	824	0.29
Kansas	Kansas Control	2.165	0.5%	200	283,000	760.9	762.6	0.00047	10.6	27729	852	0.30
Kansas	Kansas Control	2.165	0.2%	500	341,000	765.1	767.1	0.00048	11.4	31299	5371	0.31
Kansas	Kansas Control	2.165	0.133%	750	367,000	767.3	769.3	0.00047	11.7	33189	6163	0.31
Kansas	Kansas Control	2.165	0.100%	1000	388,000	769.2	771.4	0.00045	11.8	34893	6728	0.30
Kansas	Missouri Control	2.165	0.080%	1250	391,000	770.6	772.6	0.00042	11.5	36031	6948	0.29
Kansas	Missouri Control	2.165	0.067%	1500	407,000	771.6	773.7	0.00042	11.7	36961	6956	0.29
Kansas	Kansas Control	2.172	Kansas Avenue East Bridge									
Kansas	Kansas Control	2.179	10%	10	121,000	747.1	747.9	0.00038	7.1	17065	697	0.25
Kansas	Kansas Control	2.179	1%	100	241,000	758.1	759.5	0.00045	9.7	25288	796	0.29
Kansas	Kansas Control	2.179	0.5%	200	283,000	761.1	762.8	0.00047	10.5	27703	817	0.30
Kansas	Kansas Control	2.179	0.2%	500	341,000	765.5	767.4	0.00047	11.3	31323	5430	0.30
Kansas	Kansas Control	2.179	0.133%	750	367,000	767.8	769.8	0.00045	11.5	33249	5885	0.30
Kansas	Kansas Control	2.179	0.100%	1000	388,000	769.9	771.9	0.00043	11.6	34987	6889	0.30
Kansas	Missouri Control	2.179	0.080%	1250	391,000	771.3	773.2	0.00040	11.3	36112	6946	0.29
Kansas	Missouri Control	2.179	0.067%	1500	407,000	772.4	774.4	0.00040	11.5	37077	6950	0.29
Kansas	Kansas Control	2.491	10%	10	121,000	747.7	748.5	0.00034	7.2	16762	597	0.24
Kansas	Kansas Control	2.491	1%	100	241,000	758.7	760.3	0.00045	10.2	23814	681	0.29
Kansas	Kansas Control	2.491	0.5%	200	283,000	761.7	763.6	0.00048	11.1	25877	693	0.30
Kansas	Kansas Control	2.491	0.2%	500	341,000	766.1	768.3	0.00049	12.1	28910	6601	0.32
Kansas	Kansas Control	2.491	0.133%	750	367,000	768.3	770.7	0.00048	12.4	30537	6608	0.31
Kansas	Kansas Control	2.491	0.100%	1000	388,000	770.4	772.8	0.00047	12.5	32001	6614	0.31
Kansas	Kansas Control	2.491	0.080%	1250	403,000	771.7	774.2	0.00046	12.7	32940	6617	0.31
Kansas	Kansas Control	2.491	0.067%	1500	417,000	772.8	775.4	0.00046	12.8	33749	6621	0.31
Kansas	Kansas Control	2.525	10%	10	121,000	747.7	748.5	0.00033	7.3	16658	609	0.24
Kansas	Kansas Control	2.525	1%	100	241,000	758.8	760.4	0.00044	10.4	23935	709	0.29
Kansas	Kansas Control	2.525	0.5%	200	283,000	761.7	763.7	0.00047	11.3	26091	723	0.30
Kansas	Kansas Control	2.525	0.2%	500	341,000	766.1	768.4	0.00049	12.3	29241	6556	0.32
Kansas	Kansas Control	2.525	0.133%	750	367,000	768.4	770.8	0.00048	12.6	30890	6574	0.32
Kansas	Kansas Control	2.525	0.100%	1000	388,000	770.4	772.9	0.00047	12.7	32373	6591	0.31
Kansas	Kansas Control	2.525	0.080%	1250	403,000	771.8	774.3	0.00046	12.9	33325	6601	0.31
Kansas	Missouri Control	2.525	0.067%	1500	407,000	772.9	775.3	0.00044	12.7	34148	6609	0.30
Kansas	Kansas Control	2.531	KC Terminal Bridge									
Kansas	Kansas Control	2.536	10%	10	121,000	747.8	748.6	0.00035	7.2	16827	624	0.24
Kansas	Kansas Control	2.536	1%	100	241,000	759.0	760.6	0.00043	10.1	24342	710	0.29
Kansas	Kansas Control	2.536	0.5%	200	283,000	762.1	764.0	0.00046	11.0	26552	710	0.30
Kansas	Kansas Control	2.536	0.2%	500	341,000	766.6	768.8	0.00047	11.9	29769	6567	0.31
Kansas	Kansas Control	2.536	0.133%	750	367,000	769.2	771.4	0.00045	12.1	31556	6588	0.30
Kansas	Kansas Control	2.536	0.100%	1000	388,000	771.4	773.7	0.00043	12.2	33137	6603	0.30
Kansas	Kansas Control	2.536	0.080%	1250	403,000	772.8	775.1	0.00043	12.3	34163	6611	0.30
Kansas	Kansas Control	2.536	0.067%	1500	417,000	774.1	776.4	0.00042	12.4	35054	6618	0.30
Kansas	Kansas Control	3.050	10%	10	121,000	749.0	749.7	0.00035	6.7	18055	740	0.24
Kansas	Kansas Control	3.050	1%	100	241,000	760.6	761.9	0.00037	9.0	27104	805	0.26
Kansas	Kansas Control	3.050	0.5%	200	283,000	763.9	765.4	0.00039	9.7	29746	818	0.27
Kansas	Kansas Control	3.050	0.2%	500	341,000	768.5	770.2	0.00038	10.4	33584	6368	0.28
Kansas	Kansas Control	3.050	0.133%	750	367,000	771.0	772.8	0.00037	10.6	35662	6471	0.27
Kansas	Kansas Control	3.050	0.100%	1000	388,000	773.2	775.0	0.00035	10.7	37482	6499	0.27
Kansas	Kansas Control	3.050	0.080%	1250	403,000	774.6	776.4	0.00034	10.8	38676	6518	0.27
Kansas	Kansas Control	3.050	0.067%	1500	417,000	775.9	777.7	0.00034	10.9	39720	6535	0.27

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	3.405	10%	10	121,000	749.7	750.4	0.00038	6.7	18197	801	0.25
Kansas	Kansas Control	3.405	1%	100	241,000	761.5	762.6	0.00037	8.7	28090	876	0.26
Kansas	Kansas Control	3.405	0.5%	200	283,000	764.8	766.1	0.00038	9.3	31246	980	0.27
Kansas	Kansas Control	3.405	0.2%	500	341,000	769.4	770.9	0.00037	9.9	35982	6777	0.27
Kansas	Kansas Control	3.405	0.133%	750	367,000	771.9	773.5	0.00035	10.0	38578	6834	0.26
Kansas	Kansas Control	3.405	0.100%	1000	388,000	774.1	775.6	0.00033	10.0	40850	6895	0.26
Kansas	Kansas Control	3.405	0.080%	1250	403,000	775.5	777.1	0.00032	10.1	42349	6922	0.26
Kansas	Kansas Control	3.405	0.067%	1500	417,000	776.8	778.3	0.00031	10.2	43667	6947	0.25
Kansas	Kansas Control	3.416	7th Street Bridge									
Kansas	Kansas Control	3.427	10%	10	121,000	749.8	750.5	0.00037	6.3	19164	803	0.23
Kansas	Kansas Control	3.427	1%	100	241,000	761.6	762.7	0.00038	8.4	29025	879	0.25
Kansas	Kansas Control	3.427	0.5%	200	283,000	764.9	766.2	0.00039	9.0	32290	1017	0.25
Kansas	Kansas Control	3.427	0.2%	500	341,000	769.8	771.2	0.00038	9.6	37254	6850	0.25
Kansas	Kansas Control	3.427	0.133%	750	367,000	772.3	773.7	0.00036	9.7	39916	6913	0.25
Kansas	Kansas Control	3.427	0.100%	1000	388,000	774.5	776.0	0.00034	9.7	42253	6975	0.25
Kansas	Kansas Control	3.427	0.080%	1250	403,000	776.0	777.5	0.00033	9.8	43802	7023	0.24
Kansas	Kansas Control	3.427	0.067%	1500	417000	777.3	778.8	0.00032	9.8	45171	7065	0.24
Kansas	Kansas Control	3.960	10%	10	121,000	750.7	751.3	0.00022	6.2	20849	840	0.19
Kansas	Kansas Control	3.960	1%	100	241,000	762.6	763.7	0.00029	8.8	31367	948	0.23
Kansas	Kansas Control	3.960	0.5%	200	283,000	765.9	767.2	0.00031	9.5	34698	1044	0.24
Kansas	Kansas Control	3.960	0.2%	500	341,000	770.7	772.2	0.00032	10.2	39787	7119	0.24
Kansas	Kansas Control	3.960	0.133%	750	367,000	773.2	774.7	0.00031	10.3	42481	7160	0.24
Kansas	Kansas Control	3.960	0.100%	1000	388,000	775.4	776.9	0.00030	10.4	44835	7202	0.24
Kansas	Kansas Control	3.960	0.080%	1250	403,000	776.9	778.4	0.00030	10.5	46414	7244	0.24
Kansas	Kansas Control	3.960	0.067%	1500	417,000	778.1	779.7	0.00029	10.6	47839	7351	0.24
Kansas	Kansas Control	4.276	10%	10	121000	751.0	751.6	0.00029	6.5	20029	889	0.21
Kansas	Kansas Control	4.276	1%	100	241,000	763.0	764.1	0.00033	8.7	31160	970	0.24
Kansas	Kansas Control	4.276	0.5%	200	283,000	766.4	767.7	0.00034	9.3	34495	993	0.24
Kansas	Kansas Control	4.276	0.2%	500	341,000	771.2	772.6	0.00034	10.0	39357	7370	0.25
Kansas	Kansas Control	4.276	0.133%	750	367,000	773.7	775.2	0.00033	10.1	41909	7374	0.25
Kansas	Kansas Control	4.276	0.100%	1000	388,000	775.9	777.4	0.00032	10.2	44132	7378	0.24
Kansas	Kansas Control	4.276	0.080%	1250	403,000	777.3	778.8	0.00031	10.3	45617	7380	0.24
Kansas	Kansas Control	4.276	0.067%	1500	417,000	778.6	780.1	0.00031	10.3	46944	7382	0.24
Kansas	Kansas Control	4.280	12th Street Bridge									
Kansas	Kansas Control	4.284	10%	10	121000	751.1	751.7	0.00033	6.4	20077	889	0.21
Kansas	Kansas Control	4.284	1%	100	241,000	763.1	764.2	0.00038	8.6	31245	971	0.24
Kansas	Kansas Control	4.284	0.5%	200	283,000	766.5	767.7	0.00039	9.2	34597	994	0.24
Kansas	Kansas Control	4.284	0.2%	500	341,000	771.4	772.8	0.00039	9.9	39552	7371	0.25
Kansas	Kansas Control	4.284	0.133%	750	367,000	774.0	775.4	0.00038	10.0	42167	7375	0.24
Kansas	Kansas Control	4.284	0.100%	1000	388,000	776.2	777.6	0.00036	10.0	44463	7378	0.24
Kansas	Kansas Control	4.284	0.080%	1250	403,000	777.7	779.1	0.00035	10.1	46002	7381	0.24
Kansas	Kansas Control	4.284	0.067%	1500	417,000	779.0	780.5	0.00034	10.2	47380	7383	0.24
Kansas	Kansas Control	4.480	10%	10	121,000	751.4	752.1	0.00032	6.6	19975	808	0.20
Kansas	Kansas Control	4.480	1%	100	241,000	763.5	764.6	0.00039	9.0	30294	926	0.24
Kansas	Kansas Control	4.480	0.5%	200	283,000	766.9	768.2	0.00041	9.7	33575	1000	0.25
Kansas	Kansas Control	4.480	0.2%	500	341,000	771.8	773.3	0.00041	10.4	38700	7407	0.25
Kansas	Kansas Control	4.480	0.133%	750	367000	774.3	775.9	0.00039	10.5	41439	7450	0.25
Kansas	Kansas Control	4.480	0.100%	1000	388,000	776.5	778.1	0.00038	10.5	43846	7483	0.25
Kansas	Kansas Control	4.480	0.080%	1250	403,000	778.0	779.6	0.00037	10.6	45461	7505	0.24
Kansas	Kansas Control	4.480	0.067%	1500	417,000	779.4	780.9	0.00036	10.6	46909	7525	0.24
Kansas	Kansas Control	4.949	10%	10	121,000	752.2	752.5	0.00015	4.3	28205	1067	0.14
Kansas	Kansas Control	4.949	1%	100	241,000	764.7	765.2	0.00018	5.9	42292	1189	0.16
Kansas	Kansas Control	4.949	0.5%	200	283,000	768.2	768.8	0.00019	6.4	46549	1221	0.17
Kansas	Kansas Control	4.949	0.2%	500	341,000	773.2	773.9	0.00019	6.8	52859	7112	0.17
Kansas	Kansas Control	4.949	0.133%	750	367,000	775.7	776.4	0.00019	7.0	56120	7149	0.17

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	4.949	0.100%	1000	388,000	777.9	778.6	0.00018	7.0	58948	7180	0.17
Kansas	Kansas Control	4.949	0.080%	1250	403,000	779.4	780.1	0.00018	7.1	60849	7201	0.17
Kansas	Kansas Control	4.949	0.067%	1500	417,000	780.7	781.4	0.00018	7.1	62555	7218	0.17
Kansas	Kansas Control	4.960	18th Street Bridge									
Kansas	Kansas Control	4.970	10%	10	121,000	752.3	752.5	0.00014	4.1	29745	1143	0.14
Kansas	Kansas Control	4.970	1%	100	241,000	764.8	765.2	0.00016	5.5	44800	1261	0.15
Kansas	Kansas Control	4.970	0.5%	200	283,000	768.4	768.9	0.00017	5.9	49365	1294	0.16
Kansas	Kansas Control	4.970	0.2%	500	341,000	773.4	774.0	0.00017	6.3	56065	6860	0.16
Kansas	Kansas Control	4.970	0.133%	750	367,000	776.0	776.6	0.00017	6.4	59512	6946	0.16
Kansas	Kansas Control	4.970	0.100%	1000	388,000	778.2	778.9	0.00016	6.5	62510	7022	0.16
Kansas	Kansas Control	4.970	0.080%	1250	403000	779.7	780.4	0.00016	6.5	64530	7073	0.16
Kansas	Kansas Control	4.970	0.067%	1500	417,000	781.1	781.7	0.00016	6.6	66346	7106	0.16
Kansas	Kansas Control	5.506	10%	10	121,000	752.7	752.9	0.00016	3.9	31115	1163	0.13
Kansas	Kansas Control	5.506	1%	100	241,000	765.3	765.7	0.00019	5.3	46370	1252	0.15
Kansas	Kansas Control	5.506	0.5%	200	283,000	768.9	769.4	0.00020	5.7	50893	1265	0.15
Kansas	Kansas Control	5.506	0.2%	500	341,000	773.9	774.5	0.00020	6.1	57325	9185	0.15
Kansas	Kansas Control	5.506	0.133%	750	367,000	776.5	777.1	0.00019	6.2	60624	9221	0.15
Kansas	Kansas Control	5.506	0.100%	1000	388,000	778.7	779.3	0.00019	6.3	63531	9236	0.15
Kansas	Kansas Control	5.506	0.080%	1250	403,000	780.2	780.8	0.00019	6.3	65508	9244	0.15
Kansas	Kansas Control	5.506	0.067%	1500	417,000	781.5	782.2	0.00018	6.4	67289	9244	0.15
Kansas	Kansas Control	5.513	Kaw Power Plant Intake Structure									
Kansas	Kansas Control	5.520	10%	10	121,000	752.7	752.9	0.00016	3.9	31140	1163	0.13
Kansas	Kansas Control	5.520	1%	100	241,000	765.3	765.7	0.00019	5.3	46409	1252	0.15
Kansas	Kansas Control	5.520	0.5%	200	283,000	768.9	769.4	0.00020	5.7	50935	1265	0.15
Kansas	Kansas Control	5.520	0.2%	500	341,000	774.0	774.5	0.00020	6.1	57378	9186	0.15
Kansas	Kansas Control	5.520	0.133%	750	367,000	776.5	777.1	0.00019	6.2	60648	9222	0.15
Kansas	Kansas Control	5.520	0.100%	1000	388,000	778.7	779.3	0.00019	6.3	63487	9236	0.15
Kansas	Kansas Control	5.520	0.080%	1250	403,000	780.2	780.9	0.00019	6.3	65403	9244	0.15
Kansas	Kansas Control	5.520	0.067%	1500	417,000	781.6	782.2	0.00018	6.4	67126	9244	0.15
Kansas	Kansas Control	5.811	10%	10	121,000	753.0	753.1	0.00008	3.1	38875	1616	0.11
Kansas	Kansas Control	5.811	1%	100	241000	765.7	766.0	0.00010	4.1	60678	1806	0.12
Kansas	Kansas Control	5.811	0.5%	200	283,000	769.4	769.7	0.00010	4.3	67293	1827	0.12
Kansas	Kansas Control	5.811	0.2%	500	341,000	774.5	774.8	0.00010	4.6	76731	9776	0.12
Kansas	Kansas Control	5.811	0.133%	750	367,000	777.0	777.4	0.00010	4.7	81564	9860	0.12
Kansas	Kansas Control	5.811	0.100%	1000	388,000	779.3	779.6	0.00009	4.7	85750	9933	0.12
Kansas	Kansas Control	5.811	0.080%	1250	403,000	780.8	781.1	0.00009	4.8	88581	10100	0.12
Kansas	Kansas Control	5.811	0.067%	1500	417,000	782.1	782.5	0.00009	4.8	91128	10127	0.12
Kansas	Kansas Control	5.821	Kansas Avenue Bridge									
Kansas	Kansas Control	5.831	10%	10	121,000	753.0	753.2	0.00010	3.1	38954	1616	0.11
Kansas	Kansas Control	5.831	1%	100	241000	765.7	766.0	0.00010	4.1	60765	1806	0.12
Kansas	Kansas Control	5.831	0.5%	200	283,000	769.4	769.7	0.00010	4.3	67381	1827	0.12
Kansas	Kansas Control	5.831	0.2%	500	341,000	774.5	774.8	0.00009	4.6	76828	9777	0.12
Kansas	Kansas Control	5.831	0.133%	750	367,000	777.1	777.4	0.00009	4.7	81688	9862	0.12
Kansas	Kansas Control	5.831	0.100%	1000	388,000	779.3	779.7	0.00009	4.7	85900	9935	0.12
Kansas	Kansas Control	5.831	0.080%	1250	403,000	780.8	781.2	0.00008	4.8	88750	10101	0.12
Kansas	Kansas Control	5.831	0.067%	1500	417,000	782.2	782.5	0.00008	4.8	91321	10128	0.12
Kansas	Kansas Control	5.967	10%	10	121,000	753.0	753.2	0.00011	3.5	34183	1245	0.12
Kansas	Kansas Control	5.967	1%	100	241,000	765.8	766.1	0.00012	4.8	50611	1341	0.13
Kansas	Kansas Control	5.967	0.5%	200	283,000	769.4	769.8	0.00013	5.2	55519	1367	0.14
Kansas	Kansas Control	5.967	0.2%	500	341,000	774.5	774.9	0.00013	5.6	62559	8606	0.14
Kansas	Kansas Control	5.967	0.133%	750	367,000	777.0	777.5	0.00013	5.7	66142	8632	0.14
Kansas	Kansas Control	5.967	0.100%	1000	388000	779.3	779.8	0.00012	5.8	69247	8654	0.14
Kansas	Kansas Control	5.967	0.080%	1250	403,000	780.8	781.3	0.00012	5.8	71348	8682	0.14
Kansas	Kansas Control	5.967	0.067%	1500	417,000	782.1	782.7	0.00012	5.9	73243	8716	0.14

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	6.880	10%	10	121,000	753.5	753.7	0.00018	3.9	31313	1340	0.14
Kansas	Kansas Control	6.880	1%	100	241,000	766.3	766.6	0.00017	5.0	49104	1443	0.15
Kansas	Kansas Control	6.880	0.5%	200	283,000	769.9	770.3	0.00017	5.3	54395	1466	0.15
Kansas	Kansas Control	6.880	0.2%	500	341,000	775.0	775.5	0.00016	5.7	61967	8085	0.15
Kansas	Kansas Control	6.880	0.133%	750	367,000	777.5	778.0	0.00015	5.8	65793	8135	0.15
Kansas	Kansas Control	6.880	0.100%	1000	388,000	779.7	780.3	0.00015	5.8	69103	8178	0.14
Kansas	Kansas Control	6.880	0.080%	1250	403,000	781.2	781.8	0.00014	5.9	71347	8210	0.14
Kansas	Kansas Control	6.880	0.067%	1500	417,000	782.6	783.1	0.00014	5.9	73372	8240	0.14
Kansas	Kansas Control	7.329	10%	10	121,000	753.9	754.3	0.00024	5.1	24791	1186	0.17
Kansas	Kansas Control	7.329	1%	100	241,000	766.5	767.2	0.00026	6.7	40800	1410	0.18
Kansas	Kansas Control	7.329	0.5%	200	283,000	770.2	770.9	0.00026	7.1	46193	1534	0.19
Kansas	Kansas Control	7.329	0.2%	500	341,000	775.2	776.0	0.00025	7.5	54336	8637	0.19
Kansas	Kansas Control	7.329	0.133%	750	367,000	777.8	778.6	0.00024	7.6	58714	8700	0.19
Kansas	Kansas Control	7.329	0.100%	1000	388,000	780.0	780.8	0.00023	7.6	62553	8735	0.18
Kansas	Kansas Control	7.329	0.080%	1250	403,000	781.5	782.3	0.00022	7.7	65173	8754	0.18
Kansas	Kansas Control	7.329	0.067%	1500	417,000	782.8	783.6	0.00022	7.7	67547	8771	0.18
Kansas	Kansas Control	7.333	10%	10	121000	753.9	754.3	0.00024	5.1	24800	1186	0.17
Kansas	Kansas Control	7.333	1%	100	241,000	766.5	767.2	0.00026	6.7	40811	1410	0.18
Kansas	Kansas Control	7.333	0.5%	200	283,000	770.2	770.9	0.00026	7.1	46205	1534	0.19
Kansas	Kansas Control	7.333	0.2%	500	341,000	775.2	776.0	0.00025	7.5	54349	8637	0.19
Kansas	Kansas Control	7.333	0.133%	750	367,000	777.8	778.6	0.00024	7.6	58727	8701	0.19
Kansas	Kansas Control	7.333	0.100%	1000	388,000	780.0	780.8	0.00023	7.6	62564	8735	0.18
Kansas	Kansas Control	7.333	0.080%	1250	403,000	781.5	782.3	0.00022	7.7	65185	8754	0.18
Kansas	Kansas Control	7.333	0.067%	1500	417,000	782.8	783.6	0.00022	7.7	67559	8771	0.18
Kansas	Kansas Control	7.338	I-635 Bridge (northbound)									
Kansas	Kansas Control	7.342	10%	10	121,000	753.9	754.3	0.00024	5.1	24831	1186	0.17
Kansas	Kansas Control	7.342	1%	100	241,000	766.6	767.2	0.00026	6.7	40851	1412	0.18
Kansas	Kansas Control	7.342	0.5%	200	283,000	770.2	770.9	0.00026	7.1	46248	1535	0.19
Kansas	Kansas Control	7.342	0.2%	500	341,000	775.3	776.1	0.00025	7.5	54399	8638	0.19
Kansas	Kansas Control	7.342	0.133%	750	367,000	777.8	778.6	0.00024	7.6	58773	8701	0.19
Kansas	Kansas Control	7.342	0.100%	1000	388,000	780.0	780.8	0.00023	7.6	62612	8736	0.18
Kansas	Kansas Control	7.342	0.080%	1250	403,000	781.5	782.3	0.00022	7.6	65230	8754	0.18
Kansas	Kansas Control	7.342	0.067%	1500	417,000	782.8	783.6	0.00021	7.7	67612	8771	0.18
Kansas	Kansas Control	7.351	10%	10	121,000	753.9	754.3	0.00024	5.1	24838	1187	0.17
Kansas	Kansas Control	7.351	1%	100	241,000	766.6	767.2	0.00026	6.7	40862	1413	0.18
Kansas	Kansas Control	7.351	0.5%	200	283,000	770.2	770.9	0.00026	7.1	46262	1536	0.19
Kansas	Kansas Control	7.351	0.2%	500	341,000	775.3	776.1	0.00025	7.5	54414	8639	0.19
Kansas	Kansas Control	7.351	0.133%	750	367000	777.8	778.6	0.00024	7.6	58788	8701	0.19
Kansas	Kansas Control	7.351	0.100%	1000	388,000	780.0	780.8	0.00023	7.6	62626	8736	0.18
Kansas	Kansas Control	7.351	0.080%	1250	403,000	781.5	782.3	0.00022	7.6	65244	8755	0.18
Kansas	Kansas Control	7.351	0.067%	1500	417,000	782.8	783.7	0.00021	7.7	67625	8771	0.18
Kansas	Kansas Control	7.355	I-635 Bridge (southbound)									
Kansas	Kansas Control	7.360	10%	10	121,000	753.9	754.3	0.00024	5.1	24863	1187	0.17
Kansas	Kansas Control	7.360	1%	100	241,000	766.6	767.3	0.00026	6.7	40896	1414	0.18
Kansas	Kansas Control	7.360	0.5%	200	283,000	770.2	771.0	0.00026	7.1	46299	1536	0.19
Kansas	Kansas Control	7.360	0.2%	500	341,000	775.3	776.1	0.00025	7.5	54458	8640	0.19
Kansas	Kansas Control	7.360	0.133%	750	367,000	777.8	778.6	0.00024	7.6	58828	8702	0.19
Kansas	Kansas Control	7.360	0.100%	1000	388,000	780.0	780.8	0.00023	7.6	62667	8736	0.18
Kansas	Kansas Control	7.360	0.080%	1250	403000	781.5	782.3	0.00022	7.6	65285	8755	0.18
Kansas	Kansas Control	7.360	0.067%	1500	417,000	782.9	783.7	0.00021	7.7	67666	8772	0.18
Kansas	Kansas Control	7.364	10%	10	121,000	754.0	754.4	0.00024	5.1	24881	1187	0.17
Kansas	Kansas Control	7.364	1%	100	241,000	766.6	767.3	0.00026	6.7	40916	1415	0.18
Kansas	Kansas Control	7.364	0.5%	200	283,000	770.2	771.0	0.00026	7.1	46320	1537	0.19
Kansas	Kansas Control	7.364	0.2%	500	341,000	775.3	776.1	0.00025	7.5	54480	8641	0.19
Kansas	Kansas Control	7.364	0.133%	750	367,000	777.8	778.7	0.00024	7.6	58850	8702	0.19
Kansas	Kansas Control	7.364	0.100%	1000	388,000	780.0	780.8	0.00023	7.6	62688	8736	0.18

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	7.364	0.080%	1250	403,000	781.5	782.3	0.00022	7.6	65306	8755	0.18
Kansas	Kansas Control	7.364	0.067%	1500	417,000	782.9	783.7	0.00021	7.7	67687	8772	0.18
Kansas	Kansas Control	7.650	10%	10	121,000	754.3	754.7	0.00028	5.2	23629	1098	0.18
Kansas	Kansas Control	7.650	1%	100	241,000	767.0	767.7	0.00028	6.8	39350	1348	0.19
Kansas	Kansas Control	7.650	0.5%	200	283,000	770.6	771.4	0.00028	7.2	44432	1483	0.19
Kansas	Kansas Control	7.650	0.2%	500	341,000	775.6	776.5	0.00027	7.6	52055	7982	0.19
Kansas	Kansas Control	7.650	0.133%	750	367,000	778.2	779.0	0.00026	7.7	55926	8131	0.19
Kansas	Kansas Control	7.650	0.100%	1000	388,000	780.3	781.2	0.00024	7.7	59290	8242	0.19
Kansas	Kansas Control	7.650	0.080%	1250	403,000	781.8	782.7	0.00024	7.7	61581	8255	0.18
Kansas	Kansas Control	7.650	0.067%	1500	417,000	783.2	784.0	0.00023	7.7	63666	8267	0.18
Kansas	Kansas Control	8.420	10%	10	121,000	755.2	755.7	0.00021	5.6	25843	1543	0.16
Kansas	Kansas Control	8.420	1%	100	241,000	768.0	768.7	0.00023	7.2	48393	1985	0.18
Kansas	Kansas Control	8.420	0.5%	200	283,000	771.7	772.4	0.00023	7.5	55745	2020	0.18
Kansas	Kansas Control	8.420	0.2%	500	341000	776.7	777.5	0.00022	7.7	66119	7021	0.18
Kansas	Kansas Control	8.420	0.133%	750	367,000	779.2	779.9	0.00021	7.8	71310	7041	0.17
Kansas	Kansas Control	8.420	0.100%	1000	388,000	781.4	782.1	0.00020	7.7	75790	7061	0.17
Kansas	Kansas Control	8.420	0.080%	1250	403,000	782.9	783.5	0.00019	7.7	78850	7075	0.17
Kansas	Kansas Control	8.420	0.067%	1500	417,000	784.2	784.9	0.00019	7.7	81636	7088	0.17
Kansas	Kansas Control	9.040	10%	10	121,000	755.8	756.3	0.00024	5.7	24970	2622	0.17
Kansas	Kansas Control	9.040	1%	100	241,000	768.6	769.4	0.00026	7.4	44075	3243	0.19
Kansas	Kansas Control	9.040	0.5%	200	283,000	772.3	773.1	0.00026	7.8	50085	3269	0.19
Kansas	Kansas Control	9.040	0.2%	500	341,000	777.3	778.1	0.00025	8.2	58437	7222	0.19
Kansas	Kansas Control	9.040	0.133%	750	367,000	779.8	780.6	0.00024	8.2	62562	7265	0.19
Kansas	Kansas Control	9.040	0.100%	1000	388000	781.9	782.7	0.00023	8.2	66111	7303	0.19
Kansas	Kansas Control	9.040	0.080%	1250	403,000	783.3	784.1	0.00023	8.3	68533	7329	0.18
Kansas	Kansas Control	9.040	0.067%	1500	417,000	784.6	785.5	0.00022	8.3	70736	7352	0.18
Kansas	Kansas Control	9.490	10%	10	121,000	756.6	756.9	0.00022	4.6	26495	1129	0.16
Kansas	Kansas Control	9.490	1%	100	241,000	769.4	770.0	0.00022	6.1	42240	4375	0.17
Kansas	Kansas Control	9.490	0.5%	200	283,000	773.0	773.7	0.00023	6.5	46880	4462	0.17
Kansas	Kansas Control	9.490	0.2%	500	341,000	778.0	778.7	0.00022	6.9	53395	6667	0.18
Kansas	Kansas Control	9.490	0.133%	750	367,000	780.4	781.1	0.00022	7.1	56631	6766	0.18
Kansas	Kansas Control	9.490	0.100%	1000	388,000	782.5	783.2	0.00021	7.1	59411	6804	0.17
Kansas	Kansas Control	9.490	0.080%	1250	403,000	783.9	784.7	0.00021	7.2	61312	6815	0.17
Kansas	Kansas Control	9.490	0.067%	1500	417000	785.2	786.0	0.00020	7.2	63044	6825	0.17
Kansas	Kansas Control	9.498	Kansas Avenue West Bridge									
Kansas	Kansas Control	9.505	10%	10	121,000	756.6	756.9	0.00022	4.6	26562	1130	0.16
Kansas	Kansas Control	9.505	1%	100	241,000	769.4	770.0	0.00022	6.1	42320	4377	0.17
Kansas	Kansas Control	9.505	0.5%	200	283,000	773.1	773.7	0.00023	6.5	46962	4463	0.17
Kansas	Kansas Control	9.505	0.2%	500	341,000	778.0	778.7	0.00022	6.9	53481	6669	0.18
Kansas	Kansas Control	9.505	0.133%	750	367,000	780.5	781.2	0.00022	7.0	56775	6768	0.17
Kansas	Kansas Control	9.505	0.100%	1000	388,000	782.6	783.3	0.00021	7.1	59606	6805	0.17
Kansas	Kansas Control	9.505	0.080%	1250	403,000	784.0	784.8	0.00020	7.2	61545	6816	0.17
Kansas	Kansas Control	9.505	0.067%	1500	417000	785.4	786.1	0.00020	7.2	63313	6827	0.17
Kansas	Kansas Control	9.820	10%	10	121,000	756.7	757.2	0.00021	5.6	26356	1259	0.16
Kansas	Kansas Control	9.820	1%	100	241,000	769.8	770.4	0.00020	6.7	58183	4463	0.17
Kansas	Kansas Control	9.820	0.5%	200	283,000	773.5	774.1	0.00019	6.8	68766	4523	0.16
Kansas	Kansas Control	9.820	0.2%	500	341,000	778.6	779.1	0.00017	6.9	83205	5848	0.16
Kansas	Kansas Control	9.820	0.133%	750	367,000	781.1	781.6	0.00016	6.8	90311	5871	0.15
Kansas	Kansas Control	9.820	0.100%	1000	388,000	783.2	783.7	0.00015	6.7	96396	5887	0.15
Kansas	Kansas Control	9.820	0.080%	1250	403,000	784.7	785.1	0.00014	6.7	100566	5898	0.15
Kansas	Kansas Control	9.820	0.067%	1500	417,000	786.0	786.4	0.00014	6.7	104368	5908	0.14
Kansas	Kansas Control	10.400	10%	10	121,000	757.2	757.8	0.00019	6.1	21399	647	0.17
Kansas	Kansas Control	10.400	1%	100	241,000	770.1	771.1	0.00026	8.5	53720	4829	0.21
Kansas	Kansas Control	10.400	0.5%	200	283,000	773.8	774.8	0.00025	8.8	71229	4899	0.21
Kansas	Kansas Control	10.400	0.2%	500	341,000	778.8	779.8	0.00023	8.9	95947	4957	0.20
Kansas	Kansas Control	10.400	0.133%	750	367,000	781.3	782.2	0.00022	8.8	108244	5016	0.19

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	file Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	10.400	0.100%	1000	388,000	783.4	784.3	0.00020	8.7	118877	5039	0.19
Kansas	Kansas Control	10.400	0.080%	1250	403,000	784.8	785.7	0.00019	8.6	126200	5055	0.19
Kansas	Kansas Control	10.400	0.067%	1500	417,000	786.2	787.0	0.00019	8.6	132899	5070	0.18
Kansas	Kansas Control	10.600	10%	10	121,000	757.4	758.1	0.00022	6.4	20595	646	0.18
Kansas	Kansas Control	10.600	1%	100	241,000	770.4	771.5	0.00028	8.8	50930	4130	0.21
Kansas	Kansas Control	10.600	0.5%	200	283,000	774.0	775.2	0.00029	9.3	65414	4543	0.22
Kansas	Kansas Control	10.600	0.2%	500	341,000	779.0	780.1	0.00027	9.5	89325	4954	0.21
Kansas	Kansas Control	10.600	0.133%	750	367,000	781.5	782.5	0.00025	9.4	101635	5028	0.21
Kansas	Kansas Control	10.600	0.100%	1000	388,000	783.6	784.6	0.00023	9.3	112281	5067	0.20
Kansas	Kansas Control	10.600	0.080%	1250	403,000	785.0	786.0	0.00022	9.2	119636	5094	0.20
Kansas	Kansas Control	10.600	0.067%	1500	417,000	786.3	787.3	0.00022	9.1	126382	5118	0.19
Kansas	Kansas Control	10.900	10%	10	121,000	758.0	758.4	0.00017	5.4	25219	1059	0.16
Kansas	Kansas Control	10.900	1%	100	241,000	771.2	771.9	0.00019	7.1	61421	4365	0.18
Kansas	Kansas Control	10.900	0.5%	200	283,000	774.9	775.6	0.00018	7.3	77891	5067	0.17
Kansas	Kansas Control	10.900	0.2%	500	341,000	779.9	780.5	0.00017	7.5	102995	5343	0.17
Kansas	Kansas Control	10.900	0.133%	750	367,000	782.3	782.9	0.00016	7.4	115863	5377	0.17
Kansas	Kansas Control	10.900	0.100%	1000	388,000	784.3	784.9	0.00015	7.3	126919	5403	0.16
Kansas	Kansas Control	10.900	0.080%	1250	403,000	785.7	786.3	0.00015	7.3	134566	5421	0.16
Kansas	Kansas Control	10.900	0.067%	1500	417,000	787.0	787.6	0.00014	7.3	141582	5438	0.16
Kansas	Kansas Control	11.350	10%	10	121,000	758.3	758.7	0.00018	5.5	25153	1683	0.16
Kansas	Kansas Control	11.350	1%	100	241,000	771.7	772.3	0.00017	6.6	60912	3699	0.17
Kansas	Kansas Control	11.350	0.5%	200	283,000	775.4	775.9	0.00017	6.9	77320	5105	0.17
Kansas	Kansas Control	11.350	0.2%	500	341,000	780.3	780.8	0.00015	6.9	102222	5285	0.16
Kansas	Kansas Control	11.350	0.133%	750	367,000	782.7	783.2	0.00014	6.8	114821	5309	0.15
Kansas	Kansas Control	11.350	0.100%	1000	388,000	784.7	785.2	0.00013	6.7	125612	5330	0.15
Kansas	Kansas Control	11.350	0.080%	1250	403,000	786.1	786.6	0.00012	6.7	133079	5344	0.15
Kansas	Kansas Control	11.350	0.067%	1500	417,000	787.4	787.8	0.00012	6.6	139930	5357	0.14
Kansas	Kansas Control	11.850	10%	10	121,000	758.8	759.3	0.00017	5.5	25458	2705	0.16
Kansas	Kansas Control	11.850	1%	100	241,000	772.3	772.7	0.00013	6.0	76987	5086	0.15
Kansas	Kansas Control	11.850	0.5%	200	283,000	776.0	776.4	0.00012	6.1	93536	5350	0.14
Kansas	Kansas Control	11.850	0.2%	500	341,000	780.9	781.3	0.00012	6.4	116842	5707	0.15
Kansas	Kansas Control	11.850	0.133%	750	367,000	783.2	783.6	0.00011	6.3	130336	5819	0.14
Kansas	Kansas Control	11.850	0.100%	1000	388,000	785.2	785.6	0.00010	6.2	142037	5914	0.13
Kansas	Kansas Control	11.850	0.080%	1250	403,000	786.6	786.9	0.00010	6.1	150226	5958	0.13
Kansas	Kansas Control	11.850	0.067%	1500	417,000	787.8	788.2	0.00009	6.0	157757	5971	0.13
Kansas	Kansas Control	12.400	10%	10	121,000	759.4	759.7	0.00011	4.4	28837	976	0.13
Kansas	Kansas Control	12.400	1%	100	241,000	772.7	773.1	0.00011	5.4	78170	5725	0.13
Kansas	Kansas Control	12.400	0.5%	200	283,000	776.4	776.7	0.00010	5.4	94527	5790	0.13
Kansas	Kansas Control	12.400	0.2%	500	341,000	781.2	781.6	0.00009	5.5	116522	5875	0.13
Kansas	Kansas Control	12.400	0.133%	750	367,000	783.5	783.8	0.00009	5.5	127055	5937	0.12
Kansas	Kansas Control	12.400	0.100%	1000	388,000	785.5	785.8	0.00009	5.8	137891	5995	0.13
Kansas	Kansas Control	12.400	0.080%	1250	403,000	786.8	787.2	0.00009	5.7	146070	6006	0.12
Kansas	Kansas Control	12.400	0.067%	1500	417,000	788.1	788.4	0.00008	5.6	153581	6016	0.12
Kansas	Kansas Control	12.940	10%	10	121,000	759.7	760.0	0.00012	4.7	32758	1424	0.13
Kansas	Kansas Control	12.940	1%	100	241,000	772.9	773.4	0.00013	5.9	78921	5767	0.14
Kansas	Kansas Control	12.940	0.5%	200	283,000	776.6	777.0	0.00012	6.0	95811	5813	0.14
Kansas	Kansas Control	12.940	0.2%	500	341,000	781.4	781.8	0.00011	6.0	118594	5966	0.14
Kansas	Kansas Control	12.940	0.133%	750	367,000	783.7	784.1	0.00011	6.3	130226	6014	0.14
Kansas	Kansas Control	12.940	0.100%	1000	388,000	785.7	786.1	0.00010	6.2	142065	6031	0.14
Kansas	Kansas Control	12.940	0.080%	1250	403,000	787.0	787.4	0.00010	6.1	150212	6042	0.13
Kansas	Kansas Control	12.940	0.067%	1500	417,000	788.3	788.6	0.00009	6.0	157700	6052	0.13
Kansas	Kansas Control	13.300	10%	10	121,000	759.9	760.2	0.00011	4.5	33697	1412	0.13
Kansas	Kansas Control	13.300	1%	100	241,000	773.2	773.6	0.00011	5.6	81459	6111	0.14
Kansas	Kansas Control	13.300	0.5%	200	283,000	776.9	777.2	0.00010	5.6	100819	6187	0.13
Kansas	Kansas Control	13.300	0.2%	500	341,000	781.7	782.0	0.00010	5.7	126705	6305	0.13
Kansas	Kansas Control	13.300	0.133%	750	367,000	784.0	784.3	0.00009	5.6	141363	6340	0.12
Kansas	Kansas Control	13.300	0.100%	1000	388,000	786.0	786.3	0.00008	5.5	153667	6370	0.12

Kansas River Future Conditions Without Project Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	file Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	13.300	0.080%	1250	403,000	787.3	787.6	0.00008	5.4	162164	6390	0.12
Kansas	Kansas Control	13.300	0.067%	1500	417,000	788.5	788.8	0.00007	5.4	169991	6408	0.12
Kansas	Kansas Control	13.650	10%	10	121,000	760.2	760.4	0.00008	4.1	38749	2752	0.11
Kansas	Kansas Control	13.650	1%	100	241,000	773.6	773.9	0.00008	4.9	97422	5129	0.11
Kansas	Kansas Control	13.650	0.5%	200	283,000	777.2	777.4	0.00008	5.0	116309	5549	0.11
Kansas	Kansas Control	13.650	0.2%	500	341,000	782.0	782.2	0.00007	5.1	142549	5858	0.11
Kansas	Kansas Control	13.650	0.133%	750	367,000	784.3	784.5	0.00007	5.1	155954	6001	0.11
Kansas	Kansas Control	13.650	0.100%	1000	388,000	786.2	786.4	0.00007	5.1	167559	6067	0.11
Kansas	Kansas Control	13.650	0.080%	1250	403,000	787.5	787.8	0.00006	5.1	175626	6107	0.11
Kansas	Kansas Control	13.650	0.067%	1500	417,000	788.7	789.0	0.00006	5.1	183091	6144	0.11
Kansas	Kansas Control	14.250	10%	10	121,000	760.5	760.7	0.00010	3.9	36135	1666	0.12
Kansas	Kansas Control	14.250	1%	100	241,000	773.8	774.1	0.00010	5.0	96601	6213	0.13
Kansas	Kansas Control	14.250	0.5%	200	283,000	777.4	777.7	0.00010	5.2	118601	6394	0.13
Kansas	Kansas Control	14.250	0.2%	500	341,000	782.2	782.5	0.00009	5.4	148258	6485	0.13
Kansas	Kansas Control	14.250	0.133%	750	367,000	784.4	784.8	0.00009	5.4	163028	6525	0.13
Kansas	Kansas Control	14.250	0.100%	1000	388,000	786.4	786.7	0.00009	5.4	175510	6542	0.12
Kansas	Kansas Control	14.250	0.080%	1250	403,000	787.7	788.0	0.00009	5.4	184135	6554	0.12
Kansas	Kansas Control	14.250	0.067%	1500	417,000	788.9	789.2	0.00008	5.4	192083	6565	0.12
Kansas	Kansas Control	14.620	10%	10	121,000	760.7	760.9	0.00006	3.5	38542	1216	0.10
Kansas	Kansas Control	14.620	1%	100	241,000	774.0	774.3	0.00008	5.0	91201	6358	0.12
Kansas	Kansas Control	14.620	0.5%	200	283,000	777.5	777.9	0.00008	5.2	113959	6422	0.12
Kansas	Kansas Control	14.620	0.2%	500	341,000	782.3	782.7	0.00008	5.5	144493	6521	0.12
Kansas	Kansas Control	14.620	0.133%	750	367,000	784.6	785.0	0.00008	5.5	159355	6543	0.12
Kansas	Kansas Control	14.620	0.100%	1000	388,000	786.5	786.9	0.00008	5.5	171802	6562	0.12
Kansas	Kansas Control	14.620	0.080%	1250	403,000	787.8	788.2	0.00008	5.5	180411	6574	0.12
Kansas	Kansas Control	14.620	0.067%	1500	417,000	789.0	789.4	0.00008	5.5	188345	6586	0.12

EXHIBIT A-2.114
Kansas River Future Conditions With Tree Removal Alternative
Water Surface Elevations

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	0.010	10%	10	121,000	742.4	742.9	0.00026	5.9	20554	812	0.21
Kansas	Missouri Control	0.010	1%	100	192,000	751.2	751.9	0.00025	6.8	28952	1044	0.23
Kansas	Missouri Control	0.010	0.5%	200	237,000	753.6	754.6	0.00029	7.8	31524	1090	0.25
Kansas	Missouri Control	0.010	0.2%	500	308,000	756.8	758.1	0.00037	9.3	35048	1151	0.28
Kansas	Missouri Control	0.010	0.133%	750	343,000	758.0	759.6	0.00041	10.0	36578	1277	0.30
Kansas	Missouri Control	0.010	0.100%	1000	369,000	759.0	760.6	0.00044	10.5	37776	1335	0.31
Kansas	Missouri Control	0.010	0.080%	1250	391,000	759.7	761.5	0.00046	10.9	38804	1382	0.32
Kansas	Missouri Control	0.010	0.067%	1500	407,000	760.3	762.2	0.00048	11.2	39584	1434	0.33
Kansas	Kansas Control	0.140	10%	10	121,000	742.5	743.1	0.00028	6.2	19438	737	0.21
Kansas	Missouri Control	0.140	1%	100	192,000	751.3	752.1	0.00027	7.4	26175	803	0.22
Kansas	Missouri Control	0.140	0.5%	200	237,000	753.7	754.8	0.00033	8.5	28129	820	0.25
Kansas	Missouri Control	0.140	0.2%	500	308,000	756.8	758.4	0.00043	10.2	30790	924	0.28
Kansas	Missouri Control	0.140	0.133%	750	343,000	758.1	760.0	0.00048	10.9	31999	1009	0.30
Kansas	Missouri Control	0.140	0.100%	1000	369,000	759.0	761.1	0.00051	11.5	32921	1025	0.31
Kansas	Missouri Control	0.140	0.080%	1250	391,000	759.8	762.0	0.00054	12.0	33689	1038	0.32
Kansas	Missouri Control	0.140	0.067%	1500	407,000	760.3	762.6	0.00056	12.3	34259	1044	0.33
Kansas	Kansas Control	0.220	10%	10	121,000	742.6	743.3	0.00039	7.0	17193	697	0.25
Kansas	Missouri Control	0.220	1%	100	192,000	751.3	752.3	0.00036	8.2	23732	786	0.25
Kansas	Missouri Control	0.220	0.5%	200	237,000	753.7	755.1	0.00043	9.4	25636	803	0.28
Kansas	Missouri Control	0.220	0.2%	500	308,000	756.8	758.7	0.00054	11.2	28170	826	0.32
Kansas	Missouri Control	0.220	0.133%	750	343,000	758.1	760.3	0.00060	12.1	29220	836	0.34
Kansas	Missouri Control	0.220	0.100%	1000	369,000	759.0	761.4	0.00065	12.7	29971	843	0.35
Kansas	Missouri Control	0.220	0.080%	1250	391,000	759.7	762.4	0.00068	13.2	30607	923	0.36
Kansas	Missouri Control	0.220	0.067%	1500	407,000	760.2	763.1	0.00072	13.6	31111	991	0.37
Kansas	Kansas Control	0.253	10%	10	121,000	742.6	743.4	0.00043	7.4	16385	667	0.26
Kansas	Missouri Control	0.253	1%	100	192,000	751.3	752.4	0.00040	8.6	22641	758	0.26
Kansas	Missouri Control	0.253	0.5%	200	237,000	753.7	755.2	0.00048	9.9	24472	775	0.29
Kansas	Missouri Control	0.253	0.2%	500	308,000	756.8	758.9	0.00060	11.7	26905	798	0.33
Kansas	Missouri Control	0.253	0.133%	750	343,000	758.0	760.5	0.00067	12.6	27912	807	0.35
Kansas	Missouri Control	0.253	0.100%	1000	369,000	758.9	761.6	0.00072	13.3	28644	834	0.37
Kansas	Missouri Control	0.253	0.080%	1250	391,000	759.6	762.6	0.00076	13.8	29253	836	0.38
Kansas	Missouri Control	0.253	0.067%	1500	407,000	760.2	763.3	0.00079	14.2	29705	836	0.39
Kansas	Kansas Control	0.256	Missouri Pacific Bridge No. 1									
Kansas	Kansas Control	0.259	10%	10	121,000	742.6	743.5	0.00044	7.4	16272	667	0.27
Kansas	Missouri Control	0.259	1%	100	192,000	751.4	752.5	0.00040	8.6	22563	764	0.27
Kansas	Missouri Control	0.259	0.5%	200	237,000	753.8	755.3	0.00048	9.9	24425	781	0.29
Kansas	Missouri Control	0.259	0.2%	500	308,000	756.9	759.0	0.00061	11.7	26911	806	0.34
Kansas	Missouri Control	0.259	0.133%	750	343,000	758.2	760.6	0.00067	12.6	27947	814	0.35
Kansas	Missouri Control	0.259	0.100%	1000	369,000	759.1	761.8	0.00072	13.3	28686	817	0.37
Kansas	Missouri Control	0.259	0.080%	1250	391,000	759.9	762.8	0.00076	13.8	29337	820	0.38
Kansas	Missouri Control	0.259	0.067%	1500	407,000	760.5	763.5	0.00078	14.1	29828	5638	0.39
Kansas	Kansas Control	0.274	10%	10	121,000	742.9	743.6	0.00039	6.6	18245	810	0.25
Kansas	Missouri Control	0.274	1%	100	192,000	751.7	752.6	0.00033	7.5	25743	886	0.24
Kansas	Missouri Control	0.274	0.5%	200	237,000	754.3	755.4	0.00038	8.6	28010	903	0.26
Kansas	Missouri Control	0.274	0.2%	500	308,000	757.6	759.2	0.00047	10.1	31075	926	0.29
Kansas	Missouri Control	0.274	0.133%	750	343,000	759.0	760.8	0.00051	10.8	32387	965	0.31
Kansas	Missouri Control	0.274	0.100%	1000	369,000	760.0	762.0	0.00054	11.4	33366	1005	0.32
Kansas	Missouri Control	0.274	0.080%	1250	391,000	760.9	763.0	0.00057	11.8	34262	5880	0.33
Kansas	Missouri Control	0.274	0.067%	1500	407,000	761.5	763.8	0.00058	12.0	34951	6011	0.33
Kansas	Kansas Control	0.280	I-70 Bridge (westbound)									
Kansas	Kansas Control	0.286	10%	10	121,000	743.0	743.7	0.00039	6.7	18182	808	0.25
Kansas	Missouri Control	0.286	1%	100	192,000	751.8	752.7	0.00034	7.5	25688	886	0.24
Kansas	Missouri Control	0.286	0.5%	200	237,000	754.4	755.5	0.00040	8.5	27977	903	0.26
Kansas	Missouri Control	0.286	0.2%	500	308,000	757.8	759.3	0.00048	10.0	31079	927	0.29
Kansas	Missouri Control	0.286	0.133%	750	343,000	759.2	760.9	0.00052	10.7	32414	961	0.31
Kansas	Missouri Control	0.286	0.100%	1000	369,000	760.2	762.1	0.00055	11.2	33400	1011	0.32

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	file Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	0.286	0.080%	1250	391,000	761.1	763.1	0.00057	11.6	34297	5875	0.33
Kansas	Missouri Control	0.286	0.067%	1500	407,000	761.7	763.9	0.00059	11.8	34968	5992	0.33
Kansas	Kansas Control	0.297	10%	10	121,000	743.0	743.7	0.00040	6.7	18067	801	0.25
Kansas	Missouri Control	0.297	1%	100	192,000	751.8	752.7	0.00035	7.5	25528	881	0.24
Kansas	Missouri Control	0.297	0.5%	200	237,000	754.4	755.5	0.00040	8.6	27806	899	0.27
Kansas	Missouri Control	0.297	0.2%	500	308,000	757.8	759.3	0.00049	10.1	30896	923	0.30
Kansas	Missouri Control	0.297	0.133%	750	343,000	759.2	761.0	0.00053	10.8	32226	956	0.31
Kansas	Missouri Control	0.297	0.100%	1000	369,000	760.2	762.2	0.00056	11.3	33207	1005	0.32
Kansas	Missouri Control	0.297	0.080%	1250	391,000	761.1	763.2	0.00058	11.7	34099	5867	0.33
Kansas	Missouri Control	0.297	0.067%	1500	407,000	761.8	763.9	0.00059	11.9	34766	5983	0.33
Kansas	Kansas Control	0.303	I-70 Bridge (eastbound)									
Kansas	Kansas Control	0.309	10%	10	121,000	743.1	743.8	0.00040	6.8	17931	786	0.25
Kansas	Missouri Control	0.309	1%	100	192,000	751.9	752.8	0.00035	7.6	25261	865	0.24
Kansas	Missouri Control	0.309	0.5%	200	237,000	754.5	755.6	0.00041	8.7	27518	887	0.27
Kansas	Missouri Control	0.309	0.2%	500	308,000	757.9	759.5	0.00049	10.2	30627	924	0.30
Kansas	Missouri Control	0.309	0.133%	750	343,000	759.3	761.2	0.00053	10.9	31978	958	0.31
Kansas	Missouri Control	0.309	0.100%	1000	369,000	760.4	762.4	0.00056	11.4	32975	994	0.32
Kansas	Missouri Control	0.309	0.080%	1250	391,000	761.3	763.4	0.00058	11.8	33870	5874	0.33
Kansas	Missouri Control	0.309	0.067%	1500	407,000	761.9	764.2	0.00060	12.0	34538	5990	0.34
Kansas	Kansas Control	0.440	10%	10	121,000	743.2	744.1	0.00050	7.4	16376	742	0.28
Kansas	Kansas Control	0.440	1%	100	241,000	752.0	753.7	0.00066	10.5	23229	817	0.33
Kansas	Missouri Control	0.440	0.5%	200	237,000	754.6	755.9	0.00049	9.5	25331	837	0.29
Kansas	Missouri Control	0.440	0.2%	500	308,000	758.0	759.9	0.00059	11.1	28242	865	0.32
Kansas	Missouri Control	0.440	0.133%	750	343,000	759.4	761.6	0.00064	11.9	29515	904	0.34
Kansas	Missouri Control	0.440	0.100%	1000	369,000	760.4	762.8	0.00067	12.5	30446	5279	0.35
Kansas	Missouri Control	0.440	0.080%	1250	391,000	761.3	763.9	0.00070	12.9	31266	5468	0.36
Kansas	Missouri Control	0.440	0.067%	1500	407,000	762.0	764.7	0.00071	13.2	31878	5609	0.37
Kansas	Kansas Control	0.496	10%	10	121,000	743.5	744.2	0.00041	6.7	17981	804	0.25
Kansas	Kansas Control	0.496	1%	100	241,000	752.5	753.9	0.00052	9.5	25628	889	0.30
Kansas	Missouri Control	0.496	0.5%	200	237,000	754.9	756.1	0.00039	8.6	27809	909	0.26
Kansas	Missouri Control	0.496	0.2%	500	308,000	758.5	760.1	0.00047	10.1	31076	928	0.29
Kansas	Missouri Control	0.496	0.133%	750	343,000	760.0	761.8	0.00051	10.8	32589	966	0.31
Kansas	Missouri Control	0.496	0.100%	1000	369,000	761.1	763.0	0.00054	11.3	33630	5557	0.32
Kansas	Missouri Control	0.496	0.080%	1250	391,000	762.0	764.1	0.00056	11.7	34535	5735	0.32
Kansas	Missouri Control	0.496	0.067%	1500	407,000	762.7	764.9	0.00057	11.9	35209	5867	0.33
Kansas	Kansas Control	0.500	James Street Bridge									
Kansas	Kansas Control	0.504	10%	10	121,000	743.6	744.3	0.00040	6.7	18047	798	0.25
Kansas	Kansas Control	0.504	1%	100	241,000	752.7	754.0	0.00052	9.5	25676	877	0.30
Kansas	Missouri Control	0.504	0.5%	200	237,000	755.1	756.2	0.00039	8.6	27805	896	0.26
Kansas	Missouri Control	0.504	0.2%	500	308,000	758.6	760.2	0.00047	10.1	31093	951	0.29
Kansas	Missouri Control	0.504	0.133%	750	343,000	760.2	762.0	0.00050	10.8	32559	956	0.31
Kansas	Missouri Control	0.504	0.100%	1000	369,000	761.3	763.2	0.00053	11.3	33609	5595	0.31
Kansas	Missouri Control	0.504	0.080%	1250	391,000	762.2	764.3	0.00055	11.7	34523	5777	0.32
Kansas	Missouri Control	0.504	0.067%	1500	407,000	763.0	765.1	0.00056	11.9	35217	5915	0.33
Kansas	Kansas Control	0.640	10%	10	121,000	743.8	744.6	0.00032	7.1	17469	692	0.23
Kansas	Kansas Control	0.640	1%	100	241,000	752.9	754.6	0.00050	10.6	24052	759	0.30
Kansas	Missouri Control	0.640	0.5%	200	237,000	755.2	756.7	0.00039	9.8	25823	774	0.27
Kansas	Missouri Control	0.640	0.2%	500	308,000	758.8	760.8	0.00049	11.6	28642	799	0.31
Kansas	Missouri Control	0.640	0.133%	750	343,000	760.3	762.6	0.00054	12.4	29869	818	0.32
Kansas	Missouri Control	0.640	0.100%	1000	369,000	761.4	763.9	0.00057	13.0	31025	5812	0.34
Kansas	Missouri Control	0.640	0.080%	1250	391,000	762.3	765.0	0.00060	13.5	32007	5996	0.34
Kansas	Missouri Control	0.640	0.067%	1500	407,000	763.1	765.9	0.00061	13.8	32752	6136	0.35
Kansas	Kansas Control	0.812	10%	10	121,000	744.0	745.0	0.00039	8.0	15840	657	0.26
Kansas	Kansas Control	0.812	1%	100	241,000	753.1	755.2	0.00059	11.8	22135	723	0.33
Kansas	Kansas Control	0.812	0.5%	200	283,000	755.4	757.9	0.00067	13.0	23788	737	0.36

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	file Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	0.812	0.2%	500	308,000	759.0	761.4	0.00058	12.8	26465	751	0.34
Kansas	Missouri Control	0.812	0.133%	750	343,000	760.5	763.3	0.00064	13.7	27619	756	0.35
Kansas	Missouri Control	0.812	0.100%	1000	369,000	761.6	764.6	0.00068	14.4	28449	6077	0.37
Kansas	Missouri Control	0.812	0.080%	1250	391,000	762.5	765.8	0.00071	14.9	29171	6242	0.38
Kansas	Missouri Control	0.812	0.067%	1500	407,000	763.2	766.6	0.00073	15.2	29716	6368	0.38
Kansas	Kansas Control	0.815	KC Southern Bridge									
Kansas	Kansas Control	0.817	10%	10	121,000	744.1	745.0	0.00040	8.0	15822	656	0.26
Kansas	Kansas Control	0.817	1%	100	241,000	753.2	755.3	0.00061	11.8	22139	722	0.33
Kansas	Kansas Control	0.817	0.5%	200	283,000	755.5	758.0	0.00068	13.0	23802	736	0.35
Kansas	Missouri Control	0.817	0.2%	500	308,000	759.1	761.5	0.00060	12.8	26462	752	0.34
Kansas	Missouri Control	0.817	0.133%	750	343,000	760.7	763.5	0.00065	13.7	27719	760	0.35
Kansas	Missouri Control	0.817	0.100%	1000	369,000	762.0	764.9	0.00068	14.3	28650	1471	0.36
Kansas	Missouri Control	0.817	0.080%	1250	391,000	763.0	766.2	0.00071	14.7	29462	6329	0.37
Kansas	Missouri Control	0.817	0.067%	1500	407,000	763.8	767.1	0.00072	15.0	30082	6473	0.38
Kansas	Kansas Control	1.106	10%	10	121,000	744.6	745.6	0.00039	8.0	15750	643	0.25
Kansas	Kansas Control	1.106	1%	100	241,000	754.1	756.2	0.00059	11.8	22110	695	0.33
Kansas	Kansas Control	1.106	0.5%	200	283,000	756.5	759.0	0.00066	13.0	23781	703	0.35
Kansas	Missouri Control	1.106	0.2%	500	308,000	759.9	762.4	0.00059	12.9	26213	715	0.34
Kansas	Missouri Control	1.106	0.133%	750	343,000	761.7	764.4	0.00064	13.8	27460	720	0.35
Kansas	Missouri Control	1.106	0.100%	1000	369,000	762.9	765.9	0.00067	14.4	28375	7013	0.36
Kansas	Missouri Control	1.106	0.080%	1250	391,000	764.0	767.2	0.00069	14.9	29167	7212	0.37
Kansas	Missouri Control	1.106	0.067%	1500	407,000	764.9	768.2	0.00071	15.2	29767	7360	0.37
Kansas	Kansas Control	1.112	Central Avenue Bridge									
Kansas	Kansas Control	1.117	10%	10	121,000	744.7	745.7	0.00038	8.0	15816	643	0.25
Kansas	Kansas Control	1.117	1%	100	241,000	754.2	756.3	0.00058	11.8	22196	694	0.33
Kansas	Kansas Control	1.117	0.5%	200	283,000	756.6	759.1	0.00065	12.9	23872	702	0.35
Kansas	Missouri Control	1.117	0.2%	500	308,000	760.0	762.5	0.00058	12.9	26282	713	0.33
Kansas	Missouri Control	1.117	0.133%	750	343,000	761.9	764.7	0.00062	13.7	27642	5397	0.35
Kansas	Missouri Control	1.117	0.100%	1000	369,000	763.3	766.3	0.00065	14.3	28645	7146	0.36
Kansas	Missouri Control	1.117	0.080%	1250	391,000	764.5	767.7	0.00067	14.7	29534	7379	0.36
Kansas	Missouri Control	1.117	0.067%	1500	407,000	765.5	768.7	0.00068	15.0	30213	7547	0.37
Kansas	Kansas Control	1.270	10%	10	121,000	745.2	746.0	0.00037	7.1	17036	648	0.24
Kansas	Kansas Control	1.270	1%	100	241,000	755.1	756.7	0.00051	10.3	23776	709	0.30
Kansas	Kansas Control	1.270	0.5%	200	283,000	757.6	759.6	0.00056	11.3	25592	718	0.32
Kansas	Kansas Control	1.270	0.2%	500	341,000	761.0	763.4	0.00061	12.5	28001	730	0.34
Kansas	Missouri Control	1.270	0.133%	750	343,000	763.0	765.2	0.00053	12.0	29457	6410	0.32
Kansas	Missouri Control	1.270	0.100%	1000	369,000	764.4	766.8	0.00055	12.5	30537	6608	0.32
Kansas	Missouri Control	1.270	0.080%	1250	391,000	765.7	768.2	0.00056	12.8	31475	6780	0.33
Kansas	Missouri Control	1.270	0.067%	1500	407,000	766.7	769.3	0.00057	13.1	32185	6910	0.33
Kansas	Kansas Control	1.385	10%	10	121,000	745.4	746.2	0.00041	7.4	16405	626	0.25
Kansas	Kansas Control	1.385	1%	100	241,000	755.3	757.1	0.00055	10.6	22884	674	0.31
Kansas	Kansas Control	1.385	0.5%	200	283,000	757.9	760.0	0.00060	11.7	24619	683	0.33
Kansas	Kansas Control	1.385	0.2%	500	341,000	761.2	763.8	0.00066	12.9	26919	694	0.35
Kansas	Missouri Control	1.385	0.133%	750	343,000	763.2	765.5	0.00057	12.4	28275	6011	0.33
Kansas	Missouri Control	1.385	0.100%	1000	369,000	764.6	767.2	0.00059	12.9	29304	6247	0.34
Kansas	Missouri Control	1.385	0.080%	1250	391,000	765.9	768.6	0.00061	13.3	30197	6452	0.34
Kansas	Missouri Control	1.385	0.067%	1500	407,000	766.9	769.7	0.00061	13.5	30872	6628	0.34
Kansas	Kansas Control	1.399	I-670 Bridge									
Kansas	Kansas Control	1.413	10%	10	121,000	745.5	746.4	0.00040	7.4	16413	624	0.25
Kansas	Kansas Control	1.413	1%	100	241,000	755.6	757.3	0.00055	10.6	22952	674	0.31
Kansas	Kansas Control	1.413	0.5%	200	283,000	758.2	760.3	0.00060	11.6	24713	683	0.33
Kansas	Kansas Control	1.413	0.2%	500	341,000	761.6	764.1	0.00065	12.8	27047	695	0.35
Kansas	Missouri Control	1.413	0.133%	750	343,000	763.5	765.8	0.00057	12.3	28372	6061	0.33
Kansas	Missouri Control	1.413	0.100%	1000	369,000	765.0	767.5	0.00059	12.8	29424	6324	0.33
Kansas	Missouri Control	1.413	0.080%	1250	391,000	766.3	769.0	0.00060	13.2	30349	6571	0.34

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	1.413	0.067%	1500	407,000	767.3	770.1	0.00060	13.4	31054	6719	0.34
Kansas	Kansas Control	1.614	10%	10	121,000	745.6	746.5	0.00042	7.6	15938	597	0.26
Kansas	Kansas Control	1.614	1%	100	241,000	755.6	757.5	0.00059	10.9	22336	669	0.32
Kansas	Kansas Control	1.614	0.5%	200	283,000	758.2	760.4	0.00064	11.9	24087	678	0.34
Kansas	Kansas Control	1.614	0.2%	500	341,000	761.6	764.3	0.00070	13.1	26405	690	0.36
Kansas	Missouri Control	1.614	0.133%	750	343,000	763.5	766.0	0.00061	12.6	27716	6097	0.34
Kansas	Missouri Control	1.614	0.100%	1000	369,000	765.0	767.7	0.00063	13.1	28779	6297	0.34
Kansas	Missouri Control	1.614	0.080%	1250	391,000	766.3	769.1	0.00064	13.4	29711	6474	0.35
Kansas	Missouri Control	1.614	0.067%	1500	407,000	767.3	770.2	0.00064	13.7	30423	6608	0.35
Kansas	Kansas Control	1.619	Missouri Pacific Bridge No. 72									
Kansas	Kansas Control	1.624	10%	10	121,000	745.7	746.6	0.00042	7.6	15987	598	0.26
Kansas	Kansas Control	1.624	1%	100	241,000	755.8	757.6	0.00058	10.8	22436	670	0.32
Kansas	Kansas Control	1.624	0.5%	200	283,000	758.4	760.6	0.00063	11.8	24208	679	0.34
Kansas	Kansas Control	1.624	0.2%	500	341,000	762.1	764.7	0.00067	13.0	26741	692	0.35
Kansas	Missouri Control	1.624	0.133%	750	343,000	764.1	766.5	0.00058	12.4	28123	6175	0.33
Kansas	Missouri Control	1.624	0.100%	1000	369,000	765.8	768.3	0.00059	12.8	29309	6403	0.33
Kansas	Missouri Control	1.624	0.080%	1250	391,000	767.2	769.9	0.00060	13.2	30312	6594	0.34
Kansas	Missouri Control	1.624	0.067%	1500	407,000	768.3	771.0	0.00060	13.4	31014	6760	0.34
Kansas	Kansas Control	1.634	10%	10	121,000	745.7	746.6	0.00042	7.6	15937	594	0.26
Kansas	Kansas Control	1.634	1%	100	241,000	755.8	757.6	0.00059	10.8	22364	670	0.32
Kansas	Kansas Control	1.634	0.5%	200	283,000	758.4	760.6	0.00064	11.8	24141	681	0.34
Kansas	Kansas Control	1.634	0.2%	500	341,000	762.1	764.7	0.00068	13.0	26683	694	0.35
Kansas	Missouri Control	1.634	0.133%	750	343,000	764.1	766.5	0.00059	12.4	28066	6116	0.33
Kansas	Missouri Control	1.634	0.100%	1000	369,000	765.8	768.4	0.00060	12.9	29256	6334	0.34
Kansas	Missouri Control	1.634	0.080%	1250	391,000	767.3	769.9	0.00060	13.2	30262	6519	0.34
Kansas	Missouri Control	1.634	0.067%	########	407,000	768.3	771.1	0.00061	13.4	30967	6649	0.34
Kansas	Kansas Control	1.638	Union Pacific Bridge No. 3									
Kansas	Kansas Control	1.643	10%	10	121,000	745.8	746.7	0.00042	7.6	15987	595	0.26
Kansas	Kansas Control	1.643	1%	100	241,000	756.0	757.8	0.00058	10.8	22467	670	0.32
Kansas	Kansas Control	1.643	0.5%	200	283,000	758.6	760.8	0.00063	11.8	24257	679	0.34
Kansas	Kansas Control	1.643	0.2%	500	341,000	762.3	764.9	0.00067	12.9	26809	692	0.35
Kansas	Missouri Control	1.643	0.133%	750	343,000	764.4	766.8	0.00057	12.4	28268	6156	0.33
Kansas	Missouri Control	1.643	0.100%	1000	369,000	766.3	768.8	0.00058	12.7	29535	6389	0.33
Kansas	Missouri Control	1.643	0.080%	1250	391,000	767.7	770.3	0.00058	13.1	30540	6574	0.33
Kansas	Missouri Control	1.643	0.067%	1500	407,000	768.7	771.4	0.00059	13.3	31245	6706	0.34
Kansas	Kansas Control	2.016	10%	10	121,000	746.6	747.4	0.00035	7.5	16254	585	0.24
Kansas	Kansas Control	2.016	1%	100	241,000	757.0	758.9	0.00051	11.0	22769	663	0.30
Kansas	Kansas Control	2.016	0.5%	200	283,000	759.8	762.0	0.00056	12.0	24613	683	0.32
Kansas	Kansas Control	2.016	0.2%	500	341,000	763.5	766.2	0.00060	13.2	27257	711	0.34
Kansas	Kansas Control	2.016	0.133%	750	367,000	765.5	768.3	0.00060	13.6	28657	6486	0.34
Kansas	Kansas Control	2.016	0.100%	1000	369,000	767.3	769.9	0.00054	13.1	29977	6785	0.32
Kansas	Missouri Control	2.016	0.080%	1250	391,000	768.8	771.5	0.00054	13.5	31038	7021	0.33
Kansas	Missouri Control	2.016	0.067%	1500	407,000	769.8	772.6	0.00055	13.7	31783	7179	0.33
Kansas	Kansas Control	2.097	10%	10	121,000	746.7	747.6	0.00038	7.6	16008	586	0.25
Kansas	Kansas Control	2.097	1%	100	241,000	757.3	759.1	0.00052	10.9	22639	673	0.31
Kansas	Kansas Control	2.097	0.5%	200	283,000	760.0	762.2	0.00056	11.9	24539	696	0.33
Kansas	Kansas Control	2.097	0.2%	500	341,000	763.9	766.5	0.00060	13.1	27259	5103	0.34
Kansas	Kansas Control	2.097	0.133%	750	367,000	765.8	768.6	0.00060	13.4	28674	5212	0.34
Kansas	Kansas Control	2.097	0.100%	1000	388,000	767.6	770.4	0.00059	13.6	29985	6034	0.34
Kansas	Missouri Control	2.097	0.080%	1250	391,000	769.1	771.7	0.00054	13.3	31035	6676	0.33
Kansas	Missouri Control	2.097	0.067%	1500	407,000	770.1	772.8	0.00054	13.5	31785	7094	0.33
Kansas	Kansas Control	2.104	CRI&P Bridge									
Kansas	Kansas Control	2.111	10%	10	121,000	746.8	747.7	0.00037	7.5	16076	589	0.25
Kansas	Kansas Control	2.111	1%	100	241,000	757.4	759.2	0.00049	10.8	22801	678	0.31

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	2.111	0.5%	200	283,000	760.2	762.4	0.00054	11.8	24735	702	0.32
Kansas	Kansas Control	2.111	0.2%	500	341,000	764.2	766.7	0.00057	12.9	27574	5117	0.34
Kansas	Kansas Control	2.111	0.133%	750	367,000	766.3	769.0	0.00056	13.2	29129	5401	0.34
Kansas	Kansas Control	2.111	0.100%	1000	388,000	768.3	771.0	0.00054	13.4	30579	6299	0.33
Kansas	Missouri Control	2.111	0.080%	1250	391,000	769.7	772.2	0.00050	13.1	31583	6925	0.32
Kansas	Missouri Control	2.111	0.067%	1500	407,000	770.7	773.4	0.00050	13.3	32342	7092	0.33
Kansas	Kansas Control	2.165	10%	10	121,000	747.0	747.8	0.00038	7.1	16991	692	0.25
Kansas	Kansas Control	2.165	1%	100	241,000	757.9	759.4	0.00045	9.8	25206	824	0.29
Kansas	Kansas Control	2.165	0.5%	200	283,000	760.8	762.6	0.00047	10.6	27661	852	0.30
Kansas	Kansas Control	2.165	0.2%	500	341,000	765.0	767.0	0.00048	11.4	31194	5371	0.31
Kansas	Kansas Control	2.165	0.133%	750	367,000	767.1	769.2	0.00047	11.7	33064	6122	0.31
Kansas	Kansas Control	2.165	0.100%	1000	388,000	769.1	771.2	0.00045	11.7	34784	6691	0.30
Kansas	Missouri Control	2.165	0.080%	1250	391,000	770.4	772.4	0.00041	11.5	35928	6947	0.29
Kansas	Missouri Control	2.165	0.067%	1500	407,000	771.5	773.6	0.00042	11.7	36846	6955	0.29
Kansas	Kansas Control	2.172	Kansas Avenue East Bridge									
Kansas	Kansas Control	2.179	10%	10	121,000	747.1	747.9	0.00038	7.1	17059	697	0.25
Kansas	Kansas Control	2.179	1%	100	241,000	758.0	759.5	0.00045	9.7	25242	796	0.29
Kansas	Kansas Control	2.179	0.5%	200	283,000	761.0	762.7	0.00047	10.5	27618	816	0.30
Kansas	Kansas Control	2.179	0.2%	500	341,000	765.3	767.3	0.00047	11.3	31210	5429	0.30
Kansas	Kansas Control	2.179	0.133%	750	367,000	767.6	769.7	0.00045	11.5	33115	5808	0.30
Kansas	Kansas Control	2.179	0.100%	1000	388,000	769.7	771.8	0.00043	11.6	34864	6818	0.30
Kansas	Missouri Control	2.179	0.080%	1250	391,000	771.1	773.1	0.00040	11.3	35994	6945	0.29
Kansas	Missouri Control	2.179	0.067%	1500	407,000	772.3	774.3	0.00040	11.5	36945	6950	0.29
Kansas	Kansas Control	2.491	10%	10	121,000	747.7	748.5	0.00034	7.2	16757	597	0.24
Kansas	Kansas Control	2.491	1%	100	241,000	758.7	760.3	0.00045	10.2	23774	680	0.29
Kansas	Kansas Control	2.491	0.5%	200	283,000	761.6	763.5	0.00048	11.1	25806	693	0.31
Kansas	Kansas Control	2.491	0.2%	500	341,000	765.9	768.2	0.00050	12.1	28815	5458	0.32
Kansas	Kansas Control	2.491	0.133%	750	367,000	768.2	770.5	0.00049	12.4	30420	6607	0.32
Kansas	Kansas Control	2.491	0.100%	1000	388,000	770.2	772.6	0.00047	12.5	31892	6613	0.31
Kansas	Kansas Control	2.491	0.080%	1250	403,000	771.5	774.0	0.00047	12.7	32827	6617	0.31
Kansas	Kansas Control	2.491	0.067%	1500	407,000	772.7	775.1	0.00044	12.5	33636	6620	0.30
Kansas	Kansas Control	2.525	10%	10	121,000	747.7	748.5	0.00033	7.3	16653	609	0.24
Kansas	Kansas Control	2.525	1%	100	241,000	758.7	760.4	0.00044	10.4	23898	709	0.29
Kansas	Kansas Control	2.525	0.5%	200	283,000	761.7	763.6	0.00047	11.3	26023	723	0.30
Kansas	Kansas Control	2.525	0.2%	500	341,000	766.0	768.3	0.00049	12.3	29152	5587	0.32
Kansas	Kansas Control	2.525	0.133%	750	367,000	768.2	770.6	0.00048	12.6	30783	6573	0.31
Kansas	Kansas Control	2.525	0.100%	1000	388,000	770.3	772.7	0.00047	12.7	32275	6590	0.31
Kansas	Kansas Control	2.525	0.080%	1250	403,000	771.6	774.1	0.00046	12.8	33223	6600	0.31
Kansas	Missouri Control	2.525	0.067%	1500	407,000	772.7	775.2	0.00044	12.7	34041	6608	0.30
Kansas	Kansas Control	2.531	KC Terminal Bridge									
Kansas	Kansas Control	2.536	10%	10	121,000	747.8	748.6	0.00035	7.2	16822	624	0.24
Kansas	Kansas Control	2.536	1%	100	241,000	758.9	760.5	0.00043	10.1	24299	710	0.29
Kansas	Kansas Control	2.536	0.5%	200	283,000	762.0	763.9	0.00046	11.0	26476	710	0.30
Kansas	Kansas Control	2.536	0.2%	500	341,000	766.5	768.7	0.00047	11.9	29696	6566	0.31
Kansas	Kansas Control	2.536	0.133%	750	367,000	769.0	771.2	0.00046	12.1	31428	6586	0.31
Kansas	Kansas Control	2.536	0.100%	1000	388,000	771.2	773.5	0.00044	12.2	33016	6602	0.30
Kansas	Kansas Control	2.536	0.080%	1250	403,000	772.7	775.0	0.00043	12.3	34036	6610	0.30
Kansas	Kansas Control	2.536	0.067%	1500	417,000	773.9	776.2	0.00042	12.4	34918	6617	0.30
Kansas	Kansas Control	3.050	10%	10	121,000	749.0	749.7	0.00035	6.7	18049	740	0.24
Kansas	Kansas Control	3.050	1%	100	241,000	760.6	761.9	0.00038	9.0	27058	805	0.26
Kansas	Kansas Control	3.050	0.5%	200	283,000	763.8	765.3	0.00039	9.7	29662	818	0.27
Kansas	Kansas Control	3.050	0.2%	500	341,000	768.4	770.1	0.00039	10.4	33496	6368	0.28
Kansas	Kansas Control	3.050	0.133%	750	367,000	770.9	772.6	0.00037	10.6	35515	6469	0.27
Kansas	Kansas Control	3.050	0.100%	1000	388,000	773.0	774.8	0.00035	10.7	37340	6497	0.27
Kansas	Kansas Control	3.050	0.080%	1250	403,000	774.5	776.2	0.00035	10.8	38526	6515	0.27
Kansas	Kansas Control	3.050	0.067%	1500	417,000	775.7	777.5	0.00034	10.9	39559	6532	0.27

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	3.405	10%	10	121,000	749.7	750.4	0.00038	6.7	18192	801	0.25
Kansas	Kansas Control	3.405	1%	100	241,000	761.4	762.6	0.00037	8.7	28041	875	0.26
Kansas	Kansas Control	3.405	0.5%	200	283,000	764.7	766.0	0.00038	9.3	31149	979	0.27
Kansas	Kansas Control	3.405	0.2%	500	341,000	769.3	770.8	0.00037	9.9	35875	6776	0.27
Kansas	Kansas Control	3.405	0.133%	750	367,000	771.8	773.3	0.00035	10.0	38402	6829	0.26
Kansas	Kansas Control	3.405	0.100%	1000	388,000	773.9	775.5	0.00033	10.0	40680	6891	0.26
Kansas	Kansas Control	3.405	0.080%	1250	403,000	775.3	776.9	0.00032	10.1	42170	6919	0.26
Kansas	Kansas Control	3.405	0.067%	1500	417,000	776.6	778.1	0.00031	10.1	43474	6943	0.25
Kansas	Kansas Control	3.416	7th Street Bridge									
Kansas	Kansas Control	3.427	10%	10	121,000	749.8	750.5	0.00037	6.3	19159	803	0.23
Kansas	Kansas Control	3.427	1%	100	241,000	761.6	762.7	0.00038	8.4	28976	878	0.25
Kansas	Kansas Control	3.427	0.5%	200	283,000	764.8	766.1	0.00039	9.0	32190	1017	0.25
Kansas	Kansas Control	3.427	0.2%	500	341,000	769.7	771.1	0.00038	9.6	37149	6849	0.25
Kansas	Kansas Control	3.427	0.133%	750	367,000	772.1	773.6	0.00036	9.7	39741	6908	0.25
Kansas	Kansas Control	3.427	0.100%	1000	388,000	774.4	775.8	0.00034	9.7	42081	6970	0.25
Kansas	Kansas Control	3.427	0.080%	1250	403,000	775.8	777.3	0.00033	9.7	43621	7018	0.24
Kansas	Kansas Control	3.427	0.067%	1500	417000	777.1	778.6	0.00032	9.8	44975	7059	0.24
Kansas	Kansas Control	3.960	10%	10	121,000	750.7	751.3	0.00022	6.2	20847	840	0.19
Kansas	Kansas Control	3.960	1%	100	241,000	762.5	763.6	0.00029	8.6	31336	948	0.22
Kansas	Kansas Control	3.960	0.5%	200	283,000	765.9	767.1	0.00030	9.3	34626	1042	0.23
Kansas	Kansas Control	3.960	0.2%	500	341,000	770.6	772.0	0.00031	10.0	39709	7118	0.24
Kansas	Kansas Control	3.960	0.133%	750	367,000	773.1	774.5	0.00030	10.1	42337	7158	0.24
Kansas	Kansas Control	3.960	0.100%	1000	388,000	775.3	776.7	0.00029	10.2	44694	7199	0.23
Kansas	Kansas Control	3.960	0.080%	1250	403,000	776.7	778.2	0.00028	10.3	46262	7239	0.23
Kansas	Kansas Control	3.960	0.067%	1500	417,000	778.0	779.4	0.00028	10.3	47668	7282	0.23
Kansas	Kansas Control	4.276	10%	10	121000	751.0	751.6	0.00029	6.4	20025	889	0.21
Kansas	Kansas Control	4.276	1%	100	241,000	763.0	764.0	0.00032	8.6	31115	970	0.23
Kansas	Kansas Control	4.276	0.5%	200	283,000	766.3	767.5	0.00034	9.2	34408	992	0.24
Kansas	Kansas Control	4.276	0.2%	500	341,000	771.1	772.5	0.00033	9.8	39254	7370	0.24
Kansas	Kansas Control	4.276	0.133%	750	367,000	773.6	774.9	0.00032	9.9	41740	7374	0.24
Kansas	Kansas Control	4.276	0.100%	1000	388,000	775.7	777.1	0.00031	10.0	43964	7378	0.24
Kansas	Kansas Control	4.276	0.080%	1250	403,000	777.2	778.6	0.00030	10.0	45438	7380	0.24
Kansas	Kansas Control	4.276	0.067%	1500	417,000	778.4	779.8	0.00030	10.1	46739	7382	0.24
Kansas	Kansas Control	4.280	12th Street Bridge									
Kansas	Kansas Control	4.284	10%	10	121000	751.1	751.7	0.00033	6.4	20074	889	0.21
Kansas	Kansas Control	4.284	1%	100	241,000	763.1	764.1	0.00037	8.5	31196	970	0.23
Kansas	Kansas Control	4.284	0.5%	200	283,000	766.4	767.6	0.00038	9.1	34504	993	0.24
Kansas	Kansas Control	4.284	0.2%	500	341,000	771.3	772.6	0.00038	9.7	39442	7371	0.24
Kansas	Kansas Control	4.284	0.133%	750	367,000	773.8	775.1	0.00036	9.8	41987	7375	0.24
Kansas	Kansas Control	4.284	0.100%	1000	388,000	776.0	777.4	0.00034	9.8	44277	7378	0.23
Kansas	Kansas Control	4.284	0.080%	1250	403,000	777.5	778.9	0.00034	9.9	45800	7380	0.23
Kansas	Kansas Control	4.284	0.067%	1500	417,000	778.8	780.2	0.00033	9.9	47150	7383	0.23
Kansas	Kansas Control	4.480	10%	10	121,000	751.4	752.0	0.00031	6.5	19971	808	0.20
Kansas	Kansas Control	4.480	1%	100	241,000	763.4	764.5	0.00038	8.9	30241	925	0.24
Kansas	Kansas Control	4.480	0.5%	200	283,000	766.8	768.1	0.00039	9.5	33474	997	0.24
Kansas	Kansas Control	4.480	0.2%	500	341,000	771.7	773.1	0.00039	10.1	38575	7405	0.25
Kansas	Kansas Control	4.480	0.133%	750	367000	774.1	775.6	0.00038	10.2	41242	7447	0.24
Kansas	Kansas Control	4.480	0.100%	1000	388,000	776.4	777.8	0.00036	10.3	43643	7480	0.24
Kansas	Kansas Control	4.480	0.080%	1250	403,000	777.8	779.3	0.00035	10.3	45242	7502	0.24
Kansas	Kansas Control	4.480	0.067%	1500	417,000	779.1	780.6	0.00034	10.3	46660	7521	0.24
Kansas	Kansas Control	4.949	10%	10	121,000	752.2	752.5	0.00015	4.3	28178	1067	0.14
Kansas	Kansas Control	4.949	1%	100	241,000	764.5	765.1	0.00018	5.9	42151	1188	0.16
Kansas	Kansas Control	4.949	0.5%	200	283,000	768.0	768.6	0.00019	6.4	46337	1219	0.17
Kansas	Kansas Control	4.949	0.2%	500	341,000	773.0	773.7	0.00019	6.8	52589	7109	0.17
Kansas	Kansas Control	4.949	0.133%	750	367,000	775.4	776.1	0.00019	7.0	55760	7145	0.17

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	4.949	0.100%	1000	388,000	777.6	778.3	0.00018	7.0	58575	7176	0.17
Kansas	Kansas Control	4.949	0.080%	1250	403,000	779.1	779.8	0.00018	7.1	60455	7196	0.17
Kansas	Kansas Control	4.949	0.067%	1500	417,000	780.4	781.1	0.00017	7.1	62123	7214	0.17
Kansas	Kansas Control	4.960	18th Street Bridge									
Kansas	Kansas Control	4.970	10%	10	121,000	752.2	752.5	0.00014	4.1	29716	1143	0.14
Kansas	Kansas Control	4.970	1%	100	241,000	764.7	765.1	0.00016	5.5	44646	1260	0.16
Kansas	Kansas Control	4.970	0.5%	200	283,000	768.2	768.7	0.00017	5.9	49132	1293	0.16
Kansas	Kansas Control	4.970	0.2%	500	341,000	773.2	773.8	0.00017	6.3	55771	6852	0.16
Kansas	Kansas Control	4.970	0.133%	750	367,000	775.7	776.3	0.00016	6.4	59119	6937	0.16
Kansas	Kansas Control	4.970	0.100%	1000	388,000	777.9	778.5	0.00016	6.5	62104	7012	0.16
Kansas	Kansas Control	4.970	0.080%	1250	403000	779.4	780.0	0.00015	6.5	64100	7062	0.16
Kansas	Kansas Control	4.970	0.067%	1500	417,000	780.7	781.4	0.00015	6.6	65875	7098	0.16
Kansas	Kansas Control	5.506	10%	10	121,000	752.6	752.9	0.00016	3.9	31079	1162	0.13
Kansas	Kansas Control	5.506	1%	100	241,000	765.1	765.6	0.00019	5.3	46200	1251	0.15
Kansas	Kansas Control	5.506	0.5%	200	283,000	768.7	769.2	0.00019	5.7	50645	1264	0.15
Kansas	Kansas Control	5.506	0.2%	500	341,000	773.7	774.3	0.00019	6.1	57019	9181	0.15
Kansas	Kansas Control	5.506	0.133%	750	367,000	776.2	776.8	0.00019	6.2	60215	9219	0.15
Kansas	Kansas Control	5.506	0.100%	1000	388,000	778.4	779.0	0.00018	6.3	63103	9234	0.15
Kansas	Kansas Control	5.506	0.080%	1250	403,000	779.9	780.5	0.00018	6.3	65051	9243	0.15
Kansas	Kansas Control	5.506	0.067%	1500	417,000	781.2	781.8	0.00018	6.4	66793	9244	0.15
Kansas	Kansas Control	5.513	Kaw Power Plant Intake Structure									
Kansas	Kansas Control	5.520	10%	10	121,000	752.7	752.9	0.00016	3.9	31104	1163	0.13
Kansas	Kansas Control	5.520	1%	100	241,000	765.2	765.6	0.00018	5.3	46238	1251	0.15
Kansas	Kansas Control	5.520	0.5%	200	283,000	768.7	769.2	0.00019	5.7	50687	1264	0.15
Kansas	Kansas Control	5.520	0.2%	500	341,000	773.7	774.3	0.00019	6.1	57070	9182	0.15
Kansas	Kansas Control	5.520	0.133%	750	367,000	776.2	776.8	0.00019	6.2	60247	9220	0.15
Kansas	Kansas Control	5.520	0.100%	1000	388,000	778.4	779.0	0.00018	6.3	63071	9234	0.15
Kansas	Kansas Control	5.520	0.080%	1250	403,000	779.9	780.5	0.00018	6.3	64962	9244	0.15
Kansas	Kansas Control	5.520	0.067%	1500	417,000	781.2	781.8	0.00018	6.4	66647	9244	0.15
Kansas	Kansas Control	5.811	10%	10	121,000	753.0	753.1	0.00008	3.1	38818	1615	0.11
Kansas	Kansas Control	5.811	1%	100	241000	765.6	765.8	0.00009	4.1	60418	1804	0.12
Kansas	Kansas Control	5.811	0.5%	200	283,000	769.2	769.5	0.00009	4.3	66921	1826	0.12
Kansas	Kansas Control	5.811	0.2%	500	341,000	774.2	774.5	0.00009	4.6	76265	9768	0.12
Kansas	Kansas Control	5.811	0.133%	750	367,000	776.7	777.1	0.00009	4.7	80961	9850	0.12
Kansas	Kansas Control	5.811	0.100%	1000	388,000	778.9	779.3	0.00009	4.7	85126	9922	0.12
Kansas	Kansas Control	5.811	0.080%	1250	403,000	780.4	780.8	0.00008	4.8	87921	10093	0.12
Kansas	Kansas Control	5.811	0.067%	1500	417,000	781.7	782.1	0.00008	4.8	90412	10119	0.12
Kansas	Kansas Control	5.821	Kansas Avenue Bridge									
Kansas	Kansas Control	5.831	10%	10	121,000	753.0	753.1	0.00010	3.1	38896	1616	0.11
Kansas	Kansas Control	5.831	1%	100	241000	765.6	765.9	0.00010	4.1	60505	1804	0.12
Kansas	Kansas Control	5.831	0.5%	200	283,000	769.2	769.5	0.00010	4.3	67009	1826	0.12
Kansas	Kansas Control	5.831	0.2%	500	341,000	774.2	774.6	0.00009	4.6	76363	9769	0.12
Kansas	Kansas Control	5.831	0.133%	750	367,000	776.8	777.1	0.00009	4.7	81084	9851	0.12
Kansas	Kansas Control	5.831	0.100%	1000	388,000	779.0	779.3	0.00009	4.7	85275	9924	0.12
Kansas	Kansas Control	5.831	0.080%	1250	403,000	780.5	780.8	0.00008	4.8	88089	10095	0.12
Kansas	Kansas Control	5.831	0.067%	1500	417,000	781.8	782.2	0.00008	4.8	90601	10121	0.12
Kansas	Kansas Control	5.967	10%	10	121,000	753.0	753.2	0.00011	3.6	34139	1244	0.12
Kansas	Kansas Control	5.967	1%	100	241,000	765.6	766.0	0.00012	4.8	50418	1339	0.13
Kansas	Kansas Control	5.967	0.5%	200	283,000	769.2	769.6	0.00013	5.2	55240	1366	0.14
Kansas	Kansas Control	5.967	0.2%	500	341,000	774.2	774.7	0.00013	5.6	62212	8604	0.14
Kansas	Kansas Control	5.967	0.133%	750	367,000	776.7	777.2	0.00013	5.7	65694	8629	0.14
Kansas	Kansas Control	5.967	0.100%	1000	388000	778.9	779.4	0.00012	5.8	68783	8651	0.14
Kansas	Kansas Control	5.967	0.080%	1250	403,000	780.4	780.9	0.00012	5.8	70857	8673	0.14
Kansas	Kansas Control	5.967	0.067%	1500	417,000	781.7	782.3	0.00012	5.9	72709	8707	0.14

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	6.880	10%	10	121,000	753.5	753.7	0.00018	3.9	31268	1340	0.14
Kansas	Kansas Control	6.880	1%	100	241,000	766.1	766.5	0.00017	5.0	48903	1442	0.15
Kansas	Kansas Control	6.880	0.5%	200	283,000	769.7	770.1	0.00017	5.3	54105	1465	0.15
Kansas	Kansas Control	6.880	0.2%	500	341,000	774.7	775.2	0.00016	5.7	61603	7718	0.15
Kansas	Kansas Control	6.880	0.133%	750	367,000	777.2	777.7	0.00016	5.8	65322	8129	0.15
Kansas	Kansas Control	6.880	0.100%	1000	388,000	779.4	779.9	0.00015	5.8	68613	8172	0.15
Kansas	Kansas Control	6.880	0.080%	1250	403,000	780.9	781.4	0.00015	5.9	70828	8203	0.14
Kansas	Kansas Control	6.880	0.067%	1500	417,000	782.2	782.7	0.00014	5.9	72807	8232	0.14
Kansas	Kansas Control	7.329	10%	10	121,000	753.8	754.2	0.00024	5.1	24755	1185	0.17
Kansas	Kansas Control	7.329	1%	100	241,000	766.4	767.0	0.00025	6.6	40631	1403	0.18
Kansas	Kansas Control	7.329	0.5%	200	283,000	770.0	770.7	0.00025	7.0	45928	1530	0.18
Kansas	Kansas Control	7.329	0.2%	500	341,000	775.0	775.7	0.00024	7.3	53983	1687	0.18
Kansas	Kansas Control	7.329	0.133%	750	367,000	777.5	778.2	0.00023	7.4	58234	8696	0.18
Kansas	Kansas Control	7.329	0.100%	1000	388,000	779.7	780.4	0.00021	7.3	62050	8731	0.18
Kansas	Kansas Control	7.329	0.080%	1250	403,000	781.1	781.9	0.00020	7.3	64638	8750	0.17
Kansas	Kansas Control	7.329	0.067%	1500	417,000	782.5	783.2	0.00020	7.3	66960	8767	0.17
Kansas	Kansas Control	7.333	10%	10	121000	753.9	754.2	0.00024	5.1	24764	1185	0.17
Kansas	Kansas Control	7.333	1%	100	241,000	766.4	767.0	0.00025	6.6	40641	1403	0.18
Kansas	Kansas Control	7.333	0.5%	200	283,000	770.0	770.7	0.00025	7.0	45940	1530	0.18
Kansas	Kansas Control	7.333	0.2%	500	341,000	775.0	775.8	0.00024	7.3	53995	8628	0.18
Kansas	Kansas Control	7.333	0.133%	750	367,000	777.5	778.2	0.00023	7.4	58246	8696	0.18
Kansas	Kansas Control	7.333	0.100%	1000	388,000	779.7	780.4	0.00021	7.3	62061	8731	0.18
Kansas	Kansas Control	7.333	0.080%	1250	403,000	781.2	781.9	0.00020	7.3	64649	8750	0.17
Kansas	Kansas Control	7.333	0.067%	1500	417,000	782.5	783.2	0.00020	7.3	66970	8767	0.17
Kansas	Kansas Control	7.338	I-635 Bridge (northbound)									
Kansas	Kansas Control	7.342	10%	10	121,000	753.9	754.3	0.00024	5.1	24794	1186	0.17
Kansas	Kansas Control	7.342	1%	100	241,000	766.4	767.1	0.00025	6.6	40677	1405	0.18
Kansas	Kansas Control	7.342	0.5%	200	283,000	770.0	770.7	0.00025	7.0	45978	1530	0.18
Kansas	Kansas Control	7.342	0.2%	500	341,000	775.0	775.8	0.00024	7.3	54039	8629	0.18
Kansas	Kansas Control	7.342	0.133%	750	367,000	777.5	778.3	0.00023	7.3	58285	8697	0.18
Kansas	Kansas Control	7.342	0.100%	1000	388,000	779.7	780.4	0.00021	7.3	62102	8731	0.18
Kansas	Kansas Control	7.342	0.080%	1250	403,000	781.2	781.9	0.00020	7.3	64690	8751	0.17
Kansas	Kansas Control	7.342	0.067%	1500	417,000	782.5	783.2	0.00020	7.3	67011	8767	0.17
Kansas	Kansas Control	7.351	10%	10	121,000	753.9	754.3	0.00024	5.1	24802	1186	0.17
Kansas	Kansas Control	7.351	1%	100	241,000	766.5	767.1	0.00025	6.6	40688	1405	0.18
Kansas	Kansas Control	7.351	0.5%	200	283,000	770.0	770.7	0.00025	7.0	45991	1531	0.18
Kansas	Kansas Control	7.351	0.2%	500	341,000	775.1	775.8	0.00023	7.3	54053	8629	0.18
Kansas	Kansas Control	7.351	0.133%	750	367000	777.5	778.3	0.00022	7.3	58299	8697	0.18
Kansas	Kansas Control	7.351	0.100%	1000	388,000	779.7	780.4	0.00021	7.3	62114	8731	0.18
Kansas	Kansas Control	7.351	0.080%	1250	403,000	781.2	781.9	0.00020	7.3	64702	8751	0.17
Kansas	Kansas Control	7.351	0.067%	1500	417,000	782.5	783.2	0.00020	7.3	67023	8767	0.17
Kansas	Kansas Control	7.355	I-635 Bridge (southbound)									
Kansas	Kansas Control	7.360	10%	10	121,000	753.9	754.3	0.00024	5.1	24826	1186	0.17
Kansas	Kansas Control	7.360	1%	100	241,000	766.5	767.1	0.00025	6.6	40717	1407	0.18
Kansas	Kansas Control	7.360	0.5%	200	283,000	770.0	770.7	0.00025	6.9	46022	1531	0.18
Kansas	Kansas Control	7.360	0.2%	500	341,000	775.1	775.8	0.00023	7.3	54091	8631	0.18
Kansas	Kansas Control	7.360	0.133%	750	367,000	777.5	778.3	0.00022	7.3	58331	8697	0.18
Kansas	Kansas Control	7.360	0.100%	1000	388,000	779.7	780.5	0.00021	7.3	62148	8732	0.18
Kansas	Kansas Control	7.360	0.080%	1250	403000	781.2	781.9	0.00020	7.3	64737	8751	0.17
Kansas	Kansas Control	7.360	0.067%	1500	417,000	782.5	783.3	0.00020	7.3	67052	8767	0.17
Kansas	Kansas Control	7.364	10%	10	121,000	753.9	754.3	0.00024	5.1	24844	1187	0.17
Kansas	Kansas Control	7.364	1%	100	241,000	766.5	767.1	0.00025	6.6	40737	1407	0.18
Kansas	Kansas Control	7.364	0.5%	200	283,000	770.1	770.7	0.00025	6.9	46043	1532	0.18
Kansas	Kansas Control	7.364	0.2%	500	341,000	775.1	775.8	0.00023	7.3	54112	8631	0.18
Kansas	Kansas Control	7.364	0.133%	750	367,000	777.5	778.3	0.00022	7.3	58352	8697	0.18
Kansas	Kansas Control	7.364	0.100%	1000	388,000	779.7	780.5	0.00021	7.3	62169	8732	0.17

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	7.364	0.080%	1250	403,000	781.2	781.9	0.00020	7.3	64756	8751	0.17
Kansas	Kansas Control	7.364	0.067%	1500	417,000	782.5	783.3	0.00020	7.3	67071	8767	0.17
Kansas	Kansas Control	7.650	10%	10	121,000	754.3	754.7	0.00028	5.2	23593	1097	0.18
Kansas	Kansas Control	7.650	1%	100	241,000	766.8	767.5	0.00027	6.7	39156	1344	0.19
Kansas	Kansas Control	7.650	0.5%	200	283,000	770.4	771.1	0.00027	7.1	44132	1481	0.19
Kansas	Kansas Control	7.650	0.2%	500	341,000	775.4	776.2	0.00026	7.4	51678	7968	0.19
Kansas	Kansas Control	7.650	0.133%	750	367,000	777.9	778.6	0.00024	7.5	55441	8112	0.19
Kansas	Kansas Control	7.650	0.100%	1000	388,000	780.0	780.8	0.00023	7.4	58783	8239	0.18
Kansas	Kansas Control	7.650	0.080%	1250	403,000	781.5	782.3	0.00022	7.5	61046	8252	0.18
Kansas	Kansas Control	7.650	0.067%	1500	417,000	782.8	783.6	0.00022	7.5	63071	8263	0.18
Kansas	Kansas Control	8.420	10%	10	121,000	755.2	755.7	0.00020	5.5	25789	1543	0.16
Kansas	Kansas Control	8.420	1%	100	241,000	767.9	768.4	0.00020	6.7	48122	1984	0.17
Kansas	Kansas Control	8.420	0.5%	200	283,000	771.5	772.1	0.00019	6.9	55346	2018	0.16
Kansas	Kansas Control	8.420	0.2%	500	341000	776.5	777.1	0.00018	7.0	65585	2077	0.16
Kansas	Kansas Control	8.420	0.133%	750	367,000	778.9	779.5	0.00017	7.0	70619	7039	0.16
Kansas	Kansas Control	8.420	0.100%	1000	388,000	781.0	781.6	0.00016	6.9	75055	7057	0.15
Kansas	Kansas Control	8.420	0.080%	1250	403,000	782.5	783.0	0.00015	6.9	78067	7071	0.15
Kansas	Kansas Control	8.420	0.067%	1500	417,000	783.8	784.3	0.00015	6.9	80768	7084	0.15
Kansas	Kansas Control	9.040	10%	10	121,000	755.8	756.3	0.00023	5.6	24896	2620	0.17
Kansas	Kansas Control	9.040	1%	100	241,000	768.4	769.0	0.00023	7.0	43710	3241	0.18
Kansas	Kansas Control	9.040	0.5%	200	283,000	772.0	772.7	0.00023	7.2	49591	3267	0.18
Kansas	Kansas Control	9.040	0.2%	500	341,000	776.9	777.6	0.00022	7.5	57818	7216	0.18
Kansas	Kansas Control	9.040	0.133%	750	367,000	779.3	780.0	0.00021	7.5	61819	7257	0.17
Kansas	Kansas Control	9.040	0.100%	1000	388000	781.4	782.1	0.00019	7.5	65336	7295	0.17
Kansas	Kansas Control	9.040	0.080%	1250	403,000	782.8	783.5	0.00019	7.5	67723	7320	0.17
Kansas	Kansas Control	9.040	0.067%	1500	417,000	784.1	784.8	0.00018	7.5	69862	7343	0.17
Kansas	Kansas Control	9.490	10%	10	121,000	756.5	756.8	0.00022	4.7	26391	1127	0.16
Kansas	Kansas Control	9.490	1%	100	241,000	769.0	769.6	0.00023	6.1	41784	4360	0.17
Kansas	Kansas Control	9.490	0.5%	200	283,000	772.6	773.2	0.00023	6.5	46288	4455	0.17
Kansas	Kansas Control	9.490	0.2%	500	341,000	777.4	778.1	0.00022	6.9	52663	6643	0.18
Kansas	Kansas Control	9.490	0.133%	750	367,000	779.8	780.5	0.00022	7.0	55806	6749	0.17
Kansas	Kansas Control	9.490	0.100%	1000	388,000	781.9	782.6	0.00021	7.1	58568	6797	0.17
Kansas	Kansas Control	9.490	0.080%	1250	403,000	783.3	784.0	0.00021	7.1	60446	6810	0.17
Kansas	Kansas Control	9.490	0.067%	1500	417000	784.5	785.3	0.00020	7.2	62131	6820	0.17
Kansas	Kansas Control	9.498	Kansas Avenue West Bridge									
Kansas	Kansas Control	9.505	10%	10	121,000	756.5	756.8	0.00022	4.6	26459	1128	0.16
Kansas	Kansas Control	9.505	1%	100	241,000	769.1	769.6	0.00022	6.1	41864	4361	0.17
Kansas	Kansas Control	9.505	0.5%	200	283,000	772.6	773.2	0.00023	6.4	46370	4455	0.17
Kansas	Kansas Control	9.505	0.2%	500	341,000	777.5	778.2	0.00022	6.9	52748	6644	0.18
Kansas	Kansas Control	9.505	0.133%	750	367,000	779.9	780.6	0.00022	7.0	55935	6752	0.17
Kansas	Kansas Control	9.505	0.100%	1000	388,000	782.0	782.7	0.00021	7.0	58744	6799	0.17
Kansas	Kansas Control	9.505	0.080%	1250	403,000	783.4	784.1	0.00020	7.1	60661	6811	0.17
Kansas	Kansas Control	9.505	0.067%	1500	417,000	784.7	785.4	0.00020	7.1	62381	6821	0.17
Kansas	Kansas Control	9.820	10%	10	121,000	756.7	757.1	0.00020	5.4	26263	1259	0.16
Kansas	Kansas Control	9.820	1%	100	241,000	769.5	770.0	0.00017	6.1	57401	4451	0.15
Kansas	Kansas Control	9.820	0.5%	200	283,000	773.2	773.6	0.00016	6.1	67701	4520	0.15
Kansas	Kansas Control	9.820	0.2%	500	341,000	778.1	778.5	0.00013	6.0	81860	5843	0.14
Kansas	Kansas Control	9.820	0.133%	750	367,000	780.5	780.9	0.00012	5.9	88728	5867	0.13
Kansas	Kansas Control	9.820	0.100%	1000	388,000	782.6	783.0	0.00011	5.8	94743	5883	0.13
Kansas	Kansas Control	9.820	0.080%	1250	403,000	784.1	784.4	0.00011	5.8	98852	5894	0.13
Kansas	Kansas Control	9.820	0.067%	1500	417,000	785.4	785.7	0.00010	5.7	102541	5903	0.12
Kansas	Kansas Control	10.400	10%	10	121,000	757.1	757.7	0.00019	6.1	21326	646	0.17
Kansas	Kansas Control	10.400	1%	100	241,000	769.7	770.7	0.00027	8.6	51948	4798	0.21
Kansas	Kansas Control	10.400	0.5%	200	283,000	773.2	774.3	0.00027	9.0	68556	4893	0.21
Kansas	Kansas Control	10.400	0.2%	500	341,000	778.1	779.2	0.00025	9.1	92713	4950	0.21
Kansas	Kansas Control	10.400	0.133%	750	367,000	780.5	781.5	0.00023	9.0	104567	5008	0.20

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	file Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	10.400	0.100%	1000	388,000	782.6	783.6	0.00022	8.9	115085	5031	0.19
Kansas	Kansas Control	10.400	0.080%	1250	403,000	784.1	785.0	0.00021	8.9	122304	5047	0.19
Kansas	Kansas Control	10.400	0.067%	1500	417,000	785.4	786.2	0.00020	8.8	128810	5061	0.19
Kansas	Kansas Control	10.600	10%	10	121,000	757.3	758.0	0.00022	6.4	20524	645	0.18
Kansas	Kansas Control	10.600	1%	100	241,000	770.0	771.1	0.00030	8.9	49422	4034	0.22
Kansas	Kansas Control	10.600	0.5%	200	283,000	773.5	774.7	0.00030	9.4	63044	4488	0.22
Kansas	Kansas Control	10.600	0.2%	500	341,000	778.4	779.6	0.00029	9.7	86150	4938	0.22
Kansas	Kansas Control	10.600	0.133%	750	367,000	780.7	781.9	0.00027	9.6	98005	5015	0.21
Kansas	Kansas Control	10.600	0.100%	1000	388,000	782.8	783.9	0.00025	9.5	108519	5053	0.21
Kansas	Kansas Control	10.600	0.080%	1250	403,000	784.3	785.3	0.00024	9.4	115760	5080	0.20
Kansas	Kansas Control	10.600	0.067%	1500	417,000	785.5	786.5	0.00023	9.3	122302	5103	0.20
Kansas	Kansas Control	10.900	10%	10	121,000	757.9	758.3	0.00017	5.4	25107	1055	0.16
Kansas	Kansas Control	10.900	1%	100	241,000	770.9	771.5	0.00020	7.1	59796	4294	0.18
Kansas	Kansas Control	10.900	0.5%	200	283,000	774.4	775.2	0.00019	7.4	75696	5030	0.18
Kansas	Kansas Control	10.900	0.2%	500	341,000	779.3	780.0	0.00018	7.6	99897	5323	0.18
Kansas	Kansas Control	10.900	0.133%	750	367,000	781.6	782.3	0.00017	7.6	112274	5369	0.17
Kansas	Kansas Control	10.900	0.100%	1000	388,000	783.6	784.2	0.00016	7.5	123178	5395	0.17
Kansas	Kansas Control	10.900	0.080%	1250	403,000	785.0	785.6	0.00015	7.5	130699	5412	0.16
Kansas	Kansas Control	10.900	0.067%	1500	417,000	786.3	786.9	0.00015	7.4	137500	5428	0.16
Kansas	Kansas Control	11.350	10%	10	121,000	758.2	758.6	0.00018	5.5	24982	1645	0.16
Kansas	Kansas Control	11.350	1%	100	241,000	771.3	771.9	0.00018	6.7	59583	3578	0.17
Kansas	Kansas Control	11.350	0.5%	200	283,000	774.9	775.5	0.00017	7.0	75100	5050	0.17
Kansas	Kansas Control	11.350	0.2%	500	341,000	779.7	780.3	0.00016	7.1	99233	5282	0.16
Kansas	Kansas Control	11.350	0.133%	750	367,000	782.0	782.6	0.00015	7.0	111407	5303	0.16
Kansas	Kansas Control	11.350	0.100%	1000	388,000	784.0	784.5	0.00014	6.9	122046	5323	0.15
Kansas	Kansas Control	11.350	0.080%	1250	403,000	785.4	785.9	0.00013	6.8	129386	5337	0.15
Kansas	Kansas Control	11.350	0.067%	1500	417,000	786.7	787.1	0.00013	6.8	136028	5349	0.15
Kansas	Kansas Control	11.850	10%	10	121,000	758.7	759.2	0.00017	5.5	25197	2662	0.16
Kansas	Kansas Control	11.850	1%	100	241,000	772.0	772.4	0.00014	6.1	75513	5040	0.15
Kansas	Kansas Control	11.850	0.5%	200	283,000	775.6	776.0	0.00013	6.2	91550	5342	0.15
Kansas	Kansas Control	11.850	0.2%	500	341,000	780.3	780.8	0.00013	6.6	113792	5682	0.15
Kansas	Kansas Control	11.850	0.133%	750	367,000	782.6	783.0	0.00012	6.4	126784	5790	0.14
Kansas	Kansas Control	11.850	0.100%	1000	388,000	784.6	784.9	0.00011	6.3	138263	5883	0.14
Kansas	Kansas Control	11.850	0.080%	1250	403,000	785.9	786.3	0.00010	6.2	146279	5948	0.14
Kansas	Kansas Control	11.850	0.067%	1500	417,000	787.1	787.5	0.00010	6.2	153580	5964	0.13
Kansas	Kansas Control	12.400	10%	10	121,000	759.3	759.6	0.00011	4.4	28747	974	0.13
Kansas	Kansas Control	12.400	1%	100	241,000	772.4	772.7	0.00011	5.4	76711	5720	0.13
Kansas	Kansas Control	12.400	0.5%	200	283,000	775.9	776.3	0.00011	5.5	92641	5782	0.13
Kansas	Kansas Control	12.400	0.2%	500	341,000	780.7	781.1	0.00010	5.6	114193	5866	0.13
Kansas	Kansas Control	12.400	0.133%	750	367,000	782.9	783.3	0.00009	5.6	124347	5918	0.13
Kansas	Kansas Control	12.400	0.100%	1000	388,000	784.8	785.2	0.00010	5.9	134158	5990	0.13
Kansas	Kansas Control	12.400	0.080%	1250	403,000	786.2	786.5	0.00009	5.8	142189	6001	0.13
Kansas	Kansas Control	12.400	0.067%	1500	417,000	787.4	787.7	0.00009	5.8	149469	6010	0.13
Kansas	Kansas Control	12.940	10%	10	121,000	759.6	759.9	0.00012	4.7	32630	1423	0.13
Kansas	Kansas Control	12.940	1%	100	241,000	772.6	773.1	0.00013	6.0	77445	5763	0.15
Kansas	Kansas Control	12.940	0.5%	200	283,000	776.2	776.6	0.00012	6.0	93911	5808	0.14
Kansas	Kansas Control	12.940	0.2%	500	341,000	780.9	781.3	0.00011	6.1	116209	5959	0.14
Kansas	Kansas Control	12.940	0.133%	750	367,000	783.1	783.6	0.00012	6.4	126743	6009	0.14
Kansas	Kansas Control	12.940	0.100%	1000	388,000	785.1	785.5	0.00011	6.3	138401	6026	0.14
Kansas	Kansas Control	12.940	0.080%	1250	403,000	786.4	786.8	0.00010	6.2	146395	6037	0.14
Kansas	Kansas Control	12.940	0.067%	1500	417,000	787.6	788.0	0.00010	6.2	153649	6047	0.13
Kansas	Kansas Control	13.300	10%	10	121,000	759.8	760.1	0.00011	4.5	33573	1409	0.13
Kansas	Kansas Control	13.300	1%	100	241,000	772.9	773.3	0.00012	5.7	79814	6105	0.14
Kansas	Kansas Control	13.300	0.5%	200	283,000	776.5	776.8	0.00011	5.7	98694	6178	0.14
Kansas	Kansas Control	13.300	0.2%	500	341,000	781.2	781.6	0.00010	5.7	124044	6277	0.13
Kansas	Kansas Control	13.300	0.133%	750	367,000	783.5	783.8	0.00009	5.7	137823	6332	0.13
Kansas	Kansas Control	13.300	0.100%	1000	388,000	785.4	785.7	0.00009	5.6	149922	6361	0.12

Kansas River Future Conditions With Tree Removal Alternative Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	file Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	13.300	0.080%	1250	403,000	786.7	787.0	0.00008	5.6	158246	6381	0.12
Kansas	Kansas Control	13.300	0.067%	1500	417,000	787.9	788.2	0.00008	5.5	165820	6399	0.12
Kansas	Kansas Control	13.650	10%	10	121,000	760.1	760.3	0.00008	4.1	38514	2719	0.11
Kansas	Kansas Control	13.650	1%	100	241,000	773.3	773.6	0.00008	5.0	95902	5126	0.12
Kansas	Kansas Control	13.650	0.5%	200	283,000	776.8	777.1	0.00008	5.1	114246	5465	0.12
Kansas	Kansas Control	13.650	0.2%	500	341,000	781.5	781.8	0.00007	5.2	139861	5838	0.11
Kansas	Kansas Control	13.650	0.133%	750	367,000	783.7	784.0	0.00007	5.2	152686	5982	0.11
Kansas	Kansas Control	13.650	0.100%	1000	388,000	785.6	785.9	0.00007	5.2	164063	6048	0.11
Kansas	Kansas Control	13.650	0.080%	1250	403,000	786.9	787.2	0.00007	5.2	171947	6089	0.11
Kansas	Kansas Control	13.650	0.067%	1500	417,000	788.1	788.3	0.00006	5.2	179153	6125	0.11
Kansas	Kansas Control	14.250	10%	10	121,000	760.4	760.6	0.00010	3.9	35997	1665	0.12
Kansas	Kansas Control	14.250	1%	100	241,000	773.5	773.9	0.00011	5.1	94858	6200	0.13
Kansas	Kansas Control	14.250	0.5%	200	283,000	777.0	777.4	0.00010	5.3	116279	6386	0.13
Kansas	Kansas Control	14.250	0.2%	500	341,000	781.7	782.0	0.00010	5.4	145275	6477	0.13
Kansas	Kansas Control	14.250	0.133%	750	367,000	783.9	784.3	0.00010	5.5	159532	6520	0.13
Kansas	Kansas Control	14.250	0.100%	1000	388,000	785.8	786.1	0.00009	5.5	171796	6537	0.13
Kansas	Kansas Control	14.250	0.080%	1250	403,000	787.1	787.4	0.00009	5.5	180243	6548	0.12
Kansas	Kansas Control	14.250	0.067%	1500	417,000	788.2	788.6	0.00009	5.5	187931	6559	0.12
Kansas	Kansas Control	14.620	10%	10	121,000	760.6	760.8	0.00006	3.5	38444	1215	0.10
Kansas	Kansas Control	14.620	1%	100	241,000	773.7	774.0	0.00009	5.0	89407	6353	0.12
Kansas	Kansas Control	14.620	0.5%	200	283,000	777.2	777.6	0.00009	5.3	111606	6416	0.12
Kansas	Kansas Control	14.620	0.2%	500	341,000	781.8	782.2	0.00009	5.5	141424	6516	0.12
Kansas	Kansas Control	14.620	0.133%	750	367,000	784.1	784.4	0.00008	5.6	155902	6538	0.12
Kansas	Kansas Control	14.620	0.100%	1000	388,000	785.9	786.3	0.00008	5.6	168128	6556	0.12
Kansas	Kansas Control	14.620	0.080%	1250	403,000	787.2	787.6	0.00008	5.6	176556	6569	0.12
Kansas	Kansas Control	14.620	0.067%	1500	417,000	788.4	788.8	0.00008	5.6	184231	6580	0.12

EXHIBIT A-2.115
Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	0.010	10%	10	121,000	742.4	742.9	0.00026	5.9	20554	812	0.21
Kansas	Missouri Control	0.010	1%	100	192,000	751.2	751.9	0.00025	6.8	28952	1044	0.23
Kansas	Missouri Control	0.010	0.5%	200	237,000	753.6	754.6	0.00029	7.8	31524	1090	0.25
Kansas	Missouri Control	0.010	0.2%	500	308,000	756.8	758.1	0.00037	9.3	35048	1151	0.28
Kansas	Missouri Control	0.010	0.133%	750	343,000	758.0	759.6	0.00041	10.0	36578	1277	0.30
Kansas	Missouri Control	0.010	0.100%	1000	369,000	759.0	760.6	0.00044	10.5	37776	1335	0.31
Kansas	Missouri Control	0.010	0.080%	1250	391,000	759.7	761.5	0.00046	10.9	38804	1382	0.32
Kansas	Missouri Control	0.010	0.067%	1500	407,000	760.3	762.2	0.00048	11.2	39584	1434	0.33
Kansas	Kansas Control	0.140	10%	10	121,000	742.5	743.1	0.00028	6.2	19438	737	0.21
Kansas	Missouri Control	0.140	1%	100	192,000	751.3	752.1	0.00027	7.4	26175	803	0.22
Kansas	Missouri Control	0.140	0.5%	200	237,000	753.7	754.8	0.00033	8.5	28129	820	0.25
Kansas	Missouri Control	0.140	0.2%	500	308,000	756.8	758.4	0.00043	10.2	30790	924	0.28
Kansas	Missouri Control	0.140	0.133%	750	343,000	758.1	760.0	0.00048	10.9	31999	1009	0.30
Kansas	Missouri Control	0.140	0.100%	1000	369,000	759.0	761.1	0.00051	11.5	32921	1025	0.31
Kansas	Missouri Control	0.140	0.080%	1250	391,000	759.8	762.0	0.00054	12.0	33689	1038	0.32
Kansas	Missouri Control	0.140	0.067%	1500	407,000	760.3	762.6	0.00056	12.3	34259	1044	0.33
Kansas	Kansas Control	0.220	10%	10	121,000	742.6	743.3	0.00039	7.0	17193	697	0.25
Kansas	Missouri Control	0.220	1%	100	192,000	751.3	752.3	0.00036	8.2	23732	786	0.25
Kansas	Missouri Control	0.220	0.5%	200	237,000	753.7	755.1	0.00043	9.4	25636	803	0.28
Kansas	Missouri Control	0.220	0.2%	500	308,000	756.8	758.7	0.00054	11.2	28170	826	0.32
Kansas	Missouri Control	0.220	0.133%	750	343,000	758.1	760.3	0.00060	12.1	29220	836	0.34
Kansas	Missouri Control	0.220	0.100%	1000	369,000	759.0	761.4	0.00065	12.7	29971	843	0.35
Kansas	Missouri Control	0.220	0.080%	1250	391,000	759.7	762.4	0.00068	13.2	30607	923	0.36
Kansas	Missouri Control	0.220	0.067%	1500	407,000	760.2	763.1	0.00072	13.6	31111	991	0.37
Kansas	Kansas Control	0.253	10%	10	121,000	742.6	743.4	0.00043	7.4	16385	667	0.26
Kansas	Missouri Control	0.253	1%	100	192,000	751.3	752.4	0.00040	8.6	22641	758	0.26
Kansas	Missouri Control	0.253	0.5%	200	237,000	753.7	755.2	0.00048	9.9	24472	775	0.29
Kansas	Missouri Control	0.253	0.2%	500	308,000	756.8	758.9	0.00060	11.7	26905	798	0.33
Kansas	Missouri Control	0.253	0.133%	750	343,000	758.0	760.5	0.00067	12.6	27912	807	0.35
Kansas	Missouri Control	0.253	0.100%	1000	369,000	758.9	761.6	0.00072	13.3	28644	834	0.37
Kansas	Missouri Control	0.253	0.080%	1250	391,000	759.6	762.6	0.00076	13.8	29253	836	0.38
Kansas	Missouri Control	0.253	0.067%	1500	407,000	760.2	763.3	0.00079	14.2	29705	836	0.39
Kansas	Kansas Control	0.256	Missouri Pacific Bridge No. 1									
Kansas	Kansas Control	0.259	10%	10	121,000	742.6	743.5	0.00044	7.4	16272	667	0.27
Kansas	Missouri Control	0.259	1%	100	192,000	751.4	752.5	0.00040	8.6	22563	764	0.27
Kansas	Missouri Control	0.259	0.5%	200	237,000	753.8	755.3	0.00048	9.9	24425	781	0.29
Kansas	Missouri Control	0.259	0.2%	500	308,000	756.9	759.0	0.00061	11.7	26911	806	0.34
Kansas	Missouri Control	0.259	0.133%	750	343,000	758.2	760.6	0.00067	12.6	27947	814	0.35
Kansas	Missouri Control	0.259	0.100%	1000	369,000	759.1	761.8	0.00072	13.3	28686	817	0.37
Kansas	Missouri Control	0.259	0.080%	1250	391,000	759.9	762.8	0.00076	13.8	29337	820	0.38
Kansas	Missouri Control	0.259	0.067%	1500	407,000	760.5	763.5	0.00078	14.1	29828	5638	0.39
Kansas	Kansas Control	0.274	10%	10	121,000	742.9	743.6	0.00039	6.6	18245	810	0.25
Kansas	Missouri Control	0.274	1%	100	192,000	751.7	752.6	0.00033	7.5	25743	886	0.24
Kansas	Missouri Control	0.274	0.5%	200	237,000	754.3	755.4	0.00038	8.6	28010	903	0.26
Kansas	Missouri Control	0.274	0.2%	500	308,000	757.6	759.2	0.00047	10.1	31075	926	0.29
Kansas	Missouri Control	0.274	0.133%	750	343,000	759.0	760.8	0.00051	10.8	32387	965	0.31
Kansas	Missouri Control	0.274	0.100%	1000	369,000	760.0	762.0	0.00054	11.4	33366	1005	0.32
Kansas	Missouri Control	0.274	0.080%	1250	391,000	760.9	763.0	0.00057	11.8	34262	5880	0.33
Kansas	Missouri Control	0.274	0.067%	1500	407,000	761.5	763.8	0.00058	12.0	34951	6011	0.33
Kansas	Kansas Control	0.280	I-70 Bridge (westbound)									
Kansas	Kansas Control	0.286	10%	10	121,000	743.0	743.7	0.00039	6.7	18182	808	0.25
Kansas	Missouri Control	0.286	1%	100	192,000	751.8	752.7	0.00034	7.5	25688	886	0.24
Kansas	Missouri Control	0.286	0.5%	200	237,000	754.4	755.5	0.00040	8.5	27977	903	0.26
Kansas	Missouri Control	0.286	0.2%	500	308,000	757.8	759.3	0.00048	10.0	31079	927	0.29
Kansas	Missouri Control	0.286	0.133%	750	343,000	759.2	760.9	0.00052	10.7	32414	961	0.31
Kansas	Missouri Control	0.286	0.100%	1000	369,000	760.2	762.1	0.00055	11.2	33400	1011	0.32

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	file Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	0.286	0.080%	1250	391,000	761.1	763.1	0.00057	11.6	34297	5875	0.33
Kansas	Missouri Control	0.286	0.067%	1500	407,000	761.7	763.9	0.00059	11.8	34968	5992	0.33
Kansas	Kansas Control	0.297	10%	10	121,000	743.0	743.7	0.00040	6.7	18067	801	0.25
Kansas	Missouri Control	0.297	1%	100	192,000	751.8	752.7	0.00035	7.5	25528	881	0.24
Kansas	Missouri Control	0.297	0.5%	200	237,000	754.4	755.5	0.00040	8.6	27806	899	0.27
Kansas	Missouri Control	0.297	0.2%	500	308,000	757.8	759.3	0.00049	10.1	30896	923	0.30
Kansas	Missouri Control	0.297	0.133%	750	343,000	759.2	761.0	0.00053	10.8	32226	956	0.31
Kansas	Missouri Control	0.297	0.100%	1000	369,000	760.2	762.2	0.00056	11.3	33207	1005	0.32
Kansas	Missouri Control	0.297	0.080%	1250	391,000	761.1	763.2	0.00058	11.7	34099	5867	0.33
Kansas	Missouri Control	0.297	0.067%	1500	407,000	761.8	763.9	0.00059	11.9	34766	5983	0.33
Kansas	Kansas Control	0.303	I-70 Bridge (eastbound)									
Kansas	Kansas Control	0.309	10%	10	121,000	743.1	743.8	0.00040	6.8	17931	786	0.25
Kansas	Missouri Control	0.309	1%	100	192,000	751.9	752.8	0.00035	7.6	25261	865	0.24
Kansas	Missouri Control	0.309	0.5%	200	237,000	754.5	755.6	0.00041	8.7	27518	887	0.27
Kansas	Missouri Control	0.309	0.2%	500	308,000	757.9	759.5	0.00049	10.2	30627	924	0.30
Kansas	Missouri Control	0.309	0.133%	750	343,000	759.3	761.2	0.00053	10.9	31978	958	0.31
Kansas	Missouri Control	0.309	0.100%	1000	369,000	760.4	762.4	0.00056	11.4	32975	994	0.32
Kansas	Missouri Control	0.309	0.080%	1250	391,000	761.3	763.4	0.00058	11.8	33870	5874	0.33
Kansas	Missouri Control	0.309	0.067%	1500	407,000	761.9	764.2	0.00060	12.0	34538	5990	0.34
Kansas	Kansas Control	0.440	10%	10	121,000	743.2	744.1	0.00050	7.4	16376	742	0.28
Kansas	Kansas Control	0.440	1%	100	241,000	752.0	753.7	0.00066	10.5	23229	817	0.33
Kansas	Missouri Control	0.440	0.5%	200	237,000	754.6	755.9	0.00049	9.5	25331	837	0.29
Kansas	Missouri Control	0.440	0.2%	500	308,000	758.0	759.9	0.00059	11.1	28242	865	0.32
Kansas	Missouri Control	0.440	0.133%	750	343,000	759.4	761.6	0.00064	11.9	29515	904	0.34
Kansas	Missouri Control	0.440	0.100%	1000	369,000	760.4	762.8	0.00067	12.5	30446	5279	0.35
Kansas	Missouri Control	0.440	0.080%	1250	391,000	761.3	763.9	0.00070	12.9	31266	5468	0.36
Kansas	Missouri Control	0.440	0.067%	1500	407,000	762.0	764.7	0.00071	13.2	31878	5609	0.37
Kansas	Kansas Control	0.496	10%	10	121,000	743.5	744.2	0.00041	6.7	17981	804	0.25
Kansas	Kansas Control	0.496	1%	100	241,000	752.5	753.9	0.00052	9.5	25628	889	0.30
Kansas	Missouri Control	0.496	0.5%	200	237,000	754.9	756.1	0.00039	8.6	27809	909	0.26
Kansas	Missouri Control	0.496	0.2%	500	308,000	758.5	760.1	0.00047	10.1	31076	928	0.29
Kansas	Missouri Control	0.496	0.133%	750	343,000	760.0	761.8	0.00051	10.8	32589	966	0.31
Kansas	Missouri Control	0.496	0.100%	1000	369,000	761.1	763.0	0.00054	11.3	33630	5557	0.32
Kansas	Missouri Control	0.496	0.080%	1250	391,000	762.0	764.1	0.00056	11.7	34535	5735	0.32
Kansas	Missouri Control	0.496	0.067%	1500	407,000	762.7	764.9	0.00057	11.9	35209	5867	0.33
Kansas	Kansas Control	0.500	James Street Bridge									
Kansas	Kansas Control	0.504	10%	10	121,000	743.6	744.3	0.00040	6.7	18047	798	0.25
Kansas	Kansas Control	0.504	1%	100	241,000	752.7	754.0	0.00052	9.5	25676	877	0.30
Kansas	Missouri Control	0.504	0.5%	200	237,000	755.1	756.2	0.00039	8.6	27805	896	0.26
Kansas	Missouri Control	0.504	0.2%	500	308,000	758.6	760.2	0.00047	10.1	31093	951	0.29
Kansas	Missouri Control	0.504	0.133%	750	343,000	760.2	762.0	0.00050	10.8	32559	956	0.31
Kansas	Missouri Control	0.504	0.100%	1000	369,000	761.3	763.2	0.00053	11.3	33609	5595	0.31
Kansas	Missouri Control	0.504	0.080%	1250	391,000	762.2	764.3	0.00055	11.7	34523	5777	0.32
Kansas	Missouri Control	0.504	0.067%	1500	407,000	763.0	765.1	0.00056	11.9	35217	5915	0.33
Kansas	Kansas Control	0.640	10%	10	121,000	743.8	744.6	0.00032	7.1	17469	692	0.23
Kansas	Kansas Control	0.640	1%	100	241,000	752.9	754.6	0.00050	10.6	24052	759	0.30
Kansas	Missouri Control	0.640	0.5%	200	237,000	755.2	756.7	0.00039	9.8	25823	774	0.27
Kansas	Missouri Control	0.640	0.2%	500	308,000	758.8	760.8	0.00049	11.6	28642	799	0.31
Kansas	Missouri Control	0.640	0.133%	750	343,000	760.3	762.6	0.00054	12.4	29869	818	0.32
Kansas	Missouri Control	0.640	0.100%	1000	369,000	761.4	763.9	0.00057	13.0	31025	5812	0.34
Kansas	Missouri Control	0.640	0.080%	1250	391,000	762.3	765.0	0.00060	13.5	32007	5996	0.34
Kansas	Missouri Control	0.640	0.067%	1500	407,000	763.1	765.9	0.00061	13.8	32752	6136	0.35
Kansas	Kansas Control	0.812	10%	10	121,000	744.0	745.0	0.00039	8.0	15840	657	0.26
Kansas	Kansas Control	0.812	1%	100	241,000	753.1	755.2	0.00059	11.8	22135	723	0.33
Kansas	Kansas Control	0.812	0.5%	200	283,000	755.4	757.9	0.00067	13.0	23788	737	0.36

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	0.812	0.2%	500	308,000	759.0	761.4	0.00058	12.8	26465	751	0.34
Kansas	Missouri Control	0.812	0.133%	750	343,000	760.5	763.3	0.00064	13.7	27619	756	0.35
Kansas	Missouri Control	0.812	0.100%	1000	369,000	761.6	764.6	0.00068	14.4	28449	6077	0.37
Kansas	Missouri Control	0.812	0.080%	1250	391,000	762.5	765.8	0.00071	14.9	29171	6242	0.38
Kansas	Missouri Control	0.812	0.067%	1500	407,000	763.2	766.6	0.00073	15.2	29716	6368	0.38
Kansas	Kansas Control	0.815	KC Southern Bridge									
Kansas	Kansas Control	0.817	10%	10	121,000	744.1	745.0	0.00040	8.0	15822	656	0.26
Kansas	Kansas Control	0.817	1%	100	241,000	753.2	755.3	0.00061	11.8	22139	722	0.33
Kansas	Kansas Control	0.817	0.5%	200	283,000	755.5	758.0	0.00068	13.0	23802	736	0.35
Kansas	Missouri Control	0.817	0.2%	500	308,000	759.1	761.5	0.00060	12.8	26462	752	0.34
Kansas	Missouri Control	0.817	0.133%	750	343,000	760.7	763.5	0.00065	13.7	27719	760	0.35
Kansas	Missouri Control	0.817	0.100%	1000	369,000	762.0	764.9	0.00068	14.3	28650	1471	0.36
Kansas	Missouri Control	0.817	0.080%	1250	391,000	763.0	766.2	0.00071	14.7	29462	6329	0.37
Kansas	Missouri Control	0.817	0.067%	1500	407,000	763.8	767.1	0.00072	15.0	30082	6473	0.38
Kansas	Kansas Control	1.106	10%	10	121,000	744.6	745.6	0.00039	8.0	15750	643	0.25
Kansas	Kansas Control	1.106	1%	100	241,000	754.1	756.2	0.00059	11.8	22110	695	0.33
Kansas	Kansas Control	1.106	0.5%	200	283,000	756.5	759.0	0.00066	13.0	23781	703	0.35
Kansas	Missouri Control	1.106	0.2%	500	308,000	759.9	762.4	0.00059	12.9	26213	715	0.34
Kansas	Missouri Control	1.106	0.133%	750	343,000	761.7	764.4	0.00064	13.8	27460	720	0.35
Kansas	Missouri Control	1.106	0.100%	1000	369,000	762.9	765.9	0.00067	14.4	28375	7013	0.36
Kansas	Missouri Control	1.106	0.080%	1250	391,000	764.0	767.2	0.00069	14.9	29167	7212	0.37
Kansas	Missouri Control	1.106	0.067%	1500	407,000	764.9	768.2	0.00071	15.2	29767	7360	0.37
Kansas	Kansas Control	1.112	Central Avenue Bridge									
Kansas	Kansas Control	1.117	10%	10	121,000	744.7	745.7	0.00038	8.0	15816	643	0.25
Kansas	Kansas Control	1.117	1%	100	241,000	754.2	756.3	0.00058	11.8	22196	694	0.33
Kansas	Kansas Control	1.117	0.5%	200	283,000	756.6	759.1	0.00065	12.9	23872	702	0.35
Kansas	Missouri Control	1.117	0.2%	500	308,000	760.0	762.5	0.00058	12.9	26282	713	0.33
Kansas	Missouri Control	1.117	0.133%	750	343,000	761.9	764.7	0.00062	13.7	27642	5397	0.35
Kansas	Missouri Control	1.117	0.100%	1000	369,000	763.3	766.3	0.00065	14.3	28645	7146	0.36
Kansas	Missouri Control	1.117	0.080%	1250	391,000	764.5	767.7	0.00067	14.7	29534	7379	0.36
Kansas	Missouri Control	1.117	0.067%	1500	407,000	765.5	768.7	0.00068	15.0	30213	7547	0.37
Kansas	Kansas Control	1.270	10%	10	121,000	745.2	746.0	0.00037	7.1	17036	648	0.24
Kansas	Kansas Control	1.270	1%	100	241,000	755.1	756.7	0.00051	10.3	23776	709	0.30
Kansas	Kansas Control	1.270	0.5%	200	283,000	757.6	759.6	0.00056	11.3	25592	718	0.32
Kansas	Kansas Control	1.270	0.2%	500	341,000	761.0	763.4	0.00061	12.5	28001	730	0.34
Kansas	Missouri Control	1.270	0.133%	750	343,000	763.0	765.2	0.00053	12.0	29457	6410	0.32
Kansas	Missouri Control	1.270	0.100%	1000	369,000	764.4	766.8	0.00055	12.5	30537	6608	0.32
Kansas	Missouri Control	1.270	0.080%	1250	391,000	765.7	768.2	0.00056	12.8	31475	6780	0.33
Kansas	Missouri Control	1.270	0.067%	1500	407,000	766.7	769.3	0.00057	13.1	32185	6910	0.33
Kansas	Kansas Control	1.385	10%	10	121,000	745.4	746.2	0.00041	7.4	16405	626	0.25
Kansas	Kansas Control	1.385	1%	100	241,000	755.3	757.1	0.00055	10.6	22884	674	0.31
Kansas	Kansas Control	1.385	0.5%	200	283,000	757.9	760.0	0.00060	11.7	24619	683	0.33
Kansas	Kansas Control	1.385	0.2%	500	341,000	761.2	763.8	0.00066	12.9	26919	694	0.35
Kansas	Missouri Control	1.385	0.133%	750	343,000	763.2	765.5	0.00057	12.4	28275	6011	0.33
Kansas	Missouri Control	1.385	0.100%	1000	369,000	764.6	767.2	0.00059	12.9	29304	6247	0.34
Kansas	Missouri Control	1.385	0.080%	1250	391,000	765.9	768.6	0.00061	13.3	30197	6452	0.34
Kansas	Missouri Control	1.385	0.067%	1500	407,000	766.9	769.7	0.00061	13.5	30872	6628	0.34
Kansas	Kansas Control	1.399	I-670 Bridge									
Kansas	Kansas Control	1.413	10%	10	121,000	745.5	746.4	0.00040	7.4	16413	624	0.25
Kansas	Kansas Control	1.413	1%	100	241,000	755.6	757.3	0.00055	10.6	22952	674	0.31
Kansas	Kansas Control	1.413	0.5%	200	283,000	758.2	760.3	0.00060	11.6	24713	683	0.33
Kansas	Kansas Control	1.413	0.2%	500	341,000	761.6	764.1	0.00065	12.8	27047	695	0.35
Kansas	Missouri Control	1.413	0.133%	750	343,000	763.5	765.8	0.00057	12.3	28372	6061	0.33
Kansas	Missouri Control	1.413	0.100%	1000	369,000	765.0	767.5	0.00059	12.8	29424	6324	0.33
Kansas	Missouri Control	1.413	0.080%	1250	391,000	766.3	769.0	0.00060	13.2	30349	6571	0.34

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Missouri Control	1.413	0.067%	1500	407,000	767.3	770.1	0.00060	13.4	31054	6719	0.34
Kansas	Kansas Control	1.614	10%	10	121,000	745.6	746.5	0.00042	7.6	15938	597	0.26
Kansas	Kansas Control	1.614	1%	100	241,000	755.6	757.5	0.00059	10.9	22336	669	0.32
Kansas	Kansas Control	1.614	0.5%	200	283,000	758.2	760.4	0.00064	11.9	24087	678	0.34
Kansas	Kansas Control	1.614	0.2%	500	341,000	761.6	764.3	0.00070	13.1	26405	690	0.36
Kansas	Missouri Control	1.614	0.133%	750	343,000	763.5	766.0	0.00061	12.6	27716	6097	0.34
Kansas	Missouri Control	1.614	0.100%	1000	369,000	765.0	767.7	0.00063	13.1	28779	6297	0.34
Kansas	Missouri Control	1.614	0.080%	1250	391,000	766.3	769.1	0.00064	13.4	29711	6474	0.35
Kansas	Missouri Control	1.614	0.067%	1500	407,000	767.3	770.2	0.00064	13.7	30423	6608	0.35
Kansas	Kansas Control	1.619	Missouri Pacific Bridge No. 72									
Kansas	Kansas Control	1.624	10%	10	121,000	745.7	746.6	0.00042	7.6	15987	598	0.26
Kansas	Kansas Control	1.624	1%	100	241,000	755.8	757.6	0.00058	10.8	22436	670	0.32
Kansas	Kansas Control	1.624	0.5%	200	283,000	758.4	760.6	0.00063	11.8	24208	679	0.34
Kansas	Kansas Control	1.624	0.2%	500	341,000	762.1	764.7	0.00067	13.0	26741	692	0.35
Kansas	Missouri Control	1.624	0.133%	750	343,000	764.1	766.5	0.00058	12.4	28123	6175	0.33
Kansas	Missouri Control	1.624	0.100%	1000	369,000	765.8	768.3	0.00059	12.8	29309	6403	0.33
Kansas	Missouri Control	1.624	0.080%	1250	391,000	767.2	769.9	0.00060	13.2	30312	6594	0.34
Kansas	Missouri Control	1.624	0.067%	1500	407,000	768.3	771.0	0.00060	13.4	31014	6760	0.34
Kansas	Kansas Control	1.634	10%	10	121,000	745.7	746.6	0.00042	7.6	15937	594	0.26
Kansas	Kansas Control	1.634	1%	100	241,000	755.8	757.6	0.00059	10.8	22364	670	0.32
Kansas	Kansas Control	1.634	0.5%	200	283,000	758.4	760.6	0.00064	11.8	24141	681	0.34
Kansas	Kansas Control	1.634	0.2%	500	341,000	762.1	764.7	0.00068	13.0	26683	694	0.35
Kansas	Missouri Control	1.634	0.133%	750	343,000	764.1	766.5	0.00059	12.4	28066	6116	0.33
Kansas	Missouri Control	1.634	0.100%	1000	369,000	765.8	768.4	0.00060	12.9	29256	6334	0.34
Kansas	Missouri Control	1.634	0.080%	1250	391,000	767.3	769.9	0.00060	13.2	30262	6519	0.34
Kansas	Missouri Control	1.634	0.067%	########	407,000	768.3	771.1	0.00061	13.4	30967	6649	0.34
Kansas	Kansas Control	1.638	Union Pacific Bridge No. 3									
Kansas	Kansas Control	1.643	10%	10	121,000	745.8	746.7	0.00042	7.6	15987	595	0.26
Kansas	Kansas Control	1.643	1%	100	241,000	756.0	757.8	0.00058	10.8	22467	670	0.32
Kansas	Kansas Control	1.643	0.5%	200	283,000	758.6	760.8	0.00063	11.8	24257	679	0.34
Kansas	Kansas Control	1.643	0.2%	500	341,000	762.3	764.9	0.00067	12.9	26809	692	0.35
Kansas	Missouri Control	1.643	0.133%	750	343,000	764.4	766.8	0.00057	12.4	28268	6156	0.33
Kansas	Missouri Control	1.643	0.100%	1000	369,000	766.3	768.8	0.00058	12.7	29535	6389	0.33
Kansas	Missouri Control	1.643	0.080%	1250	391,000	767.7	770.3	0.00058	13.1	30540	6574	0.33
Kansas	Missouri Control	1.643	0.067%	1500	407,000	768.7	771.4	0.00059	13.3	31245	6706	0.34
Kansas	Kansas Control	2.016	10%	10	121,000	746.6	747.4	0.00035	7.5	16254	585	0.24
Kansas	Kansas Control	2.016	1%	100	241,000	757.0	758.9	0.00051	11.0	22769	663	0.30
Kansas	Kansas Control	2.016	0.5%	200	283,000	759.8	762.0	0.00056	12.0	24613	683	0.32
Kansas	Kansas Control	2.016	0.2%	500	341,000	763.5	766.2	0.00060	13.2	27257	711	0.34
Kansas	Kansas Control	2.016	0.133%	750	367,000	765.5	768.3	0.00060	13.6	28657	6486	0.34
Kansas	Kansas Control	2.016	0.100%	1000	369,000	767.3	769.9	0.00054	13.1	29977	6785	0.32
Kansas	Missouri Control	2.016	0.080%	1250	391,000	768.8	771.5	0.00054	13.5	31038	7021	0.33
Kansas	Missouri Control	2.016	0.067%	1500	407,000	769.8	772.6	0.00055	13.7	31783	7179	0.33
Kansas	Kansas Control	2.097	10%	10	121,000	746.7	747.6	0.00038	7.6	16008	586	0.25
Kansas	Kansas Control	2.097	1%	100	241,000	757.3	759.1	0.00052	10.9	22639	673	0.31
Kansas	Kansas Control	2.097	0.5%	200	283,000	760.0	762.2	0.00056	11.9	24539	696	0.33
Kansas	Kansas Control	2.097	0.2%	500	341,000	763.9	766.5	0.00060	13.1	27259	5103	0.34
Kansas	Kansas Control	2.097	0.133%	750	367,000	765.8	768.6	0.00060	13.4	28674	5212	0.34
Kansas	Kansas Control	2.097	0.100%	1000	388,000	767.6	770.4	0.00059	13.6	29985	6034	0.34
Kansas	Missouri Control	2.097	0.080%	1250	391,000	769.1	771.7	0.00054	13.3	31035	6676	0.33
Kansas	Missouri Control	2.097	0.067%	1500	407,000	770.1	772.8	0.00054	13.5	31785	7094	0.33
Kansas	Kansas Control	2.104	CRI&P Bridge									
Kansas	Kansas Control	2.111	10%	10	121,000	746.8	747.7	0.00037	7.5	16076	589	0.25
Kansas	Kansas Control	2.111	1%	100	241,000	757.4	759.2	0.00049	10.8	22801	678	0.31

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	2.111	0.5%	200	283,000	760.2	762.4	0.00054	11.8	24735	702	0.32
Kansas	Kansas Control	2.111	0.2%	500	341,000	764.2	766.7	0.00057	12.9	27574	5117	0.34
Kansas	Kansas Control	2.111	0.133%	750	367,000	766.3	769.0	0.00056	13.2	29129	5401	0.34
Kansas	Kansas Control	2.111	0.100%	1000	388,000	768.3	771.0	0.00054	13.4	30579	6299	0.33
Kansas	Missouri Control	2.111	0.080%	1250	391,000	769.7	772.2	0.00050	13.1	31583	6925	0.32
Kansas	Missouri Control	2.111	0.067%	1500	407,000	770.7	773.4	0.00050	13.3	32342	7092	0.33
Kansas	Kansas Control	2.165	10%	10	121,000	747.0	747.8	0.00038	7.1	16991	692	0.25
Kansas	Kansas Control	2.165	1%	100	241,000	757.9	759.4	0.00045	9.8	25206	824	0.29
Kansas	Kansas Control	2.165	0.5%	200	283,000	760.8	762.6	0.00047	10.6	27661	852	0.30
Kansas	Kansas Control	2.165	0.2%	500	341,000	765.0	767.0	0.00048	11.4	31194	5371	0.31
Kansas	Kansas Control	2.165	0.133%	750	367,000	767.1	769.2	0.00047	11.7	33064	6122	0.31
Kansas	Kansas Control	2.165	0.100%	1000	388,000	769.1	771.2	0.00045	11.7	34784	6691	0.30
Kansas	Missouri Control	2.165	0.080%	1250	391,000	770.4	772.4	0.00041	11.5	35928	6947	0.29
Kansas	Missouri Control	2.165	0.067%	1500	407,000	771.5	773.6	0.00042	11.7	36846	6955	0.29
Kansas	Kansas Control	2.172	Kansas Avenue East Bridge									
Kansas	Kansas Control	2.179	10%	10	121,000	747.1	747.9	0.00038	7.1	17059	697	0.25
Kansas	Kansas Control	2.179	1%	100	241,000	758.0	759.5	0.00045	9.7	25242	796	0.29
Kansas	Kansas Control	2.179	0.5%	200	283,000	761.0	762.7	0.00047	10.5	27618	816	0.30
Kansas	Kansas Control	2.179	0.2%	500	341,000	765.3	767.3	0.00047	11.3	31210	5429	0.30
Kansas	Kansas Control	2.179	0.133%	750	367,000	767.6	769.7	0.00045	11.5	33115	5808	0.30
Kansas	Kansas Control	2.179	0.100%	1000	388,000	769.7	771.8	0.00043	11.6	34864	6818	0.30
Kansas	Missouri Control	2.179	0.080%	1250	391,000	771.1	773.1	0.00040	11.3	35994	6945	0.29
Kansas	Missouri Control	2.179	0.067%	1500	407,000	772.3	774.3	0.00040	11.5	36945	6950	0.29
Kansas	Kansas Control	2.491	10%	10	121,000	747.7	748.5	0.00034	7.2	16757	597	0.24
Kansas	Kansas Control	2.491	1%	100	241,000	758.7	760.3	0.00045	10.2	23774	680	0.29
Kansas	Kansas Control	2.491	0.5%	200	283,000	761.6	763.5	0.00048	11.1	25806	693	0.31
Kansas	Kansas Control	2.491	0.2%	500	341,000	765.9	768.2	0.00050	12.1	28815	5458	0.32
Kansas	Kansas Control	2.491	0.133%	750	367,000	768.2	770.5	0.00049	12.4	30420	6607	0.32
Kansas	Kansas Control	2.491	0.100%	1000	388,000	770.2	772.6	0.00047	12.5	31892	6613	0.31
Kansas	Kansas Control	2.491	0.080%	1250	403,000	771.5	774.0	0.00047	12.7	32827	6617	0.31
Kansas	Kansas Control	2.491	0.067%	1500	407,000	772.7	775.1	0.00044	12.5	33636	6620	0.30
Kansas	Kansas Control	2.525	10%	10	121,000	747.7	748.5	0.00033	7.3	16653	609	0.24
Kansas	Kansas Control	2.525	1%	100	241,000	758.7	760.4	0.00044	10.4	23898	709	0.29
Kansas	Kansas Control	2.525	0.5%	200	283,000	761.7	763.6	0.00047	11.3	26023	723	0.30
Kansas	Kansas Control	2.525	0.2%	500	341,000	766.0	768.3	0.00049	12.3	29152	5587	0.32
Kansas	Kansas Control	2.525	0.133%	750	367,000	768.2	770.6	0.00048	12.6	30783	6573	0.31
Kansas	Kansas Control	2.525	0.100%	1000	388,000	770.3	772.7	0.00047	12.7	32275	6590	0.31
Kansas	Kansas Control	2.525	0.080%	1250	403,000	771.6	774.1	0.00046	12.8	33223	6600	0.31
Kansas	Missouri Control	2.525	0.067%	1500	407,000	772.7	775.2	0.00044	12.7	34041	6608	0.30
Kansas	Kansas Control	2.531	KC Terminal Bridge									
Kansas	Kansas Control	2.536	10%	10	121,000	747.8	748.6	0.00035	7.2	16822	624	0.24
Kansas	Kansas Control	2.536	1%	100	241,000	758.9	760.5	0.00043	10.1	24299	710	0.29
Kansas	Kansas Control	2.536	0.5%	200	283,000	762.0	763.9	0.00046	11.0	26476	710	0.30
Kansas	Kansas Control	2.536	0.2%	500	341,000	766.5	768.7	0.00047	11.9	29696	6566	0.31
Kansas	Kansas Control	2.536	0.133%	750	367,000	769.0	771.2	0.00046	12.1	31428	6586	0.31
Kansas	Kansas Control	2.536	0.100%	1000	388,000	771.2	773.5	0.00044	12.2	33016	6602	0.30
Kansas	Kansas Control	2.536	0.080%	1250	403,000	772.7	775.0	0.00043	12.3	34036	6610	0.30
Kansas	Kansas Control	2.536	0.067%	1500	417,000	773.9	776.2	0.00042	12.4	34918	6617	0.30
Kansas	Kansas Control	3.050	10%	10	121,000	749.0	749.7	0.00032	6.5	18496	740	0.23
Kansas	Kansas Control	3.050	1%	100	241,000	760.6	761.8	0.00035	8.9	27518	805	0.26
Kansas	Kansas Control	3.050	0.5%	200	283,000	763.8	765.2	0.00037	9.6	30125	818	0.27
Kansas	Kansas Control	3.050	0.2%	500	341,000	768.5	770.1	0.00037	10.3	33963	6368	0.27
Kansas	Kansas Control	3.050	0.133%	750	367,000	770.9	772.6	0.00036	10.5	35983	6469	0.27
Kansas	Kansas Control	3.050	0.100%	1000	388,000	773.1	774.8	0.00034	10.6	37809	6497	0.26
Kansas	Kansas Control	3.050	0.080%	1250	403,000	774.5	776.2	0.00033	10.6	38996	6516	0.26
Kansas	Kansas Control	3.050	0.067%	1500	417,000	775.7	777.5	0.00033	10.7	40028	6533	0.26

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	3.405	10%	10	121,000	749.6	750.3	0.00037	6.6	18225	799	0.25
Kansas	Kansas Control	3.405	1%	100	241,000	761.3	762.5	0.00037	8.7	28078	875	0.26
Kansas	Kansas Control	3.405	0.5%	200	283,000	764.6	765.9	0.00038	9.3	31182	979	0.27
Kansas	Kansas Control	3.405	0.2%	500	341,000	769.3	770.8	0.00036	9.9	35911	6776	0.27
Kansas	Kansas Control	3.405	0.133%	750	367,000	771.7	773.2	0.00035	10.0	38442	6828	0.26
Kansas	Kansas Control	3.405	0.100%	1000	388,000	773.9	775.4	0.00033	10.0	40724	6890	0.26
Kansas	Kansas Control	3.405	0.080%	1250	403,000	775.3	776.8	0.00032	10.1	42217	6918	0.26
Kansas	Kansas Control	3.405	0.067%	1500	417,000	776.6	778.1	0.00031	10.1	43522	6942	0.25
Kansas	Kansas Control	3.416	7th Street Bridge									
Kansas	Kansas Control	3.427	10%	10	121,000	749.8	750.4	0.00036	6.3	19256	802	0.23
Kansas	Kansas Control	3.427	1%	100	241,000	761.5	762.6	0.00038	8.4	29077	877	0.25
Kansas	Kansas Control	3.427	0.5%	200	283,000	764.8	766.0	0.00039	9.0	32286	1016	0.25
Kansas	Kansas Control	3.427	0.2%	500	341,000	769.6	771.0	0.00037	9.5	37249	6849	0.25
Kansas	Kansas Control	3.427	0.133%	750	367,000	772.1	773.5	0.00036	9.6	39844	6907	0.25
Kansas	Kansas Control	3.427	0.100%	1000	388,000	774.3	775.8	0.00034	9.7	42189	6969	0.24
Kansas	Kansas Control	3.427	0.080%	1250	403,000	775.8	777.2	0.00033	9.7	43731	7016	0.24
Kansas	Kansas Control	3.427	0.067%	1500	417000	777.1	778.5	0.00032	9.8	45086	7058	0.24
Kansas	Kansas Control	3.960	10%	10	121,000	750.7	751.2	0.00021	5.7	21997	840	0.18
Kansas	Kansas Control	3.960	1%	100	241,000	762.6	763.5	0.00026	7.9	32530	948	0.21
Kansas	Kansas Control	3.960	0.5%	200	283,000	765.9	767.0	0.00028	8.5	35838	1044	0.22
Kansas	Kansas Control	3.960	0.2%	500	341,000	770.7	772.0	0.00028	9.2	40936	7119	0.23
Kansas	Kansas Control	3.960	0.133%	750	367,000	773.2	774.4	0.00027	9.3	43565	7159	0.22
Kansas	Kansas Control	3.960	0.100%	1000	388,000	775.4	776.6	0.00026	9.4	45922	7201	0.22
Kansas	Kansas Control	3.960	0.080%	1250	403,000	776.8	778.1	0.00026	9.5	47490	7241	0.22
Kansas	Kansas Control	3.960	0.067%	1500	417,000	778.0	779.4	0.00025	9.6	48887	7347	0.22
Kansas	Kansas Control	4.276	10%	10	121000	750.9	751.6	0.00029	6.4	19959	888	0.21
Kansas	Kansas Control	4.276	1%	100	241,000	762.9	764.0	0.00033	8.6	31037	969	0.24
Kansas	Kansas Control	4.276	0.5%	200	283,000	766.2	767.5	0.00034	9.2	34323	992	0.24
Kansas	Kansas Control	4.276	0.2%	500	341,000	771.0	772.4	0.00033	9.8	39171	7370	0.25
Kansas	Kansas Control	4.276	0.133%	750	367,000	773.5	774.9	0.00032	10.0	41663	7374	0.24
Kansas	Kansas Control	4.276	0.100%	1000	388,000	775.7	777.1	0.00031	10.0	43894	7378	0.24
Kansas	Kansas Control	4.276	0.080%	1250	403,000	777.1	778.5	0.00030	10.1	45369	7380	0.24
Kansas	Kansas Control	4.276	0.067%	1500	417,000	778.4	779.8	0.00030	10.1	46669	7382	0.24
Kansas	Kansas Control	4.280	12th Street Bridge									
Kansas	Kansas Control	4.284	10%	10	121000	751.0	751.6	0.00033	6.4	20007	889	0.21
Kansas	Kansas Control	4.284	1%	100	241,000	763.0	764.0	0.00037	8.5	31119	970	0.23
Kansas	Kansas Control	4.284	0.5%	200	283,000	766.3	767.5	0.00039	9.1	34418	993	0.24
Kansas	Kansas Control	4.284	0.2%	500	341,000	771.2	772.6	0.00038	9.7	39357	7370	0.24
Kansas	Kansas Control	4.284	0.133%	750	367,000	773.7	775.1	0.00036	9.8	41909	7374	0.24
Kansas	Kansas Control	4.284	0.100%	1000	388,000	776.0	777.3	0.00035	9.8	44206	7378	0.23
Kansas	Kansas Control	4.284	0.080%	1250	403,000	777.4	778.8	0.00034	9.9	45730	7380	0.23
Kansas	Kansas Control	4.284	0.067%	1500	417,000	778.8	780.1	0.00033	9.9	47079	7382	0.23
Kansas	Kansas Control	4.480	10%	10	121,000	751.5	751.9	0.00024	5.5	22309	808	0.18
Kansas	Kansas Control	4.480	1%	100	241,000	763.5	764.4	0.00030	7.7	32621	927	0.21
Kansas	Kansas Control	4.480	0.5%	200	283,000	766.9	767.9	0.00031	8.3	35862	1000	0.22
Kansas	Kansas Control	4.480	0.2%	500	341,000	771.8	773.0	0.00031	8.9	40973	7407	0.22
Kansas	Kansas Control	4.480	0.133%	750	367000	774.2	775.5	0.00030	9.0	43640	7448	0.22
Kansas	Kansas Control	4.480	0.100%	1000	388,000	776.5	777.7	0.00029	9.1	46038	7481	0.22
Kansas	Kansas Control	4.480	0.080%	1250	403,000	777.9	779.2	0.00029	9.1	47634	7503	0.22
Kansas	Kansas Control	4.480	0.067%	1500	417,000	779.2	780.5	0.00028	9.2	49048	7523	0.21
Kansas	Kansas Control	4.949	10%	10	121,000	752.0	752.3	0.00014	4.1	29636	1065	0.13
Kansas	Kansas Control	4.949	1%	100	241,000	764.4	764.9	0.00016	5.7	43551	1187	0.15
Kansas	Kansas Control	4.949	0.5%	200	283,000	767.8	768.4	0.00017	6.2	47713	1217	0.16
Kansas	Kansas Control	4.949	0.2%	500	341,000	772.8	773.4	0.00017	6.7	53957	7106	0.16
Kansas	Kansas Control	4.949	0.133%	750	367,000	775.2	775.9	0.00017	6.8	57147	7142	0.16

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	4.949	0.100%	1000	388,000	777.4	778.1	0.00016	6.8	59982	7173	0.16
Kansas	Kansas Control	4.949	0.080%	1250	403,000	778.9	779.6	0.00016	6.9	61869	7194	0.16
Kansas	Kansas Control	4.949	0.067%	1500	417,000	780.2	780.9	0.00016	7.0	63542	7212	0.16
Kansas	Kansas Control	4.960	18th Street Bridge									
Kansas	Kansas Control	4.970	10%	10	121,000	752.1	752.3	0.00013	3.9	31244	1142	0.13
Kansas	Kansas Control	4.970	1%	100	241,000	764.5	764.9	0.00015	5.3	46107	1258	0.15
Kansas	Kansas Control	4.970	0.5%	200	283,000	768.0	768.5	0.00016	5.7	50565	1291	0.15
Kansas	Kansas Control	4.970	0.2%	500	341,000	773.0	773.6	0.00016	6.1	57194	6845	0.16
Kansas	Kansas Control	4.970	0.133%	750	367,000	775.5	776.1	0.00015	6.3	60556	6930	0.15
Kansas	Kansas Control	4.970	0.100%	1000	388,000	777.7	778.3	0.00015	6.3	63558	7005	0.15
Kansas	Kansas Control	4.970	0.080%	1250	403000	779.2	779.8	0.00014	6.4	65558	7056	0.15
Kansas	Kansas Control	4.970	0.067%	1500	417,000	780.5	781.2	0.00014	6.4	67335	7094	0.15
Kansas	Kansas Control	5.506	10%	10	121,000	752.4	752.6	0.00010	3.5	34587	1161	0.11
Kansas	Kansas Control	5.506	1%	100	241,000	764.9	765.2	0.00012	4.9	49639	1250	0.13
Kansas	Kansas Control	5.506	0.5%	200	283,000	768.4	768.8	0.00013	5.3	54061	1263	0.14
Kansas	Kansas Control	5.506	0.2%	500	341,000	773.4	773.9	0.00013	5.8	60437	9177	0.14
Kansas	Kansas Control	5.506	0.133%	750	367,000	775.9	776.4	0.00013	5.9	63643	9217	0.14
Kansas	Kansas Control	5.506	0.100%	1000	388,000	778.1	778.7	0.00012	6.0	66549	9232	0.14
Kansas	Kansas Control	5.506	0.080%	1250	403,000	779.6	780.2	0.00012	6.0	68501	9242	0.14
Kansas	Kansas Control	5.506	0.067%	1500	417,000	780.9	781.5	0.00012	6.1	70245	9244	0.14
Kansas	Kansas Control	5.513	Kaw Power Plant Intake Structure									
Kansas	Kansas Control	5.520	10%	10	121,000	752.4	752.6	0.00010	3.5	34602	1161	0.11
Kansas	Kansas Control	5.520	1%	100	241,000	764.9	765.3	0.00012	4.9	49665	1250	0.13
Kansas	Kansas Control	5.520	0.5%	200	283,000	768.4	768.9	0.00013	5.3	54091	1263	0.14
Kansas	Kansas Control	5.520	0.2%	500	341,000	773.4	773.9	0.00013	5.8	60475	9177	0.14
Kansas	Kansas Control	5.520	0.133%	750	367,000	775.9	776.5	0.00013	5.9	63670	9217	0.14
Kansas	Kansas Control	5.520	0.100%	1000	388,000	778.2	778.7	0.00012	6.0	66514	9232	0.14
Kansas	Kansas Control	5.520	0.080%	1250	403,000	779.7	780.2	0.00012	6.0	68412	9242	0.14
Kansas	Kansas Control	5.520	0.067%	1500	417,000	781.0	781.5	0.00012	6.1	70099	9244	0.14
Kansas	Kansas Control	5.811	10%	10	121,000	752.6	752.8	0.00010	3.1	38799	1611	0.11
Kansas	Kansas Control	5.811	1%	100	241000	765.2	765.5	0.00010	4.1	60226	1798	0.12
Kansas	Kansas Control	5.811	0.5%	200	283,000	768.8	769.1	0.00010	4.4	66682	1824	0.12
Kansas	Kansas Control	5.811	0.2%	500	341,000	773.8	774.2	0.00010	4.6	76012	9755	0.12
Kansas	Kansas Control	5.811	0.133%	750	367,000	776.3	776.7	0.00009	4.7	80733	9838	0.12
Kansas	Kansas Control	5.811	0.100%	1000	388,000	778.6	778.9	0.00009	4.7	84933	9911	0.12
Kansas	Kansas Control	5.811	0.080%	1250	403,000	780.1	780.4	0.00009	4.8	87740	10086	0.12
Kansas	Kansas Control	5.811	0.067%	1500	417,000	781.4	781.7	0.00008	4.8	90238	10113	0.12
Kansas	Kansas Control	5.821	Kansas Avenue Bridge									
Kansas	Kansas Control	5.831	10%	10	121,000	752.7	752.8	0.00010	3.1	38879	1611	0.11
Kansas	Kansas Control	5.831	1%	100	241000	765.2	765.5	0.00010	4.1	60313	1799	0.12
Kansas	Kansas Control	5.831	0.5%	200	283,000	768.8	769.1	0.00010	4.4	66770	1824	0.12
Kansas	Kansas Control	5.831	0.2%	500	341,000	773.9	774.2	0.00010	4.6	76108	9756	0.12
Kansas	Kansas Control	5.831	0.133%	750	367,000	776.4	776.7	0.00009	4.7	80851	9839	0.12
Kansas	Kansas Control	5.831	0.100%	1000	388,000	778.6	779.0	0.00009	4.7	85077	9912	0.12
Kansas	Kansas Control	5.831	0.080%	1250	403,000	780.1	780.5	0.00009	4.8	87903	10088	0.12
Kansas	Kansas Control	5.831	0.067%	1500	417,000	781.5	781.8	0.00008	4.8	90421	10114	0.12
Kansas	Kansas Control	5.967	10%	10	121,000	752.7	752.9	0.00010	3.4	35340	1242	0.11
Kansas	Kansas Control	5.967	1%	100	241,000	765.2	765.6	0.00012	4.7	51508	1337	0.13
Kansas	Kansas Control	5.967	0.5%	200	283,000	768.8	769.2	0.00012	5.1	56294	1363	0.13
Kansas	Kansas Control	5.967	0.2%	500	341,000	773.8	774.3	0.00012	5.5	63257	6618	0.14
Kansas	Kansas Control	5.967	0.133%	750	367,000	776.3	776.8	0.00012	5.6	66759	8625	0.14
Kansas	Kansas Control	5.967	0.100%	1000	388000	778.6	779.1	0.00012	5.7	69874	8648	0.14
Kansas	Kansas Control	5.967	0.080%	1250	403,000	780.1	780.6	0.00011	5.8	71957	8664	0.14
Kansas	Kansas Control	5.967	0.067%	1500	417,000	781.4	781.9	0.00011	5.8	73813	8698	0.13

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	6.880	10%	10	121,000	753.1	753.3	0.00011	3.4	35737	1337	0.11
Kansas	Kansas Control	6.880	1%	100	241,000	765.7	766.0	0.00012	4.6	53306	1440	0.13
Kansas	Kansas Control	6.880	0.5%	200	283,000	769.3	769.6	0.00013	4.9	58483	1462	0.13
Kansas	Kansas Control	6.880	0.2%	500	341,000	774.3	774.8	0.00013	5.3	65988	7711	0.13
Kansas	Kansas Control	6.880	0.133%	750	367,000	776.8	777.3	0.00012	5.4	69737	8122	0.13
Kansas	Kansas Control	6.880	0.100%	1000	388,000	779.1	779.5	0.00012	5.5	73062	8165	0.13
Kansas	Kansas Control	6.880	0.080%	1250	403,000	780.5	781.0	0.00012	5.5	75290	8195	0.13
Kansas	Kansas Control	6.880	0.067%	1500	417,000	781.9	782.3	0.00012	5.6	77277	8224	0.13
Kansas	Kansas Control	7.329	10%	10	121,000	753.3	753.7	0.00026	5.2	24126	1176	0.17
Kansas	Kansas Control	7.329	1%	100	241,000	765.9	766.5	0.00026	6.6	39917	1303	0.18
Kansas	Kansas Control	7.329	0.5%	200	283,000	769.4	770.2	0.00026	7.1	45114	1520	0.19
Kansas	Kansas Control	7.329	0.2%	500	341,000	774.5	775.3	0.00025	7.4	53127	1667	0.19
Kansas	Kansas Control	7.329	0.133%	750	367,000	777.0	777.8	0.00023	7.5	57394	8688	0.18
Kansas	Kansas Control	7.329	0.100%	1000	388,000	779.2	780.0	0.00022	7.4	61254	8723	0.18
Kansas	Kansas Control	7.329	0.080%	1250	403,000	780.7	781.5	0.00021	7.4	63861	8745	0.18
Kansas	Kansas Control	7.329	0.067%	1500	417,000	782.0	782.8	0.00020	7.4	66194	8761	0.17
Kansas	Kansas Control	7.333	10%	10	121000	753.3	753.7	0.00026	5.2	24135	1176	0.17
Kansas	Kansas Control	7.333	1%	100	241,000	765.9	766.5	0.00026	6.6	39927	1303	0.18
Kansas	Kansas Control	7.333	0.5%	200	283,000	769.5	770.2	0.00026	7.1	45126	1520	0.19
Kansas	Kansas Control	7.333	0.2%	500	341,000	774.5	775.3	0.00025	7.4	53139	1667	0.19
Kansas	Kansas Control	7.333	0.133%	750	367,000	777.0	777.8	0.00023	7.5	57406	8689	0.18
Kansas	Kansas Control	7.333	0.100%	1000	388,000	779.2	780.0	0.00022	7.4	61266	8724	0.18
Kansas	Kansas Control	7.333	0.080%	1250	403,000	780.7	781.5	0.00021	7.4	63872	8745	0.18
Kansas	Kansas Control	7.333	0.067%	1500	417,000	782.0	782.8	0.00020	7.4	66205	8761	0.17
Kansas	Kansas Control	7.338	I-635 Bridge (northbound)									
Kansas	Kansas Control	7.342	10%	10	121,000	753.3	753.8	0.00026	5.2	24167	1176	0.17
Kansas	Kansas Control	7.342	1%	100	241,000	765.9	766.6	0.00026	6.6	39969	1303	0.18
Kansas	Kansas Control	7.342	0.5%	200	283,000	769.5	770.2	0.00026	7.1	45166	1521	0.19
Kansas	Kansas Control	7.342	0.2%	500	341,000	774.5	775.3	0.00024	7.4	53185	1669	0.19
Kansas	Kansas Control	7.342	0.133%	750	367,000	777.0	777.8	0.00023	7.4	57446	8689	0.18
Kansas	Kansas Control	7.342	0.100%	1000	388,000	779.2	780.0	0.00022	7.4	61307	8724	0.18
Kansas	Kansas Control	7.342	0.080%	1250	403,000	780.7	781.5	0.00021	7.4	63914	8745	0.18
Kansas	Kansas Control	7.342	0.067%	1500	417,000	782.1	782.8	0.00020	7.4	66240	8762	0.17
Kansas	Kansas Control	7.351	10%	10	121,000	753.4	753.8	0.00026	5.2	24176	1177	0.17
Kansas	Kansas Control	7.351	1%	100	241,000	765.9	766.6	0.00025	6.6	39980	1303	0.18
Kansas	Kansas Control	7.351	0.5%	200	283,000	769.5	770.2	0.00026	7.1	45179	1521	0.19
Kansas	Kansas Control	7.351	0.2%	500	341,000	774.5	775.3	0.00024	7.4	53199	1669	0.19
Kansas	Kansas Control	7.351	0.133%	750	367000	777.0	777.8	0.00023	7.4	57460	8689	0.18
Kansas	Kansas Control	7.351	0.100%	1000	388,000	779.3	780.0	0.00022	7.4	61320	8724	0.18
Kansas	Kansas Control	7.351	0.080%	1250	403,000	780.7	781.5	0.00021	7.4	63926	8745	0.18
Kansas	Kansas Control	7.351	0.067%	1500	417,000	782.1	782.8	0.00020	7.4	66252	8762	0.17
Kansas	Kansas Control	7.355	I-635 Bridge (southbound)									
Kansas	Kansas Control	7.360	10%	10	121,000	753.4	753.8	0.00026	5.2	24202	1177	0.17
Kansas	Kansas Control	7.360	1%	100	241,000	766.0	766.6	0.00025	6.6	40015	1303	0.18
Kansas	Kansas Control	7.360	0.5%	200	283,000	769.5	770.2	0.00026	7.1	45212	1521	0.19
Kansas	Kansas Control	7.360	0.2%	500	341,000	774.6	775.3	0.00024	7.4	53238	1670	0.19
Kansas	Kansas Control	7.360	0.133%	750	367,000	777.1	777.8	0.00023	7.4	57494	8690	0.18
Kansas	Kansas Control	7.360	0.100%	1000	388,000	779.3	780.0	0.00022	7.4	61355	8725	0.18
Kansas	Kansas Control	7.360	0.080%	1250	403000	780.8	781.5	0.00021	7.4	63962	8745	0.18
Kansas	Kansas Control	7.360	0.067%	1500	417,000	782.1	782.8	0.00020	7.4	66282	8762	0.17
Kansas	Kansas Control	7.364	10%	10	121,000	753.6	753.8	0.00016	4.1	30037	1180	0.13
Kansas	Kansas Control	7.364	1%	100	241,000	766.2	766.6	0.00017	5.5	45921	1389	0.15
Kansas	Kansas Control	7.364	0.5%	200	283,000	769.7	770.3	0.00018	5.9	51183	1525	0.15
Kansas	Kansas Control	7.364	0.2%	500	341,000	774.8	775.4	0.00017	6.2	59218	8617	0.16
Kansas	Kansas Control	7.364	0.133%	750	367,000	777.3	777.9	0.00017	6.3	63477	8693	0.15
Kansas	Kansas Control	7.364	0.100%	1000	388,000	779.5	780.1	0.00016	6.3	67312	8727	0.15

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	7.364	0.080%	1250	403,000	780.9	781.5	0.00015	6.4	69903	8748	0.15
Kansas	Kansas Control	7.364	0.067%	1500	417,000	782.3	782.9	0.00015	6.4	72210	8764	0.15
Kansas	Kansas Control	7.650	10%	10	121,000	753.8	754.1	0.00017	4.4	27925	1078	0.14
Kansas	Kansas Control	7.650	1%	100	241,000	766.4	766.9	0.00019	5.9	43441	1333	0.16
Kansas	Kansas Control	7.650	0.5%	200	283,000	770.0	770.5	0.00020	6.3	48360	1425	0.16
Kansas	Kansas Control	7.650	0.2%	500	341,000	775.0	775.6	0.00019	6.7	55915	1530	0.17
Kansas	Kansas Control	7.650	0.133%	750	367,000	777.5	778.1	0.00019	6.8	59711	8089	0.16
Kansas	Kansas Control	7.650	0.100%	1000	388,000	779.6	780.3	0.00018	6.8	63089	8218	0.16
Kansas	Kansas Control	7.650	0.080%	1250	403,000	781.1	781.8	0.00017	6.9	65365	8249	0.16
Kansas	Kansas Control	7.650	0.067%	1500	417,000	782.4	783.1	0.00017	6.9	67392	8260	0.16
Kansas	Kansas Control	8.420	10%	10	121,000	754.4	754.7	0.00016	4.5	29676	1529	0.14
Kansas	Kansas Control	8.420	1%	100	241,000	767.2	767.6	0.00016	5.7	51852	1977	0.15
Kansas	Kansas Control	8.420	0.5%	200	283,000	770.8	771.3	0.00016	5.9	59066	2011	0.15
Kansas	Kansas Control	8.420	0.2%	500	341000	775.9	776.3	0.00015	6.1	69374	2074	0.15
Kansas	Kansas Control	8.420	0.133%	750	367,000	778.3	778.8	0.00014	6.1	74488	7034	0.14
Kansas	Kansas Control	8.420	0.100%	1000	388,000	780.5	780.9	0.00013	6.1	79003	7052	0.14
Kansas	Kansas Control	8.420	0.080%	1250	403,000	781.9	782.4	0.00013	6.1	82052	7066	0.14
Kansas	Kansas Control	8.420	0.067%	1500	417,000	783.2	783.7	0.00012	6.1	84770	7079	0.14
Kansas	Kansas Control	9.040	10%	10	121,000	754.9	755.2	0.00018	4.2	29656	2651	0.14
Kansas	Kansas Control	9.040	1%	100	241,000	767.7	768.1	0.00019	5.1	49425	3236	0.15
Kansas	Kansas Control	9.040	0.5%	200	283,000	771.3	771.7	0.00018	5.4	55311	3262	0.15
Kansas	Kansas Control	9.040	0.2%	500	341,000	776.3	776.8	0.00017	5.7	63610	3300	0.15
Kansas	Kansas Control	9.040	0.133%	750	367,000	778.7	779.2	0.00016	5.7	67682	7247	0.15
Kansas	Kansas Control	9.040	0.100%	1000	388000	780.9	781.3	0.00016	5.7	71269	7285	0.15
Kansas	Kansas Control	9.040	0.080%	1250	403,000	782.3	782.8	0.00015	5.8	73691	7311	0.14
Kansas	Kansas Control	9.040	0.067%	1500	417,000	783.6	784.1	0.00015	5.8	75848	7334	0.14
Kansas	Kansas Control	9.490	10%	10	121,000	755.3	755.6	0.00020	4.5	26920	1101	0.15
Kansas	Kansas Control	9.490	1%	100	241,000	768.1	768.6	0.00021	6.0	42365	4318	0.17
Kansas	Kansas Control	9.490	0.5%	200	283,000	771.6	772.3	0.00021	6.4	46891	4441	0.17
Kansas	Kansas Control	9.490	0.2%	500	341,000	776.6	777.3	0.00021	6.8	53328	4522	0.17
Kansas	Kansas Control	9.490	0.133%	750	367,000	779.0	779.7	0.00021	6.9	56532	6713	0.17
Kansas	Kansas Control	9.490	0.100%	1000	388,000	781.1	781.8	0.00020	7.0	59366	6781	0.17
Kansas	Kansas Control	9.490	0.080%	1250	403,000	782.5	783.3	0.00019	7.0	61281	6804	0.17
Kansas	Kansas Control	9.490	0.067%	1500	417000	783.8	784.5	0.00019	7.1	62988	6814	0.17
Kansas	Kansas Control	9.498	Kansas Avenue West Bridge									
Kansas	Kansas Control	9.505	10%	10	121,000	755.4	755.7	0.00020	4.5	26984	1103	0.15
Kansas	Kansas Control	9.505	1%	100	241,000	768.1	768.7	0.00021	6.0	42444	4319	0.17
Kansas	Kansas Control	9.505	0.5%	200	283,000	771.7	772.3	0.00021	6.3	46972	4441	0.17
Kansas	Kansas Control	9.505	0.2%	500	341,000	776.6	777.3	0.00021	6.8	53412	4522	0.17
Kansas	Kansas Control	9.505	0.133%	750	367,000	779.1	779.8	0.00020	6.9	56641	6715	0.17
Kansas	Kansas Control	9.505	0.100%	1000	388,000	781.2	781.9	0.00020	6.9	59519	6783	0.17
Kansas	Kansas Control	9.505	0.080%	1250	403,000	782.7	783.4	0.00019	7.0	61468	6805	0.17
Kansas	Kansas Control	9.505	0.067%	1500	417000	784.0	784.7	0.00019	7.0	63209	6815	0.17
Kansas	Kansas Control	9.820	10%	10	121,000	755.5	755.9	0.00018	4.6	28468	1249	0.14
Kansas	Kansas Control	9.820	1%	100	241,000	768.6	769.0	0.00016	5.5	58334	4411	0.14
Kansas	Kansas Control	9.820	0.5%	200	283,000	772.2	772.6	0.00014	5.5	68679	4512	0.14
Kansas	Kansas Control	9.820	0.2%	500	341,000	777.3	777.6	0.00012	5.5	83028	4557	0.13
Kansas	Kansas Control	9.820	0.133%	750	367,000	779.7	780.0	0.00011	5.4	89998	5860	0.13
Kansas	Kansas Control	9.820	0.100%	1000	388,000	781.9	782.2	0.00011	5.3	96155	5877	0.12
Kansas	Kansas Control	9.820	0.080%	1250	403000	783.3	783.6	0.00010	5.3	100330	5888	0.12
Kansas	Kansas Control	9.820	0.067%	1500	417,000	784.6	784.9	0.00010	5.3	104061	5898	0.12
Kansas	Kansas Control	10.400	10%	10	121,000	755.9	756.5	0.00022	6.3	20531	638	0.18
Kansas	Kansas Control	10.400	1%	100	241,000	768.6	769.8	0.00029	8.9	47598	4691	0.22
Kansas	Kansas Control	10.400	0.5%	200	283,000	772.2	773.4	0.00030	9.3	63514	4881	0.22
Kansas	Kansas Control	10.400	0.2%	500	341,000	777.2	778.3	0.00027	9.4	88052	4939	0.21
Kansas	Kansas Control	10.400	0.133%	750	367,000	779.6	780.7	0.00025	9.3	100105	4967	0.21

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	10.400	0.100%	1000	388000	781.8	782.8	0.00023	9.2	110869	5022	0.2
Kansas	Kansas Control	10.400	0.080%	1250	403,000	783.3	784.2	0.00022	9.1	118218	5038	0.20
Kansas	Kansas Control	10.400	0.067%	1500	417,000	784.6	785.5	0.00021	9.0	124806	5052	0.19
Kansas	Kansas Control	10.600	10%	10	121,000	756.1	756.8	0.00025	6.6	19744	641	0.19
Kansas	Kansas Control	10.600	1%	100	241,000	769.0	770.2	0.00032	9.2	45675	3880	0.23
Kansas	Kansas Control	10.600	0.5%	200	283,000	772.5	773.8	0.00033	9.6	58957	4374	0.23
Kansas	Kansas Control	10.600	0.2%	500	341,000	777.4	778.7	0.00031	10.0	81595	4915	0.23
Kansas	Kansas Control	10.600	0.133%	750	367000	779.9	781.1	0.00029	9.9	93581	4998	0.22
Kansas	Kansas Control	10.600	0.100%	1000	388,000	782.0	783.1	0.00027	9.7	104347	5038	0.22
Kansas	Kansas Control	10.600	0.080%	1250	403,000	783.5	784.5	0.00026	9.6	111703	5065	0.21
Kansas	Kansas Control	10.600	0.067%	1500	417,000	784.8	785.8	0.00024	9.6	118317	5089	0.21
Kansas	Kansas Control	10.900	10%	10	121,000	756.7	757.2	0.00019	5.6	23904	1010	0.17
Kansas	Kansas Control	10.900	1%	100	241,000	769.9	770.7	0.00022	7.4	55946	3808	0.19
Kansas	Kansas Control	10.900	0.5%	200	283,000	773.5	774.3	0.00021	7.6	71491	4959	0.19
Kansas	Kansas Control	10.900	0.2%	500	341000	778.4	779.2	0.00020	7.8	95493	5293	0.18
Kansas	Kansas Control	10.900	0.133%	750	367,000	780.8	781.5	0.00018	7.8	107929	5359	0.18
Kansas	Kansas Control	10.900	0.100%	1000	388,000	782.8	783.5	0.00017	7.7	119052	5385	0.17
Kansas	Kansas Control	10.900	0.080%	1250	403,000	784.3	784.9	0.00016	7.6	126670	5403	0.17
Kansas	Kansas Control	10.900	0.067%	1500	417,000	785.5	786.2	0.00016	7.6	133530	5419	0.17
Kansas	Kansas Control	11.350	10%	10	121,000	757.1	757.6	0.00020	5.7	23321	1321	0.17
Kansas	Kansas Control	11.350	1%	100	241,000	770.4	771.0	0.00019	6.9	56492	3280	0.18
Kansas	Kansas Control	11.350	0.5%	200	283000	774.0	774.7	0.00019	7.2	70855	4943	0.18
Kansas	Kansas Control	11.350	0.2%	500	341,000	778.9	779.5	0.00017	7.3	94984	5280	0.17
Kansas	Kansas Control	11.350	0.133%	750	367,000	781.3	781.8	0.00016	7.2	107282	5295	0.16
Kansas	Kansas Control	11.350	0.100%	1000	388,000	783.3	783.8	0.00015	7.1	118120	5315	0.16
Kansas	Kansas Control	11.350	0.080%	1250	403,000	784.7	785.2	0.00014	7.0	125549	5330	0.16
Kansas	Kansas Control	11.350	0.067%	1500	417,000	785.9	786.4	0.00013	7.0	132241	5342	0.15
Kansas	Kansas Control	11.850	10%	10	121,000	757.7	758.2	0.00019	5.7	23099	817	0.17
Kansas	Kansas Control	11.850	1%	100	241000	771.1	771.6	0.00015	6.4	71950	4927	0.16
Kansas	Kansas Control	11.850	0.5%	200	283,000	774.7	775.2	0.00014	6.4	87769	5326	0.15
Kansas	Kansas Control	11.850	0.2%	500	341,000	779.6	780.0	0.00013	6.4	110106	5614	0.15
Kansas	Kansas Control	11.850	0.133%	750	367,000	781.8	782.3	0.00013	6.6	122525	5754	0.15
Kansas	Kansas Control	11.850	0.100%	1000	388,000	783.9	784.3	0.00012	6.5	134140	5850	0.14
Kansas	Kansas Control	11.850	0.080%	1250	403,000	785.2	785.6	0.00011	6.4	142204	5915	0.14
Kansas	Kansas Control	11.850	0.067%	1500	417,000	786.5	786.8	0.00011	6.3	149535	5957	0.14
Kansas	Kansas Control	12.400	10%	10	121000	758.3	758.6	0.00012	4.6	27779	954	0.13
Kansas	Kansas Control	12.400	1%	100	241,000	771.6	772.0	0.00012	5.6	73141	5705	0.14
Kansas	Kansas Control	12.400	0.5%	200	283,000	775.1	775.5	0.00011	5.7	89063	5768	0.14
Kansas	Kansas Control	12.400	0.2%	500	341,000	779.9	780.3	0.00010	5.8	110683	5853	0.13
Kansas	Kansas Control	12.400	0.133%	750	367,000	782.2	782.6	0.00010	5.7	121107	5896	0.13
Kansas	Kansas Control	12.400	0.100%	1000	388,000	784.1	784.5	0.00010	6.1	130074	5976	0.13
Kansas	Kansas Control	12.400	0.080%	1250	403,000	785.5	785.9	0.00010	6.0	138176	5996	0.13
Kansas	Kansas Control	12.400	0.067%	1500	417,000	786.7	787.1	0.00009	5.9	145493	6005	0.13
Kansas	Kansas Control	12.940	10%	10	121,000	758.6	758.9	0.00013	4.9	31244	1413	0.14
Kansas	Kansas Control	12.940	1%	100	241,000	771.8	772.3	0.00014	6.2	73840	5754	0.15
Kansas	Kansas Control	12.940	0.5%	200	283,000	775.4	775.9	0.00013	6.2	90307	5798	0.15
Kansas	Kansas Control	12.940	0.2%	500	341,000	780.2	780.6	0.00012	6.3	112618	5949	0.14
Kansas	Kansas Control	12.940	0.133%	750	367,000	782.5	782.9	0.00011	6.2	123444	5980	0.14
Kansas	Kansas Control	12.940	0.100%	1000	388,000	784.4	784.8	0.00012	6.5	134395	6020	0.14
Kansas	Kansas Control	12.940	0.080%	1250	403,000	785.7	786.2	0.00011	6.4	142455	6031	0.14
Kansas	Kansas Control	12.940	0.067%	1500	417000	787.0	787.4	0.00011	6.3	149739	6041	0.14
Kansas	Kansas Control	13.300	10%	10	121,000	758.9	759.2	0.00012	4.6	32241	1392	0.13
Kansas	Kansas Control	13.300	1%	100	241,000	772.2	772.6	0.00013	5.9	75809	6025	0.15
Kansas	Kansas Control	13.300	0.5%	200	283,000	775.7	776.1	0.00012	5.9	94677	6163	0.14
Kansas	Kansas Control	13.300	0.2%	500	341,000	780.5	780.8	0.00010	5.8	120098	6261	0.13
Kansas	Kansas Control	13.300	0.133%	750	367,000	782.7	783.1	0.00010	5.9	133217	6321	0.13
Kansas	Kansas Control	13.300	0.100%	1000	388,000	784.7	785.1	0.00009	5.8	145840	6351	0.13

Kansas River Future Conditions With Tree Removal and Channel Modifications Water Surface Elevations

Reach	Controlling Discharge	HEC-RAS River Mile	file Frequency Percent	file Frequency Year	Q Total (cfs)	Water Surface Elevation (ft)	Energy Grade Elevation (ft)	Energy Grade Slope (ft/ft)	Average Channel Velocity (ft/s)	Flow Area (sq ft)	Top Width (ft)	Channel Froude #
Kansas	Kansas Control	13.300	0.080%	1250	403000	786.1	786.4	0.00009	5.7	154216	6371	0.12
Kansas	Kansas Control	13.300	0.067%	1500	417,000	787.3	787.6	0.00008	5.6	161806	6389	0.12
Kansas	Kansas Control	13.650	10%	10	121,000	759.2	759.4	0.00008	4.1	36655	1838	0.11
Kansas	Kansas Control	13.650	1%	100	241,000	772.6	772.9	0.00009	5.1	92213	5119	0.12
Kansas	Kansas Control	13.650	0.5%	200	283,000	776.1	776.4	0.00008	5.2	110388	5308	0.12
Kansas	Kansas Control	13.650	0.2%	500	341,000	780.8	781.1	0.00008	5.3	135936	5810	0.12
Kansas	Kansas Control	13.650	0.133%	750	367,000	783.0	783.3	0.00008	5.3	148480	5917	0.12
Kansas	Kansas Control	13.650	0.100%	1000	388000	785.0	785.3	0.00007	5.3	160268	6026	0.11
Kansas	Kansas Control	13.650	0.080%	1250	403,000	786.3	786.6	0.00007	5.3	168175	6070	0.11
Kansas	Kansas Control	13.650	0.067%	1500	417,000	787.5	787.7	0.00007	5.3	175377	6106	0.11
Kansas	Kansas Control	14.250	10%	10	121,000	759.5	759.7	0.00011	4.1	34483	1652	0.13
Kansas	Kansas Control	14.250	1%	100	241,000	772.8	773.2	0.00011	5.2	90676	6088	0.13
Kansas	Kansas Control	14.250	0.5%	200	283,000	776.3	776.7	0.00011	5.4	111913	6371	0.14
Kansas	Kansas Control	14.250	0.2%	500	341,000	781.0	781.4	0.00011	5.6	140919	6466	0.13
Kansas	Kansas Control	14.250	0.133%	750	367000	783.2	783.6	0.00010	5.6	154997	6514	0.13
Kansas	Kansas Control	14.250	0.100%	1000	388,000	785.2	785.5	0.00010	5.6	167759	6531	0.13
Kansas	Kansas Control	14.250	0.080%	1250	403,000	786.5	786.8	0.00009	5.6	176247	6543	0.13
Kansas	Kansas Control	14.250	0.067%	1500	417,000	787.6	788.0	0.00009	5.6	183945	6554	0.13
Kansas	Kansas Control	14.620	10%	10	121,000	759.7	759.9	0.00007	3.6	37363	1207	0.10
Kansas	Kansas Control	14.620	1%	100	241,000	773.0	773.4	0.00009	5.1	85135	6186	0.12
Kansas	Kansas Control	14.620	0.5%	200	283,000	776.5	776.9	0.00009	5.4	107187	6403	0.12
Kansas	Kansas Control	14.620	0.2%	500	341000	781.1	781.5	0.00009	5.6	137006	6486	0.13
Kansas	Kansas Control	14.620	0.133%	750	367,000	783.4	783.8	0.00009	5.7	151427	6531	0.12
Kansas	Kansas Control	14.620	0.100%	1000	388,000	785.3	785.7	0.00009	5.7	164138	6550	0.12
Kansas	Kansas Control	14.620	0.080%	1250	403,000	786.6	787.0	0.00008	5.7	172602	6563	0.12
Kansas	Kansas Control	14.620	0.067%	1500	417,000	787.8	788.2	0.00008	5.7	180283	6574	0.12

EXHIBIT A-2.116
Relationship Between Peak Flood Flows From The Kansas and Missouri Rivers

CENWK-EC-HH 2 Jul 2002
Lance/3127

MEMORANDUM FOR RECORD

SUBJECT: Response to ITR Comment No. 6

1. References.

a.) *Kansas Cities, Missouri and Kansas Flood Damage Reduction Project Feasibility Study – Appendix B _ Missouri and Kansas River Hydraulic Analysis – Existing Conditions Report*, April 2002, Draft.

b.) e-mail ITR Comments, dtd 8 May 2002, sub: Kansas City H&H Feas. ITR, Richard Pruitt CELRL-ED-T-H.

c.) *Upper Mississippi River System Flow Frequency Study, Appendix E, Kansas City District, Hydrology*, 2002, publication pending.

d.) *Kansas River Basin Hydrology with special attention to Kansas River Hydrology near Topeka KS*, Kansas City District, March 2002.

2. Comment No. 6 of ref 1.b. raises questions about the coincidence of peak flood flows at the mouth of the Kansas River and the upper Missouri River (hereinafter called the "Upper Missouri") upstream of the confluence. This comment also raises the question of the relationship of the peak flows from each of these two rivers, from the concurrent expected flow at the Hannibal gage on the Missouri River. This gage is immediately downstream from the subject confluence. The methodology presented in ref 1.a. was identical to that used in the reconnaissance study as no additional investigations of the coincidence situation had been undertaken.

3. The purpose of this MFR is to document the study of coincident peak flows from the Kansas River and Upper Missouri Rivers, and the relationship of those peaks to the coincident flow at the Hannibal gage, and to recommend revised relationships between expected peak flows from each stream, and the concurrent flow at the gage.

4. This study has utilized some of the flow data files generated as part of the Kansas River basin study component of ref 1.c.. The specific data set used was the daily flow set for the outflow from the Kansas River basin for the period 1920 through 1997, for regulated conditions. In the context of that study "regulated conditions" is a simulation of flow based on the assumption that the present system of flood control reservoirs was in place and operated in compliance with present operating criteria throughout the entire period of simulation. A similar data set for the flows at the Hannibal gage was also produced in that study. Since the flow at the Hannibal gage is the simple sum of the flows from the Upper Missouri and Kansas Rivers (there is no intervening drainage area), a daily flow set for the Upper Missouri River was created by simply subtracting the Kansas River data set from the Hannibal gage data set. Using these data sets in lieu of the observed flow data sets (which are also available) has the advantage of reasonably representing the situation at the confluence with all reservoir effects taken into account.

5. An inspection of these records shows that the two tributary streams sometimes respond to a rainfall event that produces a pronounced peak in one hydrograph and only a weak response in the other tributary. At other times, both tributaries seem to respond to the same event, but rarely do both hydrographs peak on the same day. Although the Upper Missouri Basin is much larger than the Kansas River Basin (425,100 sm versus 60, 060 sm) all serious Upper Missouri River

floods in the immediate Kansas City area are generated by rainfall events in that portion of the Missouri River downstream of Omaha NE. The Kansas River basin and the flood-producing portion of the Upper Missouri basin are adjacent basins. The record reflects the situation where sometimes the footprint of the runoff producing rainfall falls within one of these adjacent basins, and sometimes it overlaps into both basins. The situation is complicated by the fact that sometimes flood peaks from the far upstream portions of the Missouri River basin come down the river, with no complementary impulse from the Kansas River. Because of the effects of the six upper Missouri River Reservoirs and the natural attenuation of these flood waves as they move downstream, these upriver floods do not contribute to serious flooding events in the Kansas City area.

6. In the context of the present study, the two basins (Kansas River basin and Upper Missouri River basin) are classified as semi-independent. That is, the historical record shows that each of the basins has the capacity to produce a significant flood with only a relatively minor contribution form the other basin, and sometimes both basins act in concert. Since each basin has exhibited some degree of independence, it was decided to develop an independent relationship between each basin and the lower Missouri River, as represented by the Hannibal gage. To develop these relationships, the peak annual flows from each of the tributary data sets was extracted from the dss files using the program HEC-STATS. Once this list of peak discharges was extracted, the discharge from the record for the Hannibal gage <u>on the same day as the tributary peak flow</u> was listed. Then these data were plotted. As expected, both plots demonstrated a marked degree of scatter.

7. This data scatter indicates that there is no one single relationship between upstream flows and the discharge at the gage. Rather there are multiple combinations of tributary basin flows possible to make up any discharge at the Hannibal gage. The data scatter does indicate that there are upper and lower limits to the flows from each basin for any particular discharge at the gage. In effect, there is an "envelop" of possible data. Unfortunately, this envelop is fairly well defined for lower discharges only. The paucity of data points for higher discharges restricts the definition of the envelop for higher discharges.

8. It is noted that single value relationships between upstream flows and the flow at Hannibal gage is necessary for the Kansas Cities Levee study.

9. There are several recognized methods of developing a single value rating for this type of data scatter. One is to rank each column of data independently in descending order and then plot a curve through the ranked data set. A second method is to develop an envelop curve which closely skirts the outside of the data cluster. This method is generally used to define an upper or lower bound of an existing data cluster. The third method is to simply accept the data cluster as is, and pass the a best fit curve through that cluster. All three methods were investigated in this study and the third option was chosen.

10. After several trials, it became apparent that the lack of high flow data was producing curves that were unreasonable. The principal problem was that the discharges assigned to the Hannibal gage for a particular upstream discharge were associated with a lower probability flood at the Hannibal gage. This meant, for example, that the water surface profile at the junction for a particular probability flood was significantly higher upstream of the junction than it was at the junction itself. To remedy this problem, the series of coincident frequency discharges for both the tributary and the gage were inserted into the data cluster. For example, the 0.1 % chance flood discharge for the Kansas River was paired with the 0.1 % chance flood at the gage, and that data point was included in the analysis.

11. The results of these analyzes are shown on enclosures 1 and 2, attached.

12. Upper Missouri Relationship. The analysis for the relationship between the peak flows on the Upper Missouri and the Hannibal gage is presented in encl 1. Note that the annual peak flow events for the Upper Missouri have been arranged in ascending order for plotting purposes. The best fit 3rd order polynomial curve is displayed on the plot of that data, as is the equation for that curve. The estimates for concurrent Upper Missouri River discharges and the Hannibal gage discharges for various probability events on the Upper Missouri based on that relationship are also given.

13. Kansas River Relationship. While the analysis for the Upper Missouri was reasonably straightforward, the analysis for the Kansas River-Hannibal gage relationship was not. This analysis is presented in encl 2. The principal complicating phenomena are the data points for the 1993 flood and the 1951 floods. This can be clearly seen by inspecting the plate in encl 2. An envelope curve based on the 1993 flood requires that concurrent flows at the Hannibal gage must be extremely high, well out of the range of reason for low probability discharges on the Kansas River. On the other hand, an envelope curve based on the 1951 curve suggests that low Hannibal gage flows can be associated with low probability events from the Kansas River.

14. The root cause of this problem is undoubtedly related to the unique character of the 1951 flood, where the rainfall footprint fell mostly within the Kansas River basin with very little carryover into the Upper Missouri basin. The simulation of the 1951 flood predicted that the system of Kansas River basin flood control reservoirs would have dramatic effects on the peak flows from that event. It is noted, however, that the hydrologic analysis of the Kansas River Basin in ref 1.d. predicts that flows in excess of the simulated 1951 peak discharge of 258,000 cfs can be expected on rare occasions. These rare runoff events will undoubtedly be associated with rare rainfall events with footprints that differ from the 1951 event, different intensity rainfalls or perhaps, spillage from some components of the reservoir system. It is noted that spillage through emergency spillways occurred at two projects during the 1993 flood. It is questionable then as to whether the simulated 1951 flood should be used to represent all rare flood flows from the Kansas River basin. As with the Upper Missouri analysis, this analysis used the coincident frequency data points to supplement the peak data from the regulated flow files. An usable curve which "split the difference" between the extreme data points resulted. Given the wide scatter in the input data (which is only there because it reflects the actual physical situation). this curve is considered to reasonably represent a working relationship between the Kansas River outflows and the Hannibal gage flows.

15. As a check, curves most of the data points on the charts in enclosures 1 and 2 were drawn by eye. These curves are appended as enclosures 3 and 4. Enclosure 3 for the Upper Missouri River suggests some useful information about this relationship for flows up to about 250,000 cfs, but only hints at the possible relationship for higher discharge floods. Unfortunately, it is these higher discharge floods that are of interest in the Kansas Cities levee study. Because of the radically different histories of the 1951 and 1993 floods, the envelop curves for the Kansas River were not as useful. They do suggest that a wider range of Hannibal gage flows can be associated with Kansas River flows.

16. Recommendation. The discharge relationships proposed in this MFR are recommended for use in the Kansas Cities Levee Study. Because there is not a direct, single relationship between either of these tributaries and the discharge in the lower river, it is further recommended that this additional uncertainty be accounted for in the assignment of stage (hydraulic) uncertainty in the HEC-FDA analysis. It is recommended that the stage uncertainty be developed using normal

techniques for each tributary, and then that uncertainty be increased by 0.5 feet for the Upper Missouri River and by 1.0 feet for the Kansas River.

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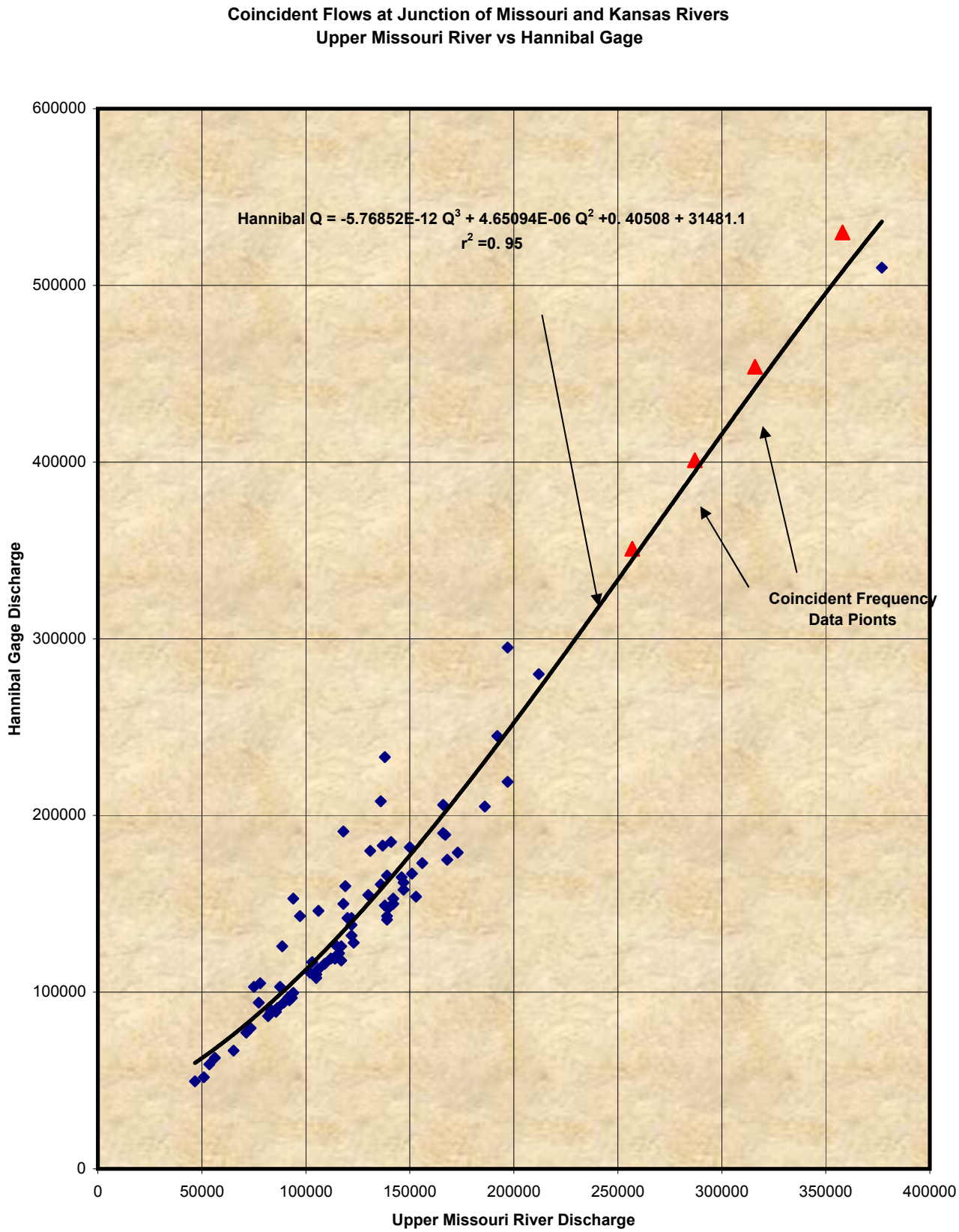
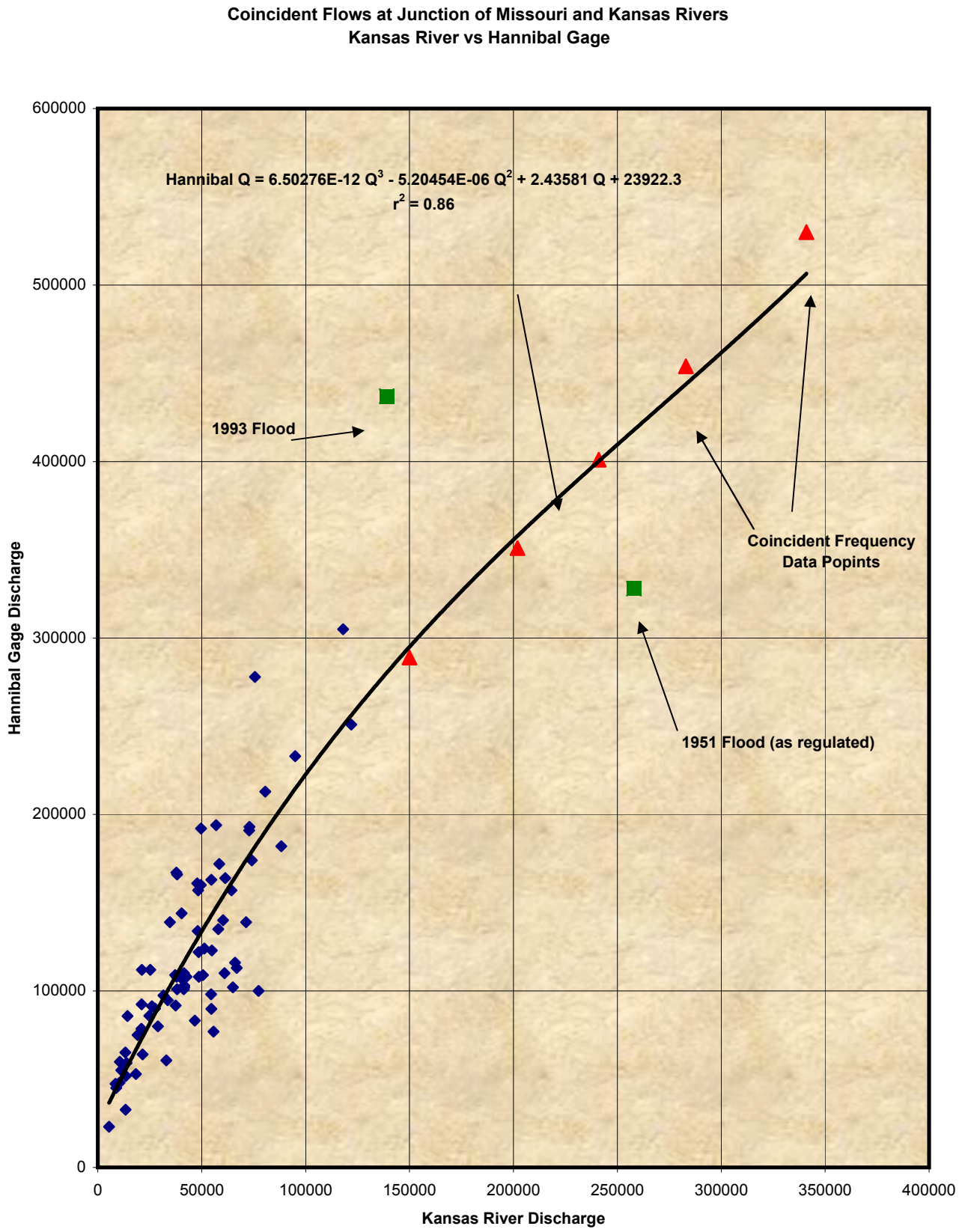
Peak Discharges Missouri River US of Kansas River				
Discharges Based on Simulated Reservoir Regulation				
			Discharge	Discharge
			Upper Missouri	Hannibal
Month	Day	Year		Gage
9	28	1933	46700	49600
6	12	1934	51000	51900
4	2	1988	53600	59200
7	4	1956	56300	62900
6	11	1940	65200	66900
3	13	1936	71400	77100
7	14	1937	73400	79700
7	27	1981	75000	103000
5	14	1930	77300	94000
10	18	1968	78000	105000
6	4	1932	81800	86500
6	26	1955	82900	88200
7	20	1938	83300	89900
2	12	1966	85200	89400
9	11	1975	85600	88900
9	22	1970	86300	91000
4	26	1976	87600	103000
11	25	1931	88600	126000
6	25	1994	89300	94100
3	16	1939	91600	97000
6	11	1953	92100	95400
6	26	1963	93200	96800
6	13	1941	94000	99600
3	31	1980	94000	153000
4	11	1922	97200	143000
6	16	1991	102000	111000
6	20	1946	103000	117000
9	5	1926	105000	108000
4	17	1969	105000	110000
6	16	1925	106000	113000
6	5	1935	106000	146000
6	23	1954	109000	116000
9	14	1972	112000	119000
7	2	1921	114000	119000
6	19	1957	114000	119000
6	1	1959	114000	127000
10	2	1923	115000	121000
6	21	1990	116000	122000
3	20	1948	117000	126000
5	10	1950	117000	118000
6	19	1943	118000	191000
9	14	1961	118000	150000
9	10	1989	119000	160000
9	13	1928	122000	132000
6	28	1942	122000	142000
6	24	1964	122000	138000
2	23	1971	123000	128000
7	31	1992	130000	155000
10	10	1985	131000	180000
4	25	1944	136000	208000
7	12	1958	136000	161000

4	21	1927	137000	183000
5	16	1945	138000	149000
5	19	1995	138000	233000
5	21	1920	139000	143000
4	24	1952	139000	166000
7	3	1983	139000	141000
3	8	1949	140000	148000
9	13	1977	141000	185000
7	8	1929	142000	150000
6	24	1996	142000	153000
4	11	1997	146000	165000
6	21	1947	147000	158000
6	3	1951	147000	162000
3	25	1979	150000	182000
6	17	1982	151000	167000
6	29	1924	153000	154000
5	19	1974	156000	173000
6	20	1967	166000	190000
5	29	1987	166000	206000
10	13	1986	167000	189000
4	1	1962	168000	175000
3	25	1978	173000	179000
7	21	1965	186000	205000
4	5	1960	197000	219000
10	14	1973	197000	295000
6	17	1984	212000	280000
7	27	1993	377000	510000
Discharge Relationships for Upper Missouri River Analysis				
P	Q - Upper Missouri	Q at Hannibal Gage	Q - Kansas River	
0.067	414000	587000	173000	
0.08	403000	573000	170000	
0.1	390000	555000	165000	
0.133	377000	536000	159000	
0.2	358000	508000	150000	
0.5	316000	442000	126000	
1	287000	394000	107000	
2	257000	345000	88000	
5	220000	284000	64000	
10	192000	240000	48000	
20	162000	195000	33000	
50	120000	137000	17000	
80	89500	101000	11500	
90	77200	87800	10600	
95	68500	79200	10700	
99	55100	67000	11900	


Coincident Flows at Junction of Missouri and Kansas Rivers
Upper Missouri River vs Hannibal Gage
Hannibal Q = -5.76852E-12 Q3 + 4.65094E-06 Q2 +0. 40508 + 31481.1
r2 =0. 95
Coincident Frequency
Data Pionts
Hannibal Gage Discharge
Upper Missouri River Discharge
600000
500000
400000
300000
200000
100000
0
0
50000
100000
150000
200000
250000
300000
350000
400000

Peak Discharges Kansas River at Mouth				
Discharges Based on Simulated Reservoir Regulation				
			Discharge	Discharge
			Kansas River	Hannibal
Month	Day	Year		Gage
11	23	1934	5440	23100
7	15	1956	8580	47300
5	19	1940	8910	45000
5	22	1933	10500	48000
3	6	1963	10600	59800
7	7	1955	11300	55100
4	4	1988	13300	65200
2	13	1937	13400	32700
6	1	1953	13500	51900
5	11	1936	13800	59200
7	8	1924	14300	85800
9	13	1946	18300	52900
4	29	1991	19100	75100
6	22	1939	21000	78600
6	27	1964	21100	92400
7	15	1920	21200	112000
6	14	1954	21600	64000
4	29	1994	24800	85900
10	5	1926	25200	112000
7	6	1932	26100	91400
6	14	1966	27600	90000
5	20	1938	28900	79900
4	22	1976	31600	97400
4	16	1952	33000	60600
5	12	1959	33700	94700
6	10	1974	34700	139000
6	5	1962	37200	109000
9	9	1972	37500	91800
4	2	1983	37800	167000
6	20	1925	37900	108000
5	25	1971	38100	101000
5	18	1986	38200	166000
9	10	1989	40400	144000
3	29	1978	40500	107000
7	24	1992	41400	101000
6	12	1975	41500	110000
6	30	1957	41600	103000
7	15	1958	41600	102000
11	24	1931	42500	108000
5	17	1990	42600	108000
2	19	1949	46700	83200
4	20	1927	47800	161000
11	18	1928	48100	134000
6	6	1996	48300	157000
6	22	1942	48500	122000
5	10	1930	48700	108000
4	12	1960	49600	160000
4	12	1997	49700	192000
7	22	1948	50600	109000
7	28	1981	51300	124000
4	15	1979	54500	98100

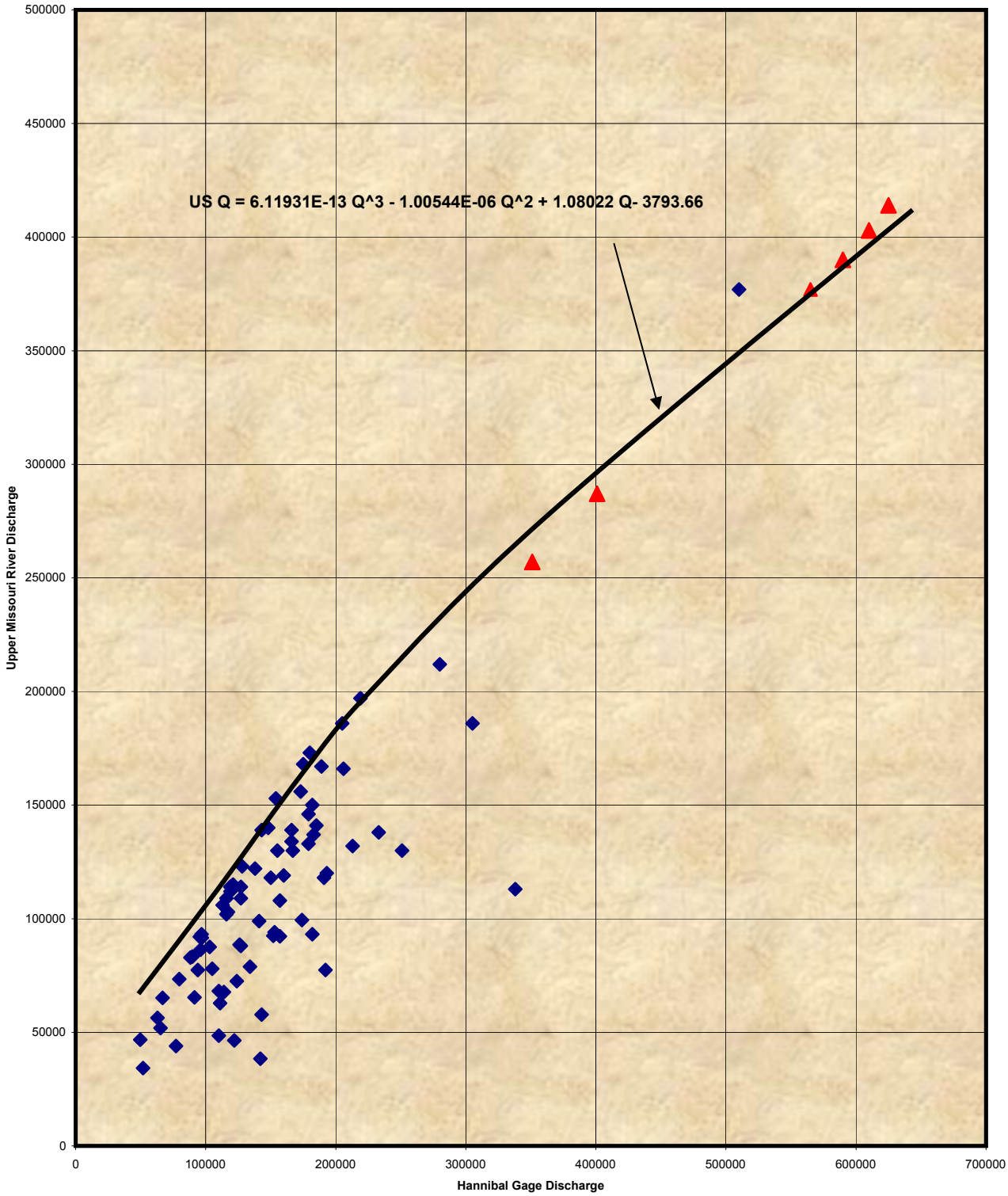
8	4	1968	54600	89800
6	11	1982	54600	163000
7	22	1950	54900	123000
6	11	1923	55700	77000
6	30	1965	56900	194000
4	10	1922	58000	135000
9	14	1977	58400	172000
4	1	1980	60300	140000
6	5	1970	61000	110000
6	29	1947	61300	164000
4	28	1969	64300	157000
5	25	1961	65000	102000
5	11	1921	66100	116000
5	29	1935	66900	113000
4	20	1987	71300	139000
6	19	1943	72800	191000
10	11	1985	73000	193000
4	17	1945	74100	174000
6	23	1984	75600	278000
10	22	1941	77400	100000
4	24	1944	80600	213000
4	22	1929	88300	182000
5	19	1995	95000	233000
10	13	1973	118000	305000
6	22	1967	122000	251000
7	29	1993	139000	437000
7	15	1951	258000	328000
Discharge Relationships for Kansas River Analysis				
P	Q - Kansas River	Q at Hannibal Gage	Q - Upper Missouri	
0.067	417000	606000	189000	
0.08	403000	586000	183000	
0.1	388000	565000	177000	
0.133	367000	538000	171000	
0.2	341000	507000	166000	
0.5	283000	444000	161000	
1	241000	400000	159000	
2	202000	357000	155000	
5	150000	294000	144000	
10	121000	254000	133000	
20	90700	207000	116300	
50	51200	136000	84800	
80	26400	84700	58300	
90	18700	67700	49000	
95	14000	57000	43000	
99	8200	43500	35300	


Coincident Flows at Junction of Missouri and Kansas Rivers
Kansas River vs Hannibal Gage
Hannibal Q = 6.50276E-12 Q3 - 5.20454E-06 Q2 + 2.43581 Q + 23922.3
r2 = 0.86
1993 Flood
Coincident Frequency Data Popints
1951 Flood (as regulated)
Hannibal Gage Discharge
Kansas River Discharge
600000
500000
400000
300000
200000
100000
0
0
50000
100000
150000
200000
250000
300000
350000
400000

Peak Discharges at Hannibal Gage				
			Discharge	**Discharge**
			at Hannibal	**Upper Missouri**
Month	Day	Year	Gage	
9	28	1933	49600	46700
6	12	1934	51900	34300
7	4	1956	62900	56300
4	4	1988	65200	51900
6	11	1940	66900	65200
3	7	1936	77200	43900
7	14	1937	79700	73400
6	26	1955	88200	82900
7	20	1938	89900	83300
7	6	1932	91400	65400
6	13	1966	93900	77400
6	11	1953	95500	92000
3	8	1994	96000	86300
6	26	1963	96800	93200
3	16	1939	97000	91600
4	26	1976	103000	87600
10	18	1968	105000	78000
6	5	1970	110000	48500
6	12	1975	110000	68200
6	16	1991	111000	62800
6	16	1925	113000	106000
5	9	1930	114000	67700
9	17	1926	116000	102000
6	23	1954	116000	109000
6	20	1946	117000	103000
7	2	1921	119000	114000
6	19	1957	119000	114000
9	14	1972	119000	112000
10	2	1923	121000	115000
10	12	1941	122000	46400
7	28	1981	124000	72500
11	25	1931	126000	88600
3	22	1948	127000	109000
6	1	1959	127000	114000
5	16	1990	127000	88000
2	23	1971	128000	123000
7	21	1950	134000	78900
6	24	1964	138000	122000
11	19	1928	141000	99000
6	28	1942	142000	38400
5	21	1920	143000	139000
4	11	1922	143000	57800
3	8	1949	148000	140000
9	14	1961	150000	118000
6	7	1935	152000	92500
3	31	1980	153000	94000
6	29	1924	154000	153000
7	31	1992	155000	130000
4	28	1969	157000	92300
6	6	1996	157000	108000
9	10	1989	160000	119000
4	24	1952	166000	139000

7	31	1958	166000	134000
4	2	1983	167000	130000
5	19	1974	173000	156000
4	17	1945	174000	99400
4	1	1962	175000	168000
6	27	1947	179000	146000
6	1	1982	179000	133000
3	25	1978	180000	173000
4	22	1929	182000	93200
3	25	1979	182000	150000
4	21	1927	183000	137000
9	13	1977	185000	141000
10	13	1986	189000	167000
6	19	1943	191000	118000
4	12	1997	192000	77400
10	11	1985	193000	120000
7	21	1965	205000	186000
5	29	1987	206000	166000
4	24	1944	213000	132000
4	5	1960	219000	197000
5	19	1995	233000	138000
6	22	1967	251000	130000
6	17	1984	280000	212000
10	13	1973	305000	186000
7	14	1951	338000	113000
7	27	1993	510000	377000
Discharge Relationships on Missouri River Through Junction of Kansas River				
P	Q at Hannibal Gage	Q - Upper Missouri	Q - Kansas River	
0.067	625000	424000	201000	424000
0.08	610000	411000	199000	411000
0.1	590000	394000	196000	394000
0.133	565000	374000	191000	374000
0.2	530000	348000	182000	348000
0.5	454000	295000	159000	295000
1	401000	261000	140000	261000
2	351000	230000	121000	230000
5	289000	194000	95000	194000
10	245000	168000	77000	168000
20	201000	143000	58000	143000
50	142000	107000	35000	107000
80	103000	82900	20100	82900
90	88300	73500	14800	73500
95	78100	66800	11300	66800
99	62900	56800	6100	56800

Coincident Flows at Junction of Missouri and Kansas Rivers
Hannibal Gage vs Upper Missouri River



Peak Discharges at Hannibal Gage					
Concurrent Flow at Mouth of the Kansas River					
			Discharge	**Discharge**	
			at Hannibal	**Kansas River**	
Month	Day	Year	Gage		
9	28	1933	49600	2900	
6	12	1934	51900	17600	
7	4	1956	62900	6600	
4	4	1988	65200	13300	
6	11	1940	66900	1700	
3	7	1936	77200	33300	
7	14	1937	79700	6300	
6	26	1955	88200	5300	
7	20	1938	89900	6600	
7	6	1932	91400	26000	
6	13	1966	93900	16500	
6	11	1953	95500	3500	
3	8	1994	96000	9700	
6	26	1963	96800	3600	
3	16	1939	97000	5400	
4	26	1976	103000	15400	
10	18	1968	105000	27000	
6	5	1970	110000	61500	
6	12	1975	110000	41800	
6	16	1991	111000	48200	
6	16	1925	113000	7000	
5	9	1930	114000	46300	
9	17	1926	116000	14000	
6	23	1954	116000	7000	
6	20	1946	117000	14000	
7	2	1921	119000	5000	
6	19	1957	119000	5000	
9	14	1972	119000	7000	
10	2	1923	121000	6000	
10	12	1941	122000	75600	
7	28	1981	124000	51500	
11	25	1931	126000	37400	
3	22	1948	127000	18000	
6	1	1959	127000	13000	
5	16	1990	127000	39000	
2	23	1971	128000	5000	
7	21	1950	134000	55100	
6	24	1964	138000	16000	
11	19	1928	141000	42000	
6	28	1942	142000	103600	
5	21	1920	143000	4000	
4	11	1922	143000	85200	
3	8	1949	148000	8000	
9	14	1961	150000	32000	
6	7	1935	152000	59500	
3	31	1980	153000	59000	
6	29	1924	154000	1000	
7	31	1992	155000	25000	
4	28	1969	157000	64700	
6	6	1996	157000	49000	
9	10	1989	160000	41000	

4	24	1952	166000	27000	
7	31	1958	166000	32000	
4	2	1983	167000	37000	
5	19	1974	173000	17000	
4	17	1945	174000	74600	
4	1	1962	175000	7000	
6	27	1947	179000	33000	
6	1	1982	179000	46000	
3	25	1978	180000	7000	
4	22	1929	182000	88800	
3	25	1979	182000	32000	
4	21	1927	183000	46000	
9	13	1977	185000	44000	
10	13	1986	189000	22000	
6	19	1943	191000	73000	
4	12	1997	192000	114600	
10	11	1985	193000	73000	
7	21	1965	205000	19000	
5	29	1987	206000	40000	
4	24	1944	213000	81000	
4	5	1960	219000	22000	
5	19	1995	233000	95000	
6	22	1967	251000	121000	
6	17	1984	280000	68000	
10	13	1973	305000	119000	
7	14	1951	338000	225000	
7	27	1993	510000	133000	
Discharge Relationships on Missouri River Through Junction of Kansas River					
P	Q at Hannibal Gage	Q - Kansas River	Q - Upper Missouri		
0.067	625000	407000	218000		
0.08	610000	391000	219000		
0.1	590000	369000	221000		
0.133	565000	343000	222000		
0.2	530000	308000	222000		
0.5	454000	237000	217000		
1	401000	192000	209000		
2	351000	154000	197000		
5	289000	111000	178000		
10	245000	84800	160200		
20	201000	61100	140000		
50	142000	34100	108000		
80	103000	19300	83700		
90	88300	14400	73900		
95	78100	11200	66900		
99	62900	6700	56200		

				Peak Discharges at Hannibal Gage				
				Concurrent Flow at Mouth of the Kansas River				
							Discharge	**Discharge**
							at Hannibal	**Kansas River**
				Month	Day	Year	Gage	
				9	28	1933	49600	2900
				6	12	1934	51900	17600
				7	4	1956	62900	6600
				4	4	1988	65200	13300
				6	11	1940	66900	1700
				3	7	1936	77200	33300
				7	14	1937	79700	6300
				6	26	1955	88200	5300
				7	20	1938	89900	6600
				7	6	1932	91400	26000
				6	13	1966	93900	16500
				6	11	1953	95500	3500
				3	8	1994	96000	9700
				6	26	1963	96800	3600
				3	16	1939	97000	5400
				4	26	1976	103000	15400
				10	18	1968	105000	27000
				6	5	1970	110000	61500
				6	12	1975	110000	41800
				6	16	1991	111000	48200
				6	16	1925	113000	7000
				5	9	1930	114000	46300
				9	17	1926	116000	14000
				6	23	1954	116000	7000
				6	20	1946	117000	14000
				7	2	1921	119000	5000
				6	19	1957	119000	5000
				9	14	1972	119000	7000
				10	2	1923	121000	6000
				10	12	1941	122000	75600
				7	28	1981	124000	51500
				11	25	1931	126000	37400
				3	22	1948	127000	18000
				6	1	1959	127000	13000
				5	16	1990	127000	39000
				2	23	1971	128000	5000
				7	21	1950	134000	55100
				6	24	1964	138000	16000
				11	19	1928	141000	42000
				6	28	1942	142000	103600
				5	21	1920	143000	4000
				4	11	1922	143000	85200
				3	8	1949	148000	8000
				9	14	1961	150000	32000
				6	7	1935	152000	59500
				3	31	1980	153000	59000
				6	29	1924	154000	1000
				7	31	1992	155000	25000
				4	28	1969	157000	64700
				6	6	1996	157000	49000
				9	10	1989	160000	41000

				4	24	1952	166000	27000
				7	31	1958	166000	32000
				4	2	1983	167000	37000
				5	19	1974	173000	17000
				4	17	1945	174000	74600
				4	1	1962	175000	7000
				6	27	1947	179000	33000
				6	1	1982	179000	46000
				3	25	1978	180000	7000
				4	22	1929	182000	88800
				3	25	1979	182000	32000
				4	21	1927	183000	46000
				9	13	1977	185000	44000
				10	13	1986	189000	22000
				6	19	1943	191000	73000
				4	12	1997	192000	114600
				10	11	1985	193000	73000
				7	21	1965	205000	19000
				5	29	1987	206000	40000
				4	24	1944	213000	81000
				4	5	1960	219000	22000
				5	19	1995	233000	95000
				6	22	1967	251000	121000
				6	17	1984	280000	68000
				10	13	1973	305000	119000
				7	14	1951	338000	225000
				7	27	1993	510000	133000
							565000	367000
							590000	388000
							610000	403000
							625000	417000
							401000	241000
							351000	202000

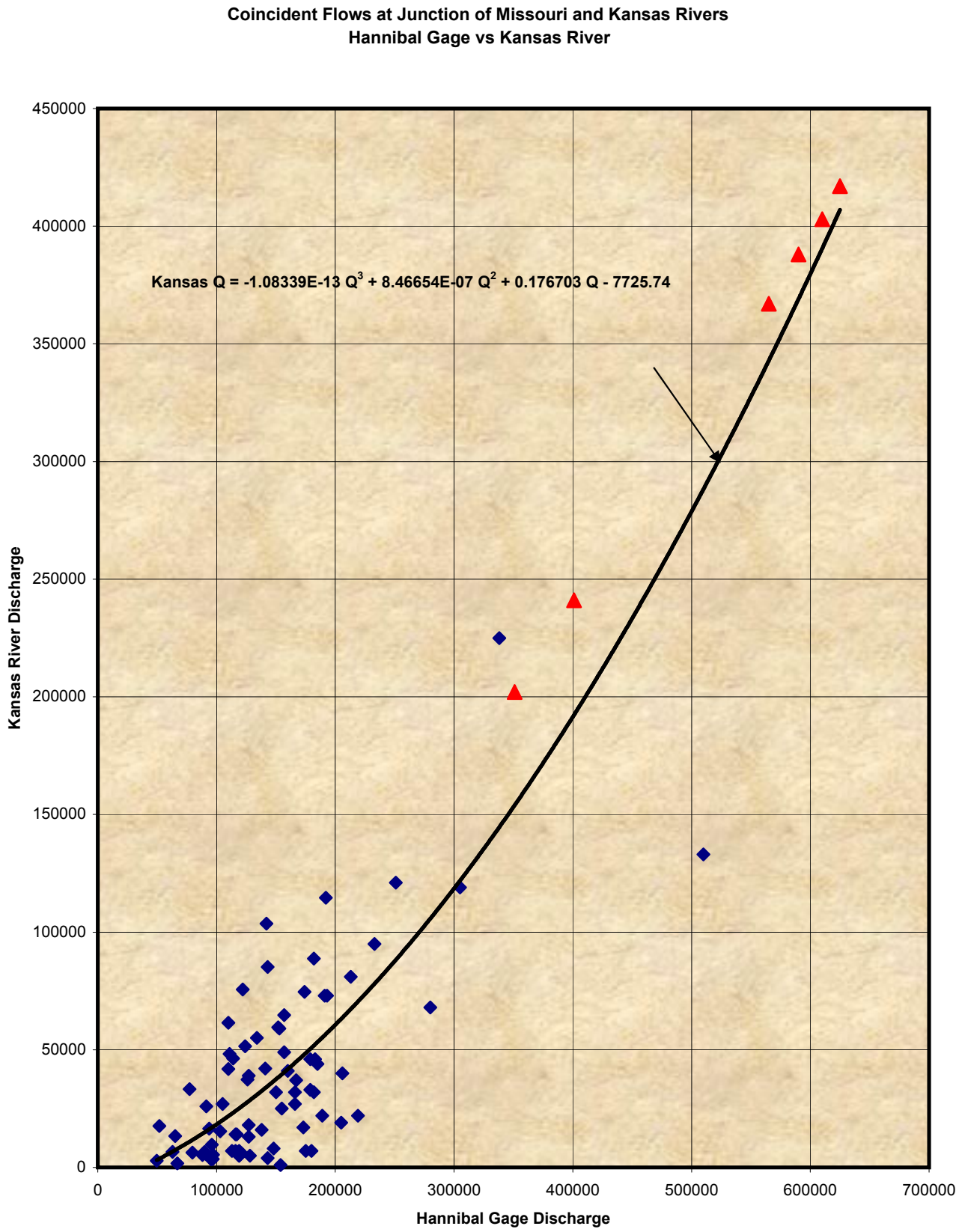

Coincident Flows at Junction of Missouri and Kansas Rivers
Hannibal Gage vs Kansas River
Kansas Q = -1.08339E-13 Q3 + 8.46654E-07 Q2 + 0.176703 Q - 7725.74
Kansas River Discharge
Hannibal Gage Discharge
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
0
100000
200000
300000
400000
500000
600000
700000

EXHIBIT A-2.117
Induced Damages Memorandum For Record

MEMORANDUM FOR RECORD

SUBJECT: Kansas Citys Feasibility Study
Argentine Levee Raise Induced Damages

1. Background. As a result of the Flood of 1993 the performance characteristics of the Kansas Citys Units were questioned. A feasibility study was begun to identify any deficiencies in the Kansas Citys system and determine if it is economically feasible to improve these levees. The Missouri River levees were found to provide adequate protection for the 0.2% chance event, but it was discovered that the performance of the Kansas River Units was lower than expected. A levee raise of the Argentine Unit has been identified as a proposed alternative in this feasibility study.

2. Problem. The feasibility study is examining the alternatives of raising the Argentine Unit (RM 4.28 to RM 9.82) along the Kansas River. Three alternatives are being examined: a raise to the nominal 0.2% chance flood event (500+0 alternative), a raise to the nominal 0.2% chance flood event plus 3.0-feet (500+3 alternative), and a raise to the nominal 0.2% chance flood event plus 5.0-feet (500+5 alternative). The feasibility study requires the analysis of any induced damages due to raises in the water surface profile caused by raises of the studied levee unit. The existing conditions HEC-RAS model of the Kansas River assumes a confined flow model with any flow behind the levee being considered ineffective. Since the interior protected area is considered ineffective in the event of overtopping, the HEC-RAS model does not reflect any change in water surface profiles due to a proposed levee raise. To identify any possible impacts upstream and opposite of the Argentine unit, limited conveyance in the protected area due to overtopping was investigated for this analysis. HEC-RAS is a steady state flow model, calculating the water surface profiles in a subcritical channel, such as the Kansas River, using backwater methodology from downstream to upstream. Therefore, HEC-RAS did not identify any impacts to the downstream levee units (Armourdale and Central Industrial District). The only method for the Argentine raise to impact downstream units is if additional flow is forced downstream due to the raise. This can only occur if the failure of the Argentine Unit in the existing conditions is temporarily reducing downstream flows as the flow through the levee breach fills the protected area and this breach flow is removed as the levee is raised.

3. Purpose of this MFR. The purpose of this MFR is to document the procedures used to estimate the induced damages upstream, opposite, and downstream of a proposed Argentine raise.

4. Outline of Study Process. A calibrated HEC-RAS model was developed for the existing conditions along the studied reach of the Kansas River as part of the Kansas Citys Feasibility Study. This existing conditions model has been peer reviewed and through ITR. The existing conditions HEC-RAS model will be used as the basis for this

analysis. This memorandum outlines the procedure used to estimate the induced damages due to the Argentine Levee raise. The procedure consisted of the following steps:

4.1 Areas downstream of the Argentine Unit

a) The flow that initiates overtopping was analyzed for the existing condition and each of the three studied alternative raises. The critical overtopping point was identified along the existing Argentine Unit at approximately levee station 240+00. This point begins overtopping at a flow of 317,000cfs. By definition the 500+0 alternative begins overtopping at the 0.2% chance event (341,000 cfs). The 500+3 and 500+5 levee raises were plotted versus the water surface profiles for the studied events. The 500+3 overtops in an event just greater than the 0.133% (750-yr event) chance event and the 500+5 alternative overtops in an event just greater than the 0.10% chance event (1000-yr event) (See Plate 1). The overtopping flow was found by interpolating between the flows associated with each frequency event bracketing the top of levee for both the 500+3 and 500+5 alternatives. The overtopping flows were found to be 372,000 cfs and 391,000 cfs for the 500+3 and 500+5 alternatives, respectively.

b) The assumption was made that overtopping initiates a levee breach which will flow at a uniform flow rate until the protected area is filled from the breach flow. The interior area will fill to an elevation equal to the lowest top of levee elevation at the downstream end of the unit (elevation 770.37) when flow would begin re-entering the Kansas River over the top of the levee. A 5-foot interval aerial contour map, supplied by the Unified Government of Wyandotte County and Kansas City, Kansas, was used for the calculation of interior volume. The following table lists the results of the analysis of the volume interior to the Argentine Levee Unit.

Table 1. Argentine Levee Interior Volume

Elevation (ft above msl)	Contour Area (acre)	Volume Below Contour (ac-ft)
752	26.6	0
755	238.7	398
760	664.5	2,258
765	1493.3	5,394
770	1916.9	9,156
	Total Volume =	**17,206**

c) To calculate the possible flow reduction due to breach flow filling the Argentine protected area a flood hydrograph needed to be developed for the Kansas River. Gage records were used for developing the peak flows associated with the various frequency events in this feasibility study and the Upper Mississippi River System Flow Frequency Study (UMRSFFS) completed by the Kansas City District in 2001. There are no hydrographs associated with these peak flows as the modeling

of the Kansas River has been steady state. The synthetic hydrograph for this analysis was based on a combination of the flood hydrograph taken from daily flow records taken at the Desoto gage during the 1951 flood event along the Kansas River and hourly flow records from the 1993 flood event taken at the Hannibal Bridge on the Missouri River. The 1951 flood event along the Kansas River had a peak flow of 486,000 cfs which is greater than the 0.067% chance event used in this study of 417,000 cfs. This flow was prior to reservoir regulation of the Kansas River basin which has greatly reduced the peak flows seen in the Kansas River and the shape of the flood hydrograph. Therefore, this hydrograph was not seen as typical of any future floods along the Kansas River. The largest discharge in the Kansas River since the 1951 flood is the 1993 flood with a peak discharge of 170,000 cfs. This discharge is between a 5% (150,000 cfs) and 2% (202,000 cfs) chance event along the Kansas River as calculated in the UMRSFFS. Since this study is analyzing floods greater than the 0.2% chance event, it was deemed that extrapolating a hydrograph from this frequent of an event to a low frequency event (0.2% chance) would distort the likely shape of the low frequency event hydrograph. Therefore, the hydrograph from the Hannibal Bridge along the Missouri River was seen as representative of a flood of this magnitude as the peak 1993 flow was 541,000 cfs (just greater than the 0.2% chance event along the Missouri River downstream of the Kansas River of 530,000 cfs). Since the Missouri River basin is also subject to reservoir control it was assumed that the hydrograph from the 1993 flood event along the Missouri River could be representative of a 500-yr hydrograph along the Kansas River. The 1951 Kansas River and 1993 Missouri River hydrographs were scaled to match the 0.2% chance flood peak of 341,000 cfs on the Kansas River. The peaks of these scaled hydrographs were then overlain with the rising limb and falling limb of the synthetic hydrograph being the average of the 1951 Kansas River hydrograph and 1993 Missouri River hydrograph at a given time before or after the peak (See Plate 2). This synthetic hydrograph shape was then scaled to match the peak flow of each frequency event to develop a hydrograph for each studied event.

d) It was assumed that a breach of constant flow would occur at the time of overtopping. The point on the rising limb of the 500-yr hydrograph when 317,000 cfs was encountered initiated a breach. This breach was assumed to introduce a constant flow of 10,000 cfs into the protected area. At the assumed rate of 10,000 cfs of inflow, the interior volume of 17,206 ac-ft would fill in approximately 21 hours before the downstream end of the Argentine Unit would begin allowing flow to re-enter the Kansas River. During this period of filling, the peak flow in the Kansas River would be reduced by the flow entering the levee breach (See Plate 3). If the breach occurred on the rising limb at a time close enough to the peak of the hydrograph, the peak would be reduced due to the loss of flow into the Argentine interior. This process was done for each event where overtopping would occur (0.2%, 0.133%, 0.1%, 0.08%, and 0.067% chance events). The peak flow in the Kansas River was recorded. Due to uncertainty of the breach flow, a series of flows were analyzed assuming breach flows of 5,000

cfs, 10,000 cfs, 20,000 cfs, and 30,000 cfs. At a breach flow of 30,000 cfs, the interior of the Argentine Levee was filled prior to the peak of the 500-yr hydrograph, thus any greater breach flow would also fill prior to the peak of the hydrograph, having no impact on peak flows seen in the Kansas River.

e) This process was repeated for each levee raise alternative to determine the impact of breach flows on peak flows seen in the Kansas River. The different levee raises consisted of breaches occurring at different flows along the rising limb of the hydrograph based on the overtopping flow associated with each alternative. A matrix seen in Table 2 was created to identify the minimum flow for each frequency of flood event for each proposed alternative. It is evident that for the 0.2% chance (500-yr) in the existing condition a levee breach can reduce the peak flow in the Kansas River to 335,625 cfs. Each proposed alternative (500+0, 500+3, and 500+5) should not allow overtopping in the 0.2% chance (500-yr) event and therefore allow the full 341,000 cfs to pass downstream. This allows a potential increase of 5,375 cfs of the peak flow seen at the Armourdale and CID Kansas Units in the 0.2% chance (500-yr) event caused by the proposed raises. It is possible to show that peak flows can be reduced by the proposed alternatives in some instances, but these cases have been neglected. The heavy "stair-stepped" line in Table 2 shows the limits of induced damages possible by the proposed raises.

Table 2. Matrix of Possible Flows With Argentine Breach

Alternative	Breach Flow	Peak Flows Seen D/S of Argentine (cfs)				
		500-yr	750-yr	1000-yr	1250-yr	1500-yr
EC Flow	---	341,000	367,000	388,000	403,000	417,000
No Raise	5k Breach	336,000	**362,000**	**383,000**	398,000	412,000
	10k Breach	**335,625**	367,000	388,000	403,000	417,000
	20k Breach	341,000	367,000	388,000	403,000	417,000
	30k Breach	341,000	367,000	388,000	403,000	417,000
500-yr Raise	5k Breach	341,000	362,000	383,000	398,000	412,000
	10k Breach	341,000	359,287	388,000	403,000	417,000
	20k Breach	341,000	367,000	388,000	403,000	417,000
	30k Breach	341,000	367,000	388,000	403,000	417,000
500-yr + 3' Raise	5k Breach	341,000	367,000	383,000	398,000	412,000
	10k Breach	341,000	367,000	378,000	398,765	417,000
	20k Breach	341,000	367,000	385,961	403,000	417,000
	30k Breach	341,000	367,000	388,000	403,000	417,000
500-yr + 5' Raise	5k Breach	341,000	367,000	388,000	398,000	412,000
	10k Breach	341,000	367,000	388,000	393,000	407,000
	20k Breach	341,000	367,000	388,000	394,530	417,000
	30k Breach	341,000	367,000	388,000	400,883	417,000

The maximum possible increase in peak flow due to the various alternatives was chosen and is tabulated below:

Table 3. Increase in Flows Seen Downstream of Argentine

Alternative	Δ Peak Flows Seen D/S of Argentine (cfs)				
	500-yr	750-yr	1000-yr	1250-yr	1500-yr
500-yr Raise	5,375	0	0	0	0
500-yr + 3' Raise	5,375	5,000	0	0	0
500-yr + 5' Raise	5,375	5,000	5,000	0	0

f) These increases in flow are actually from the possibility of the existing conditions to reduce the peak flow as compared to the full peak being able to be conveyed downstream in the proposed raise alternatives. Therefore, in actuality the existing conditions flows could be less than the UMRSFFS peak flow for a given frequency event. However, the procedure outlined in this MFR is approximate and does not justify modifying existing conditions flows. To represent this possible increase in peak flows as induced damages, the Kansas River flows were modified in HEC-RAS to be the UMRSFFS peak flow for a given frequency event plus the delta Q between the raised alternative and existing conditions. The following is an example of the 0.2% chance (500-yr) flow used in the analysis of induced damages for the 500+0 raise alternative:

$$Q_{500\,induced} = Q_{500} + \Delta Q_{500}$$

$$346{,}375\,cfs = 341{,}000\,cfs + 5{,}375\,cfs$$

Table 4. Kansas River Induced Flows

Alternative	Induced Peak Flows Seen D/S of Argentine (cfs)				
	500-yr	750-yr	1000-yr	1250-yr	1500-yr
500-yr Raise	346,375	---	---	---	---
500-yr + 3' Raise	346,375	372,000	---	---	---
500-yr + 5' Raise	346,375	372,000	393,000	---	---

g) The increased flows were run in HEC-RAS to generate an estimated water surface showing maximum induced damages due to the proposed levee raises. This estimated water surface is compared to the future conditions without project water surface profiles to determine the magnitude of induced increases in the water surface for the Kansas River. The induced damages due the 0.2% chance (500-yr) event are identical for each proposed alternative. The induced damages due the 0.133% chance (750-yr) event occur for only the 500+3 and 500+5 alternatives and are identical for both. The induced damages due the 0.1% chance (1000-yr) event occur for only the 500+5 alternative.

h) The likely overtopping point as seen on Plate 1 is near River Mile 4.48. Therefore, the induced peak flows are applicable to Kansas River Miles 4.48 and below. However, backwater effects due to this increased downstream flow cause

an increase in the water surface upstream of the breach location. Therefore, the induced water surface increase caused by the downstream analysis must be compared to that caused by the upstream and opposite of Argentine analysis, with the larger increase in water surface controlling for the HEC-FDA Induced Damages Analysis.

4.2 Areas upstream and opposite of the Argentine Unit

a) The future conditions without project were evaluated with flow behind the levee in the protected area. The protected area was set with a permanent ineffective flow area extending from the levee to the bluff line at an elevation two feet below the existing top of levee. This modification allowed the top two feet and above of protected area to convey flow in the event of overtopping. This ineffective flow area definition modeled the obstructions at the lower levels and the presence of the downstream end of the unit preventing conveyance of the full depth of the protected area.

b) The future conditions with project profiles allowing flow behind the levee were then modeled in the same manner, with the ineffective flow elevation being two feet below the proposed top of levee.

c) The deltas between the future conditions with project and without project water surface with protected area conveyance were then calculated to determine the impacts of the proposed projects on the water surface profiles.

d) The delta in water surface was then added to the design water surface profiles for the future conditions with project (confined profiles) to produce an induced damages profile for economic calculations.

e) The upstream and opposite induced damage water surface increases must be compared to the increases in water surface caused by the additional flow in the downstream analysis to determine which delta controls for the Kansas River above River Mile 4.48.

5. Results. The attached tables are a summation of the flood profiles generated in this HEC-RAS analysis and manipulated in an EXCEL spreadsheet. Table 5 displays the results of the HEC-RAS induced damages water surface increases in flood peaks for the n500+0 project alternative due to the downstream analysis described in Paragraph 4.1. Table 6 displays the results of the HEC-RAS induced damages water surface increases in flood peaks for the n500+3 project alternative due to the downstream analysis described in Paragraph 4.1. Table 7 displays the results of the HEC-RAS induced damages water surface increases in flood peaks for the n500+5 project alternative due to the downstream analysis described in Paragraph 4.1. The maximum downstream induced impact to the water surface profile is 0.50 ft seen near the downstream end of the Argentine Levee Unit. Table 8 displays the results of the HEC-RAS induced damages water surface increases for the n500+0 project alternative due to the upstream and opposite bank

analysis described in Paragraph 4.2. Table 9 displays the results of the HEC-RAS induced damages water surface increases for the n500+3 project alternative due to the upstream and opposite bank analysis described in Paragraph 4.2. Table 10 displays the results of the HEC-RAS induced damages water surface increases for the n500+5 project alternative due to the upstream and opposite bank analysis described in Paragraph 4.2. It should be noted that in all proposed raises no impacts were seen to the 0.5% and more frequent floods as they did not overtop the existing levee.

Eric Shumate, P.E.
Hydraulic Engineer

Plate 1. Argentine Levee Unit Water Surface Profiles and Proposed Raises

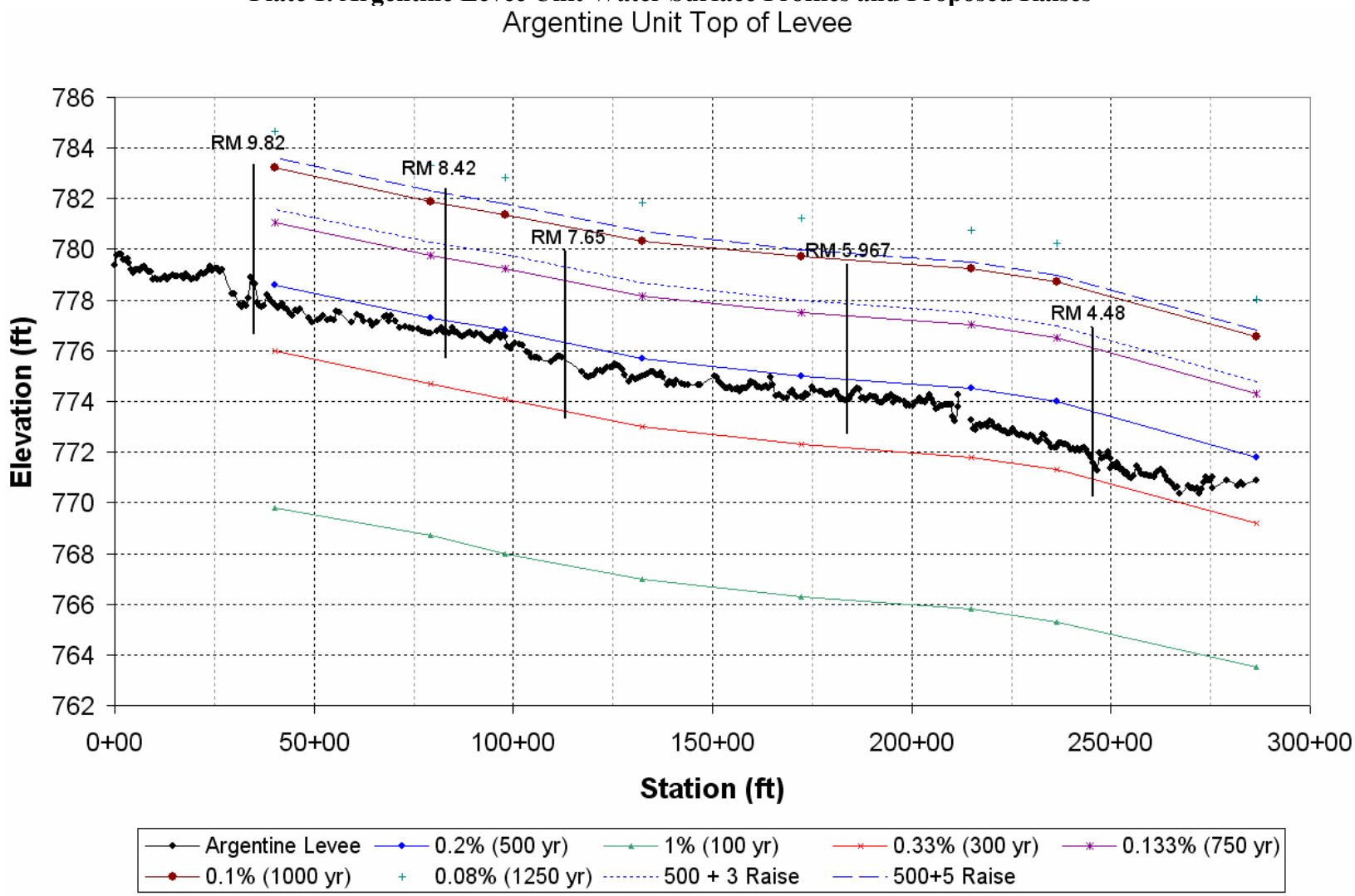


Plate 2. Kansas River Hypothetical Hydrograph

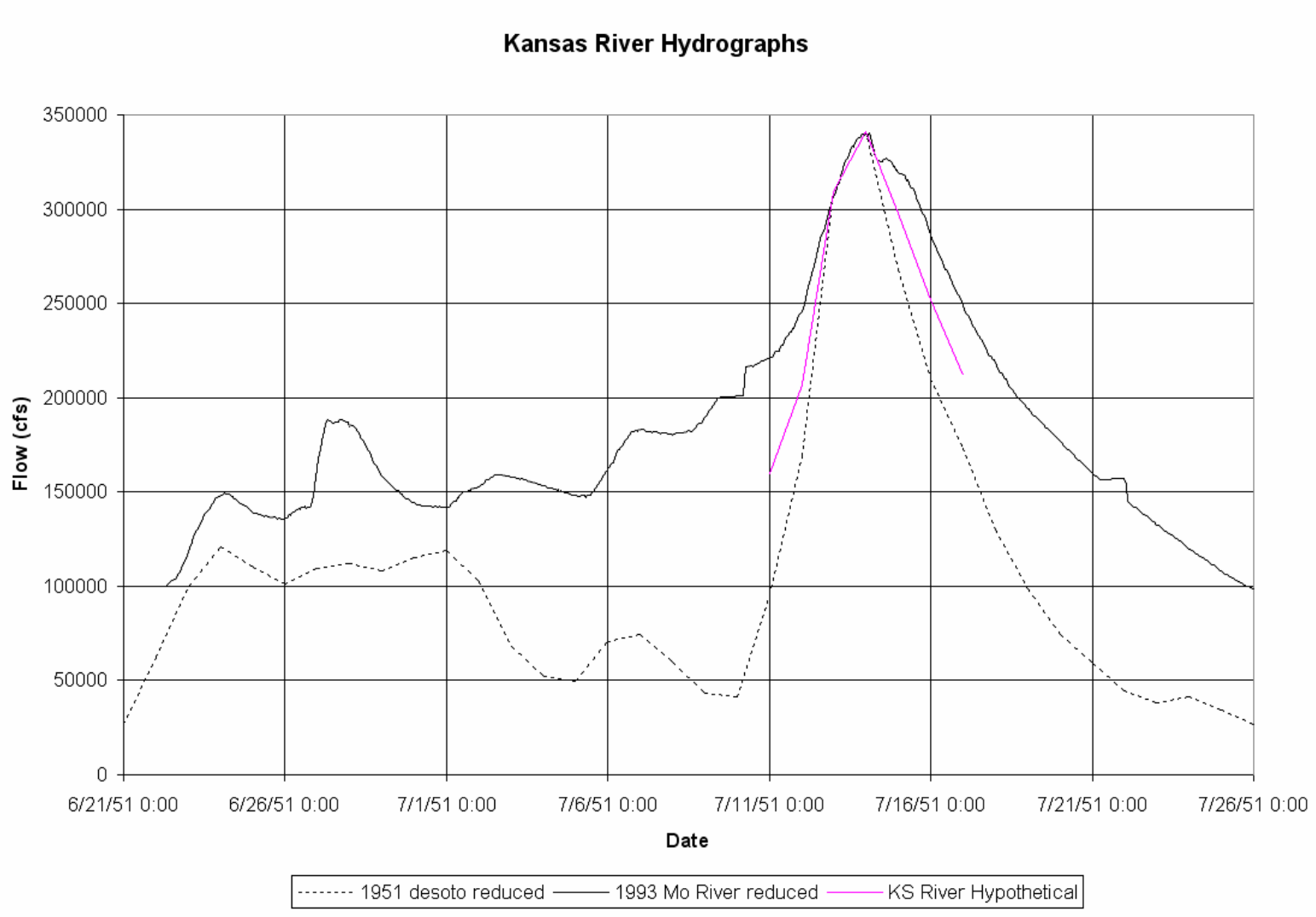


Plate 3. Sample Kansas River Hydrograph w/ Breach

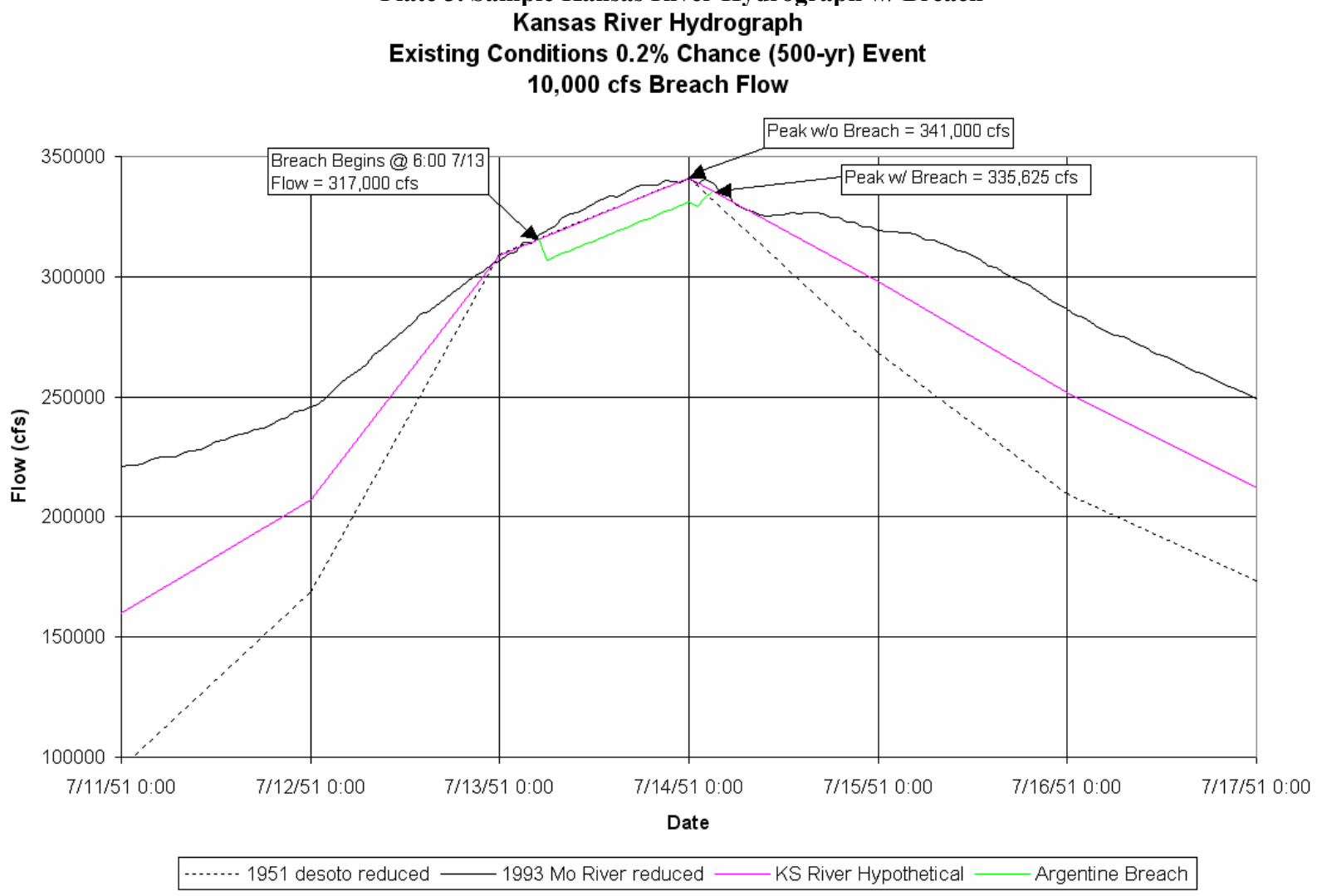


Table 5. Downstream Induced Damages Due to Argentine n500+0 Levee Raise

	Future Conditions Without Project			Estimated Future Conditions With Project			Δ Water Surface		
River	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr
Mile	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
0.01	756.75	758.02	758.93	756.75	758.02	758.93	0.00	0.00	0.00
0.14	756.83	758.10	759.01	756.83	758.10	759.01	0.00	0.00	0.00
0.22	756.79	758.05	758.94	756.79	758.05	758.94	0.00	0.00	0.00
0.253	756.77	758.02	758.90	756.77	758.02	758.90	0.00	0.00	0.00
0.259	756.89	758.17	759.07	756.89	758.17	759.07	0.00	0.00	0.00
0.273704	757.62	759.02	760.01	757.62	759.02	760.01	0.00	0.00	0.00
0.285582	757.76	759.18	760.19	757.76	759.18	760.19	0.00	0.00	0.00
0.29746	757.77	759.19	760.21	757.77	759.19	760.21	0.00	0.00	0.00
0.309339	757.90	759.34	760.36	757.90	759.34	760.36	0.00	0.00	0.00
0.44	757.98	759.41	760.43	757.98	759.41	760.43	0.00	0.00	0.00
0.496	758.50	760.00	761.08	758.50	760.00	761.08	0.00	0.00	0.00
0.504	758.64	760.18	761.28	758.64	760.18	761.28	0.00	0.00	0.00
0.64	758.78	760.29	761.36	758.78	760.29	761.36	0.00	0.00	0.00
0.812	758.93	760.45	761.53	758.93	760.45	761.53	0.00	0.00	0.00
0.817	759.04	760.70	761.92	759.04	760.70	761.92	0.00	0.00	0.00
1.106	759.91	761.64	762.91	759.91	761.64	762.91	0.00	0.00	0.00
1.117	760.02	761.91	763.31	760.03	761.91	763.31	0.01	0.00	0.00
1.27	761.08	763.06	764.54	761.37	763.06	764.54	0.29	0.00	0.00
1.385	761.34	763.28	764.76	761.63	763.28	764.76	0.29	0.00	0.00
1.413	761.67	763.56	765.08	761.96	763.56	765.08	0.29	0.00	0.00
1.614	761.74	763.61	765.14	762.03	763.61	765.14	0.29	0.00	0.00
1.62401	762.23	764.21	765.93	762.55	764.21	765.93	0.32	0.00	0.00
1.6335	762.26	764.23	765.96	762.58	764.23	765.96	0.32	0.00	0.00
1.643	762.46	764.55	766.38	762.78	764.55	766.38	0.32	0.00	0.00
2.016	763.64	765.59	767.39	763.97	765.59	767.39	0.33	0.00	0.00
2.097	763.98	765.95	767.74	764.31	765.95	767.74	0.33	0.00	0.00
2.111	764.31	766.45	768.40	764.67	766.45	768.40	0.36	0.00	0.00
2.165	765.08	767.27	769.24	765.46	767.27	769.24	0.38	0.00	0.00
2.179	765.46	767.79	769.89	765.87	767.79	769.89	0.41	0.00	0.00

	Future Conditions Without Project			Estimated Future Conditions With Project			Δ Water Surface		
River	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr
Mile	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
2.491	766.05	768.33	770.38	766.45	768.33	770.38	0.40	0.00	0.00
2.525	766.10	768.38	770.43	766.50	768.38	770.43	0.40	0.00	0.00
2.536	766.64	769.16	771.38	767.12	769.16	771.38	0.48	0.00	0.00
3.05	768.54	771.03	773.21	769.02	771.03	773.21	0.48	0.00	0.00
3.405	769.43	771.92	774.09	769.91	771.92	774.09	0.48	0.00	0.00
3.427	769.75	772.31	774.54	770.25	772.31	774.54	0.50	0.00	0.00
3.96	770.71	773.23	775.41	771.20	773.23	775.41	0.49	0.00	0.00
4.276	771.23	773.72	775.89	771.71	773.72	775.89	0.48	0.00	0.00
4.284	771.42	773.97	776.21	771.92	773.97	776.21	0.50	0.00	0.00
4.48	771.78	774.32	776.54	772.27	774.32	776.54	0.49	0.00	0.00
4.949	773.18	775.73	777.92	773.68	775.73	777.92	0.5	0.00	0.00
4.97	773.41	776.00	778.24	773.91	776.00	778.24	0.5	0.00	0.00
5.506	773.93	776.51	778.73	774.41	776.51	778.73	0.48	0.00	0.00
5.52	773.97	776.55	778.77	774.45	776.55	778.77	0.48	0.00	0.00
5.811	774.47	777.06	779.28	774.94	777.06	779.28	0.47	0.00	0.00
5.831	774.49	777.10	779.33	774.97	777.10	779.33	0.48	0.00	0.00
6.88	774.97	777.55	779.77	775.43	777.55	779.77	0.46	0.00	0.00
7.329	775.21	777.78	779.98	775.66	777.78	779.98	0.45	0.00	0.00
7.333	775.22	777.79	780.00	775.67	777.79	780.00	0.45	0.00	0.00
7.342	775.24	777.81	780.01	775.7	777.81	780.01	0.46	0.00	0.00
7.351	775.27	777.82	780.03	775.71	777.82	780.03	0.44	0.00	0.00
7.36	775.29	777.85	780.06	775.74	777.85	780.06	0.45	0.00	0.00
7.364	775.31	777.86	780.07	775.75	777.86	780.07	0.44	0.00	0.00
7.65	775.65	778.20	780.38	776.08	778.20	780.38	0.43	0.00	0.00
8.42	776.75	779.26	781.42	777.14	779.26	781.42	0.39	0.00	0.00
9.04	777.31	779.79	781.91	777.69	779.79	781.91	0.38	0.00	0.00
9.49	778.00	780.43	782.51	778.35	780.43	782.51	0.35	0.00	0.00
9.505	778.02	780.51	782.63	778.39	780.51	782.63	0.37	0.00	0.00
9.82	778.59	781.07	783.21	778.94	781.07	783.21	0.35	0.00	0.00
10.4	778.80	781.27	783.39	779.14	781.27	783.39	0.34	0.00	0.00
10.6	779.00	781.46	783.57	779.34	781.46	783.57	0.34	0.00	0.00
10.9	779.85	782.25	784.30	780.16	782.25	784.30	0.31	0.00	0.00

	Future Conditions Without Project			Estimated Future Conditions With Project			Δ Water Surface		
River	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr
Mile	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
11.35	780.29	782.67	784.70	780.6	782.67	784.70	0.31	0.00	0.00
11.85	780.85	783.19	785.19	781.14	783.19	785.19	0.29	0.00	0.00
12.4	781.22	783.52	785.45	781.5	783.52	785.45	0.28	0.00	0.00
12.94	781.44	783.70	785.68	781.71	783.70	785.68	0.27	0.00	0.00
13.3	781.68	784.02	785.97	781.95	784.02	785.97	0.27	0.00	0.00
13.65	781.96	784.26	786.18	782.22	784.26	786.18	0.26	0.00	0.00
14.25	782.15	784.43	786.35	782.4	784.43	786.35	0.25	0.00	0.00
14.62	782.30	784.58	786.48	782.55	784.58	786.48	0.25	0.00	0.00

Shaded Cells are Induced Water Surface Increases that Controlled for HEC-FDA Analysis

Table 6. Downstream Induced Damages Due to Argentine n500+3 Levee Raise

	Future Conditions Without Project			Estimated Future Conditions With Project			Δ Water Surface		
River	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr
Mile	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
0.01	756.75	758.02	758.93	756.75	758.21	758.93	0.00	0.19	0.00
0.14	756.83	758.10	759.01	756.83	758.28	759.01	0.00	0.18	0.00
0.22	756.79	758.05	758.94	756.79	758.23	758.94	0.00	0.18	0.00
0.253	756.77	758.02	758.90	756.77	758.19	758.90	0.00	0.17	0.00
0.259	756.89	758.17	759.07	756.89	758.35	759.07	0.00	0.18	0.00
0.273704	757.62	759.02	760.01	757.62	759.21	760.01	0.00	0.19	0.00
0.285582	757.76	759.18	760.19	757.76	759.38	760.19	0.00	0.20	0.00
0.29746	757.77	759.19	760.21	757.77	759.40	760.21	0.00	0.21	0.00
0.309339	757.90	759.34	760.36	757.90	759.54	760.36	0.00	0.20	0.00
0.44	757.98	759.41	760.43	757.98	759.61	760.43	0.00	0.20	0.00
0.496	758.50	760.00	761.08	758.50	760.22	761.08	0.00	0.22	0.00
0.504	758.64	760.18	761.28	758.64	760.40	761.28	0.00	0.22	0.00
0.64	758.78	760.29	761.36	758.78	760.51	761.36	0.00	0.22	0.00
0.812	758.93	760.45	761.53	758.93	760.67	761.53	0.00	0.22	0.00
0.817	759.04	760.70	761.92	759.04	760.94	761.92	0.00	0.24	0.00
1.106	759.91	761.64	762.91	759.91	761.89	762.91	0.00	0.25	0.00
1.117	760.02	761.91	763.31	760.03	762.19	763.31	0.01	0.28	0.00
1.27	761.08	763.06	764.54	761.37	763.35	764.54	0.29	0.29	0.00
1.385	761.34	763.28	764.76	761.63	763.56	764.76	0.29	0.28	0.00
1.413	761.67	763.56	765.08	761.96	763.85	765.08	0.29	0.29	0.00
1.614	761.74	763.61	765.14	762.03	763.91	765.14	0.29	0.30	0.00
1.62401	762.23	764.21	765.93	762.55	764.53	765.93	0.32	0.32	0.00
1.6335	762.26	764.23	765.96	762.58	764.56	765.96	0.32	0.33	0.00
1.643	762.46	764.55	766.38	762.78	764.90	766.38	0.32	0.35	0.00
2.016	763.64	765.59	767.39	763.97	765.94	767.39	0.33	0.35	0.00
2.097	763.98	765.95	767.74	764.31	766.29	767.74	0.33	0.34	0.00
2.111	764.31	766.45	768.40	764.67	766.83	768.40	0.36	0.38	0.00
2.165	765.08	767.27	769.24	765.46	767.66	769.24	0.38	0.39	0.00
2.179	765.46	767.79	769.89	765.87	768.21	769.89	0.41	0.42	0.00

	Future Conditions Without Project			Estimated Future Conditions With Project			Δ Water Surface		
River	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr
Mile	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
2.491	766.05	768.33	770.38	766.45	768.74	770.38	0.40	0.41	0.00
2.525	766.10	768.38	770.43	766.50	768.79	770.43	0.40	0.41	0.00
2.536	766.64	769.16	771.38	767.12	769.60	771.38	0.48	0.44	0.00
3.05	768.54	771.03	773.21	769.02	771.47	773.21	0.48	0.44	0.00
3.405	769.43	771.92	774.09	769.91	772.36	774.09	0.48	0.44	0.00
3.427	769.75	772.31	774.54	770.25	772.77	774.54	0.50	0.46	0.00
3.96	770.71	773.23	775.41	771.20	773.68	775.41	0.49	0.45	0.00
4.276	771.23	773.72	775.89	771.71	774.17	775.89	0.48	0.45	0.00
4.284	771.42	773.97	776.21	771.92	774.44	776.21	0.50	0.47	0.00
4.48	771.78	774.32	776.54	772.27	774.78	776.54	0.49	0.46	0.00
4.949	773.18	775.73	777.92	773.68	776.17	777.92	0.5	0.44	0.00
4.97	773.41	776.00	778.24	773.91	776.45	778.24	0.5	0.45	0.00
5.506	773.93	776.51	778.73	774.41	776.94	778.73	0.48	0.43	0.00
5.52	773.97	776.55	778.77	774.45	776.99	778.77	0.48	0.44	0.00
5.811	774.47	777.06	779.28	774.94	777.49	779.28	0.47	0.43	0.00
5.831	774.49	777.10	779.33	774.97	777.53	779.33	0.48	0.43	0.00
6.88	774.97	777.55	779.77	775.43	777.97	779.77	0.46	0.42	0.00
7.329	775.21	777.78	779.98	775.66	778.18	779.98	0.45	0.4	0.00
7.333	775.22	777.79	780.00	775.67	778.19	780.00	0.45	0.4	0.00
7.342	775.24	777.81	780.01	775.7	778.22	780.01	0.46	0.41	0.00
7.351	775.27	777.82	780.03	775.71	778.23	780.03	0.44	0.41	0.00
7.36	775.29	777.85	780.06	775.74	778.25	780.06	0.45	0.4	0.00
7.364	775.31	777.86	780.07	775.75	778.26	780.07	0.44	0.4	0.00
7.65	775.65	778.20	780.38	776.08	778.58	780.38	0.43	0.38	0.00
8.42	776.75	779.26	781.42	777.14	779.62	781.42	0.39	0.36	0.00
9.04	777.31	779.79	781.91	777.69	780.13	781.91	0.38	0.34	0.00
9.49	778.00	780.43	782.51	778.35	780.76	782.51	0.35	0.33	0.00
9.505	778.02	780.51	782.63	778.39	780.84	782.63	0.37	0.33	0.00
9.82	778.59	781.07	783.21	778.94	781.42	783.21	0.35	0.35	0.00
10.4	778.80	781.27	783.39	779.14	781.61	783.39	0.34	0.34	0.00
10.6	779.00	781.46	783.57	779.34	781.8	783.57	0.34	0.34	0.00
10.9	779.85	782.25	784.30	780.16	782.56	784.30	0.31	0.31	0.00

	Future Conditions Without Project			Estimated Future Conditions With Project			Δ Water Surface		
River	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr
Mile	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
11.35	780.29	782.67	784.70	780.6	782.97	784.70	0.31	0.3	0.00
11.85	780.85	783.19	785.19	781.14	783.48	785.19	0.29	0.29	0.00
12.4	781.22	783.52	785.45	781.5	783.8	785.45	0.28	0.28	0.00
12.94	781.44	783.70	785.68	781.71	783.98	785.68	0.27	0.28	0.00
13.3	781.68	784.02	785.97	781.95	784.28	785.97	0.27	0.26	0.00
13.65	781.96	784.26	786.18	782.22	784.52	786.18	0.26	0.26	0.00
14.25	782.15	784.43	786.35	782.4	784.69	786.35	0.25	0.26	0.00
14.62	782.30	784.58	786.48	782.55	784.83	786.48	0.25	0.25	0.00

Shaded Cells are Induced Water Surface Increases that Controlled for HEC-FDA Analysis

Table 7. Downstream Induced Damages Due to Argentine n500+5 Levee Raise

	Future Conditions Without Project			Estimated Future Conditions With Project			Δ Water Surface		
River	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr
Mile	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
0.01	756.75	758.02	758.93	756.75	758.21	759.13	0.00	0.19	0.20
0.14	756.83	758.10	759.01	756.83	758.28	759.20	0.00	0.18	0.19
0.22	756.79	758.05	758.94	756.79	758.23	759.14	0.00	0.18	0.20
0.253	756.77	758.02	758.90	756.77	758.19	759.09	0.00	0.17	0.19
0.259	756.89	758.17	759.07	756.89	758.35	759.27	0.00	0.18	0.20
0.273704	757.62	759.02	760.01	757.62	759.21	760.22	0.00	0.19	0.21
0.285582	757.76	759.18	760.19	757.76	759.38	760.40	0.00	0.20	0.21
0.29746	757.77	759.19	760.21	757.77	759.40	760.42	0.00	0.21	0.21
0.309339	757.90	759.34	760.36	757.90	759.54	760.58	0.00	0.20	0.22
0.44	757.98	759.41	760.43	757.98	759.61	760.64	0.00	0.20	0.21
0.496	758.50	760.00	761.08	758.50	760.22	761.30	0.00	0.22	0.22
0.504	758.64	760.18	761.28	758.64	760.40	761.50	0.00	0.22	0.22
0.64	758.78	760.29	761.36	758.78	760.51	761.58	0.00	0.22	0.22
0.812	758.93	760.45	761.53	758.93	760.67	761.76	0.00	0.22	0.23
0.817	759.04	760.70	761.92	759.04	760.94	762.17	0.00	0.24	0.25
1.106	759.91	761.64	762.91	759.91	761.89	763.17	0.00	0.25	0.26
1.117	760.02	761.91	763.31	760.03	762.19	763.60	0.01	0.28	0.29
1.27	761.08	763.06	764.54	761.37	763.35	764.84	0.29	0.29	0.30
1.385	761.34	763.28	764.76	761.63	763.56	765.06	0.29	0.28	0.30
1.413	761.67	763.56	765.08	761.96	763.85	765.39	0.29	0.29	0.31
1.614	761.74	763.61	765.14	762.03	763.91	765.45	0.29	0.30	0.31
1.62401	762.23	764.21	765.93	762.55	764.53	766.29	0.32	0.32	0.36
1.6335	762.26	764.23	765.96	762.58	764.56	766.31	0.32	0.33	0.35
1.643	762.46	764.55	766.38	762.78	764.90	766.74	0.32	0.35	0.36
2.016	763.64	765.59	767.39	763.97	765.94	767.75	0.33	0.35	0.36
2.097	763.98	765.95	767.74	764.31	766.29	768.10	0.33	0.34	0.36
2.111	764.31	766.45	768.40	764.67	766.83	768.76	0.36	0.38	0.36
2.165	765.08	767.27	769.24	765.46	767.66	769.61	0.38	0.39	0.37
2.179	765.46	767.79	769.89	765.87	768.21	770.29	0.41	0.42	0.40

	Future Conditions Without Project			Estimated Future Conditions With Project			Δ Water Surface		
River	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr
Mile	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
2.491	766.05	768.33	770.38	766.45	768.74	770.78	0.40	0.41	0.40
2.525	766.10	768.38	770.43	766.50	768.79	770.82	0.40	0.41	0.39
2.536	766.64	769.16	771.38	767.12	769.60	771.81	0.48	0.44	0.43
3.05	768.54	771.03	773.21	769.02	771.47	773.64	0.48	0.44	0.43
3.405	769.43	771.92	774.09	769.91	772.36	774.52	0.48	0.44	0.43
3.427	769.75	772.31	774.54	770.25	772.77	774.99	0.50	0.46	0.45
3.96	770.71	773.23	775.41	771.20	773.68	775.85	0.49	0.45	0.44
4.276	771.23	773.72	775.89	771.71	774.17	776.33	0.48	0.45	0.44
4.284	771.42	773.97	776.21	771.92	774.44	776.67	0.50	0.47	0.46
4.48	771.78	774.32	776.54	772.27	774.78	777.00	0.49	0.46	0.46
4.949	773.18	775.73	777.92	773.68	776.17	778.36	0.5	0.44	0.44
4.97	773.41	776.00	778.24	773.91	776.45	778.68	0.5	0.45	0.44
5.506	773.93	776.51	778.73	774.41	776.94	779.15	0.48	0.43	0.42
5.52	773.97	776.55	778.77	774.45	776.99	779.2	0.48	0.44	0.43
5.811	774.47	777.06	779.28	774.94	777.49	779.7	0.47	0.43	0.42
5.831	774.49	777.10	779.33	774.97	777.53	779.75	0.48	0.43	0.42
6.88	774.97	777.55	779.77	775.43	777.97	780.17	0.46	0.42	0.4
7.329	775.21	777.78	779.98	775.66	778.18	780.38	0.45	0.4	0.4
7.333	775.22	777.79	780.00	775.67	778.19	780.38	0.45	0.4	0.38
7.342	775.24	777.81	780.01	775.7	778.22	780.41	0.46	0.41	0.4
7.351	775.27	777.82	780.03	775.71	778.23	780.42	0.44	0.41	0.39
7.36	775.29	777.85	780.06	775.74	778.25	780.45	0.45	0.4	0.39
7.364	775.31	777.86	780.07	775.75	778.26	780.46	0.44	0.4	0.39
7.65	775.65	778.20	780.38	776.08	778.58	780.76	0.43	0.38	0.38
8.42	776.75	779.26	781.42	777.14	779.62	781.77	0.39	0.36	0.35
9.04	777.31	779.79	781.91	777.69	780.13	782.25	0.38	0.34	0.34
9.49	778.00	780.43	782.51	778.35	780.76	782.83	0.35	0.33	0.32
9.505	778.02	780.51	782.63	778.39	780.84	782.96	0.37	0.33	0.33
9.82	778.59	781.07	783.21	778.94	781.42	783.56	0.35	0.35	0.35
10.4	778.80	781.27	783.39	779.14	781.61	783.73	0.34	0.34	0.34
10.6	779.00	781.46	783.57	779.34	781.8	783.91	0.34	0.34	0.34
10.9	779.85	782.25	784.30	780.16	782.56	784.62	0.31	0.31	0.32

	Future Conditions Without Project			Estimated Future Conditions With Project			Δ Water Surface		
River	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr	500-yr	750-yr	1000-yr
Mile	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev	W.S. Elev
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
11.35	780.29	782.67	784.70	780.6	782.97	785.01	0.31	0.3	0.31
11.85	780.85	783.19	785.19	781.14	783.48	785.49	0.29	0.29	0.3
12.4	781.22	783.52	785.45	781.5	783.8	785.73	0.28	0.28	0.28
12.94	781.44	783.70	785.68	781.71	783.98	785.96	0.27	0.28	0.28
13.3	781.68	784.02	785.97	781.95	784.28	786.24	0.27	0.26	0.27
13.65	781.96	784.26	786.18	782.22	784.52	786.45	0.26	0.26	0.27
14.25	782.15	784.43	786.35	782.4	784.69	786.61	0.25	0.26	0.26
14.62	782.30	784.58	786.48	782.55	784.83	786.74	0.25	0.25	0.26

Shaded Cells are Induced Water Surface Increases that Controlled for HEC-FDA Analysis

Table 8. Upstream and Opposite Bank Induced Damages Due to Argentine n500+0 Raise

River	Future Conditions Without Project					Estimated Future Conditions With Project					Δ Water Surface				
Mile	500-yr	750-yr	1000-yr	1250-yr	1500-yr	500-yr	750-yr	1000-yr	1250-yr	1500-yr	500-yr	750-yr	1000-yr	1250-yr	1500-yr
4.949	773.18	775.73	777.92	779.38	780.68	773.18	775.73	777.92	779.38	780.68	0.00	0.00	0.00	0.00	0.00
4.97	773.41	776.00	778.24	779.74	781.07	773.41	776.00	778.25	779.75	781.08	0.00	0.00	0.01	0.01	0.01
5.506	773.93	776.51	778.73	780.22	781.54	773.93	776.51	778.73	780.22	781.54	0.00	0.00	0.00	0.00	0.00
5.52	773.97	776.55	778.77	780.27	781.59	773.97	776.55	778.77	780.27	781.59	0.00	0.00	0.00	0.00	0.00
5.811	774.47	777.06	779.28	780.78	782.11	774.49	777.09	779.32	780.85	782.19	0.02	0.03	0.04	0.07	0.08
5.831	774.49	777.10	779.33	780.84	782.18	774.53	777.14	779.41	780.95	782.29	0.04	0.04	0.08	0.11	0.11
6.88	774.97	777.55	779.77	781.26	782.59	775.01	777.62	779.86	781.37	782.73	0.04	0.07	0.09	0.11	0.14
7.329	775.21	777.78	779.98	781.46	782.80	775.25	777.84	780.09	781.58	782.94	0.04	0.06	0.11	0.12	0.14
7.333	775.22	777.79	780.00	781.47	782.81	775.28	777.87	780.10	781.60	782.96	0.06	0.08	0.10	0.13	0.15
7.342	775.24	777.81	780.01	781.50	782.83	775.26	777.82	780.04	781.53	782.86	0.02	0.01	0.03	0.03	0.03
7.351	775.27	777.82	780.03	781.51	782.84	775.27	777.84	780.04	781.52	782.86	0.00	0.02	0.01	0.01	0.02
7.36	775.29	777.85	780.06	781.54	782.87	775.29	777.85	780.06	781.54	782.87	0.00	0.00	0.00	0.00	0.00
7.364	775.31	777.86	780.07	781.55	782.88	775.31	777.86	780.07	781.55	782.88	0.00	0.00	0.00	0.00	0.00
7.65	775.65	778.20	780.38	781.85	783.17	775.65	778.20	780.38	781.85	783.17	0.00	0.00	0.00	0.00	0.00
8.42	776.75	779.26	781.42	782.87	784.18	776.83	779.39	781.61	783.10	784.47	0.08	0.13	0.19	0.23	0.29
9.04	777.31	779.79	781.91	783.34	784.63	777.39	779.94	782.15	783.63	784.98	0.08	0.15	0.24	0.29	0.35
9.49	778.00	780.43	782.51	783.92	785.19	778.14	780.65	782.84	784.33	785.66	0.14	0.22	0.33	0.41	0.47
9.505	778.02	780.51	782.63	784.07	785.36	778.16	780.71	782.95	784.44	785.80	0.14	0.20	0.32	0.37	0.44
9.82	778.59	781.07	783.21	784.67	786.00	778.75	781.31	783.57	785.10	786.49	0.16	0.24	0.36	0.43	0.49
10.4	778.80	781.27	783.39	784.84	786.17	778.96	781.53	783.77	785.29	786.71	0.16	0.26	0.38	0.45	0.54
10.6	779.00	781.46	783.57	785.02	786.34	779.16	781.70	783.94	785.47	786.86	0.16	0.24	0.37	0.45	0.52
10.9	779.85	782.25	784.30	785.71	787.01	779.99	782.48	784.64	786.13	787.51	0.14	0.23	0.34	0.42	0.50
11.35	780.29	782.67	784.70	786.10	787.38	780.43	782.89	785.05	786.52	787.88	0.14	0.22	0.35	0.42	0.50
11.85	780.85	783.19	785.19	786.57	787.84	780.99	783.40	785.51	786.97	788.31	0.14	0.21	0.32	0.40	0.47
12.4	781.22	783.52	785.45	786.81	788.07	781.36	783.73	785.77	787.20	788.53	0.14	0.21	0.32	0.39	0.46
12.94	781.44	783.70	785.68	787.03	788.28	781.58	783.91	785.99	787.40	788.72	0.14	0.21	0.31	0.37	0.44
13.3	781.68	784.02	785.97	787.31	788.54	781.80	784.21	786.27	787.69	788.98	0.12	0.19	0.30	0.38	0.44
13.65	781.96	784.26	786.18	787.51	788.73	782.06	784.46	786.47	787.87	789.17	0.10	0.20	0.29	0.36	0.44
14.25	782.15	784.43	786.35	787.66	788.88	782.27	784.61	786.65	788.01	789.30	0.12	0.18	0.30	0.35	0.42
14.62	782.30	784.58	786.48	787.79	789.00	782.42	784.78	786.77	788.14	789.41	0.12	0.20	0.29	0.35	0.41

Shaded Cells are Induced Water Surface Increases that Controlled for HEC-FDA Analysis

Table 9. Upstream and Opposite Bank Induced Damages Due to Argentine n500+3 Raise

River	Future Conditions Without Project					Estimated Future Conditions With Project					Δ Water Surface				
Mile	500-yr	750-yr	1000-yr	1250-yr	1500-yr	500-yr	750-yr	1000-yr	1250-yr	1500-yr	500-yr	750-yr	1000-yr	1250-yr	1500-yr
4.949	773.18	775.73	777.92	779.38	780.68	773.18	775.73	777.92	779.38	780.68	0.00	0.00	0.00	0.00	0.00
4.97	773.41	776.00	778.24	779.74	781.07	773.41	776.00	778.26	779.75	781.08	0.00	0.00	0.02	0.01	0.01
5.506	773.93	776.51	778.73	780.22	781.54	773.93	776.51	778.73	780.22	781.54	0.00	0.00	0.00	0.00	0.00
5.52	773.97	776.55	778.77	780.27	781.59	773.97	776.55	778.77	780.27	781.59	0.00	0.00	0.00	0.00	0.00
5.811	774.47	777.06	779.28	780.78	782.11	774.49	777.10	779.34	780.86	782.21	0.02	0.04	0.06	0.08	0.10
5.831	774.49	777.10	779.33	780.84	782.18	774.53	777.16	779.43	780.97	782.32	0.04	0.06	0.10	0.13	0.14
6.88	774.97	777.55	779.77	781.26	782.59	775.01	777.65	779.89	781.41	782.76	0.04	0.10	0.12	0.15	0.17
7.329	775.21	777.78	779.98	781.46	782.80	775.25	777.86	780.11	781.61	782.98	0.04	0.08	0.13	0.15	0.18
7.333	775.22	777.79	780.00	781.47	782.81	775.28	777.89	780.13	781.63	783.00	0.06	0.10	0.13	0.16	0.19
7.342	775.24	777.81	780.01	781.50	782.83	775.26	777.81	780.02	781.52	782.86	0.02	0.00	0.01	0.02	0.03
7.351	775.27	777.82	780.03	781.51	782.84	775.27	777.82	780.03	781.51	782.87	0.00	0.00	0.00	0.00	0.03
7.36	775.29	777.85	780.06	781.54	782.87	775.29	777.85	780.06	781.54	782.87	0.00	0.00	0.00	0.00	0.00
7.364	775.31	777.86	780.07	781.55	782.88	775.31	777.86	780.07	781.55	782.88	0.00	0.00	0.00	0.00	0.00
7.65	775.65	778.20	780.38	781.85	783.17	775.65	778.20	780.38	781.85	783.17	0.00	0.00	0.00	0.00	0.00
8.42	776.75	779.26	781.42	782.87	784.18	776.83	779.44	781.69	783.18	784.56	0.08	0.18	0.27	0.31	0.38
9.04	777.31	779.79	781.91	783.34	784.63	777.39	780.03	782.25	783.75	785.10	0.08	0.24	0.34	0.41	0.47
9.49	778.00	780.43	782.51	783.92	785.19	778.14	780.80	782.99	784.48	785.82	0.14	0.37	0.48	0.56	0.63
9.505	778.02	780.51	782.63	784.07	785.36	778.16	780.86	783.10	784.59	785.95	0.14	0.35	0.47	0.52	0.59
9.82	778.59	781.07	783.21	784.67	786.00	778.75	781.46	783.73	785.27	786.66	0.16	0.39	0.52	0.60	0.66
10.4	778.80	781.27	783.39	784.84	786.17	778.96	781.69	783.94	785.47	786.89	0.16	0.42	0.55	0.63	0.72
10.6	779.00	781.46	783.57	785.02	786.34	779.16	781.87	784.11	785.65	787.05	0.16	0.41	0.54	0.63	0.71
10.9	779.85	782.25	784.30	785.71	787.01	779.99	782.63	784.80	786.29	787.68	0.14	0.38	0.50	0.58	0.67
11.35	780.29	782.67	784.70	786.10	787.38	780.43	783.03	785.20	786.68	788.04	0.14	0.36	0.50	0.58	0.66
11.85	780.85	783.19	785.19	786.57	787.84	780.99	783.53	785.66	787.12	788.47	0.14	0.34	0.47	0.55	0.63
12.4	781.22	783.52	785.45	786.81	788.07	781.36	783.86	785.92	787.35	788.68	0.14	0.34	0.47	0.54	0.61
12.94	781.44	783.70	785.68	787.03	788.28	781.58	784.04	786.13	787.55	788.88	0.14	0.34	0.45	0.52	0.60
13.3	781.68	784.02	785.97	787.31	788.54	781.80	784.34	786.40	787.83	789.13	0.12	0.32	0.43	0.52	0.59
13.65	781.96	784.26	786.18	787.51	788.73	782.06	784.58	786.60	788.01	789.32	0.10	0.32	0.42	0.50	0.59
14.25	782.15	784.43	786.35	787.66	788.88	782.27	784.73	786.79	788.15	789.45	0.12	0.30	0.44	0.49	0.57
14.62	782.30	784.58	786.48	787.79	789.00	782.42	784.90	786.90	788.28	789.56	0.12	0.32	0.42	0.49	0.56

Shaded Cells are Induced Water Surface Increases that Controlled for HEC-FDA Analysis

Table 10. Upstream and Opposite Bank Induced Damages Due to Argentine n500+5 Raise

River	Future Conditions Without Project					Estimated Future Conditions With Project					Δ Water Surface				
Mile	500-yr	750-yr	1000-yr	1250-yr	1500-yr	500-yr	750-yr	1000-yr	1250-yr	1500-yr	500-yr	750-yr	1000-yr	1250-yr	1500-yr
4.949	773.18	775.73	777.92	779.38	780.68	773.18	775.73	777.92	779.38	780.68	0.00	0.00	0.00	0.00	0.00
4.97	773.41	776.00	778.24	779.74	781.07	773.41	776.00	778.26	779.75	781.09	0.00	0.00	0.02	0.01	0.02
5.506	773.93	776.51	778.73	780.22	781.54	773.93	776.51	778.73	780.22	781.54	0.00	0.00	0.00	0.00	0.00
5.52	773.97	776.55	778.77	780.27	781.59	773.97	776.55	778.77	780.27	781.59	0.00	0.00	0.00	0.00	0.00
5.811	774.47	777.06	779.28	780.78	782.11	774.49	777.10	779.34	780.87	782.22	0.02	0.04	0.06	0.09	0.11
5.831	774.49	777.10	779.33	780.84	782.18	774.53	777.16	779.45	780.99	782.34	0.04	0.06	0.12	0.15	0.16
6.88	774.97	777.55	779.77	781.26	782.59	775.01	777.65	779.91	781.42	782.79	0.04	0.10	0.14	0.16	0.20
7.329	775.21	777.78	779.98	781.46	782.80	775.25	777.86	780.12	781.63	783.00	0.04	0.08	0.14	0.17	0.20
7.333	775.22	777.79	780.00	781.47	782.81	775.28	777.89	780.14	781.64	783.01	0.06	0.10	0.14	0.17	0.20
7.342	775.24	777.81	780.01	781.50	782.83	775.26	777.81	780.01	781.51	782.85	0.02	0.00	0.00	0.01	0.02
7.351	775.27	777.82	780.03	781.51	782.84	775.27	777.82	780.03	781.51	782.86	0.00	0.00	0.00	0.00	0.02
7.36	775.29	777.85	780.06	781.54	782.87	775.29	777.85	780.06	781.54	782.87	0.00	0.00	0.00	0.00	0.00
7.364	775.31	777.86	780.07	781.55	782.88	775.31	777.86	780.07	781.55	782.88	0.00	0.00	0.00	0.00	0.00
7.65	775.65	778.20	780.38	781.85	783.17	775.65	778.20	780.38	781.85	783.17	0.00	0.00	0.00	0.00	0.00
8.42	776.75	779.26	781.42	782.87	784.18	776.83	779.44	781.72	783.23	784.61	0.08	0.18	0.30	0.36	0.43
9.04	777.31	779.79	781.91	783.34	784.63	777.39	780.03	782.31	783.80	785.16	0.08	0.24	0.40	0.46	0.53
9.49	778.00	780.43	782.51	783.92	785.19	778.14	780.80	783.09	784.57	785.91	0.14	0.37	0.58	0.65	0.72
9.505	778.02	780.51	782.63	784.07	785.36	778.16	780.86	783.19	784.67	786.03	0.14	0.35	0.56	0.60	0.67
9.82	778.59	781.07	783.21	784.67	786.00	778.75	781.46	783.83	785.36	786.76	0.16	0.39	0.62	0.69	0.76
10.4	778.80	781.27	783.39	784.84	786.17	778.96	781.69	784.05	785.57	787.00	0.16	0.42	0.66	0.73	0.83
10.6	779.00	781.46	783.57	785.02	786.34	779.16	781.86	784.22	785.75	787.15	0.16	0.40	0.65	0.73	0.81
10.9	779.85	782.25	784.30	785.71	787.01	779.99	782.63	784.90	786.38	787.78	0.14	0.38	0.60	0.67	0.77
11.35	780.29	782.67	784.70	786.10	787.38	780.43	783.03	785.30	786.77	788.14	0.14	0.36	0.60	0.67	0.76
11.85	780.85	783.19	785.19	786.57	787.84	780.99	783.53	785.76	787.21	788.56	0.14	0.34	0.57	0.64	0.72
12.4	781.22	783.52	785.45	786.81	788.07	781.36	783.86	786.01	787.43	788.78	0.14	0.34	0.56	0.62	0.71
12.94	781.44	783.70	785.68	787.03	788.28	781.58	784.04	786.22	787.63	788.97	0.14	0.34	0.54	0.60	0.69
13.3	781.68	784.02	785.97	787.31	788.54	781.80	784.34	786.49	787.91	789.21	0.12	0.32	0.52	0.60	0.67
13.65	781.96	784.26	786.18	787.51	788.73	782.06	784.58	786.68	788.09	789.40	0.10	0.32	0.50	0.58	0.67
14.25	782.15	784.43	786.35	787.66	788.88	782.27	784.73	786.87	788.23	789.53	0.12	0.30	0.52	0.57	0.65
14.62	782.30	784.58	786.48	787.79	789.00	782.42	784.90	786.98	788.36	789.64	0.12	0.32	0.50	0.57	0.64

Shaded Cells are Induced Water Surface Increases that Controlled for HEC-FDA Analysis