KANSAS CITY DISTRICT

NAVIGATION

Flow Analysis below Kansas City

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US Army Corps of Engineers

BUILDING STRONG®

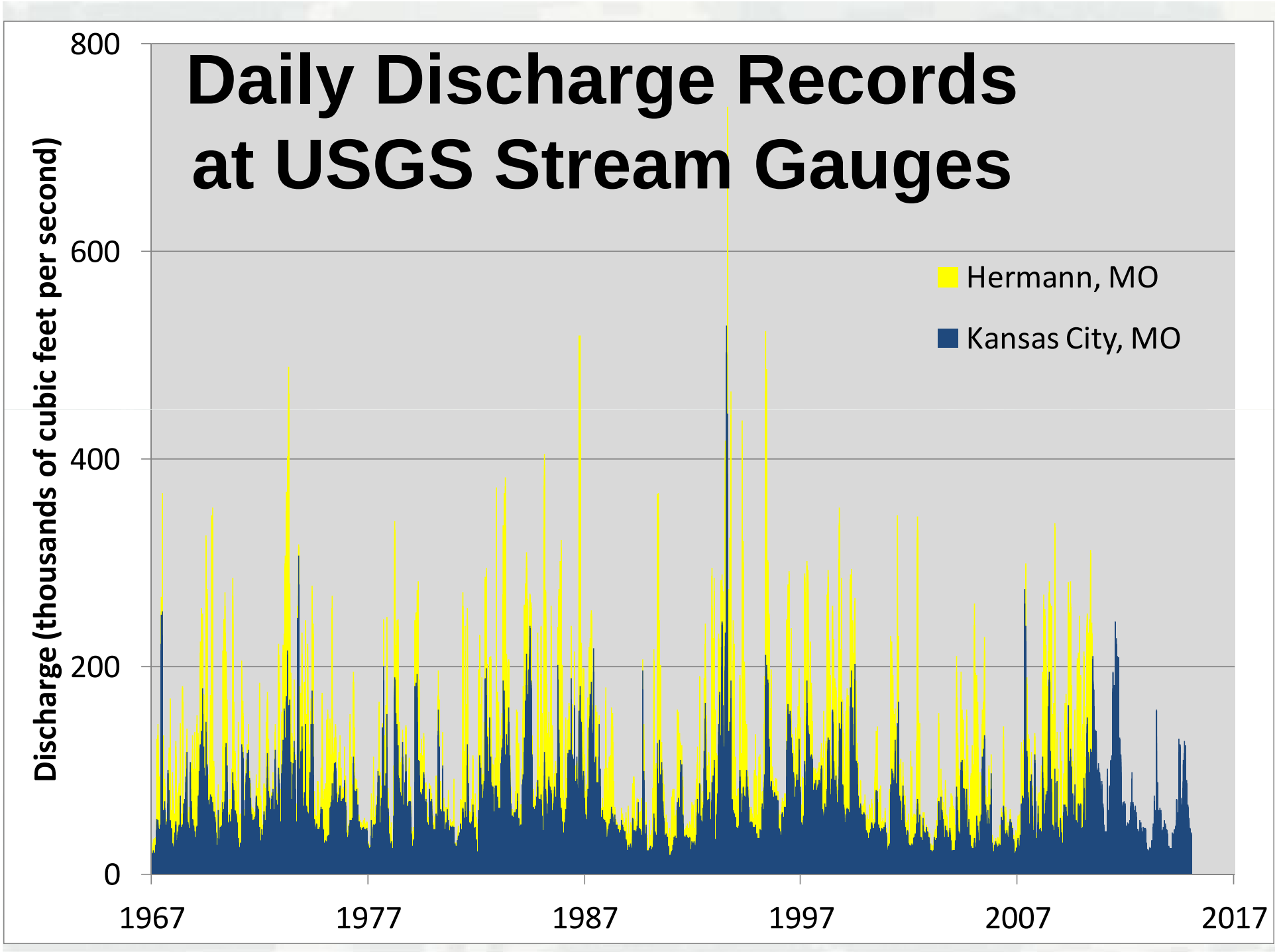
What this briefing is:

- Status brief on one of the two USACE commitments from previous meetings
  - Review Missouri River design documents to determine what inflow (Q) was assumed below Kansas City in the design of the river. Then look at actual inflows and compare them with what was anticipated in design docs.
  - Independent of any other flow regulations, etc
  - The other will be discussed in the second briefing

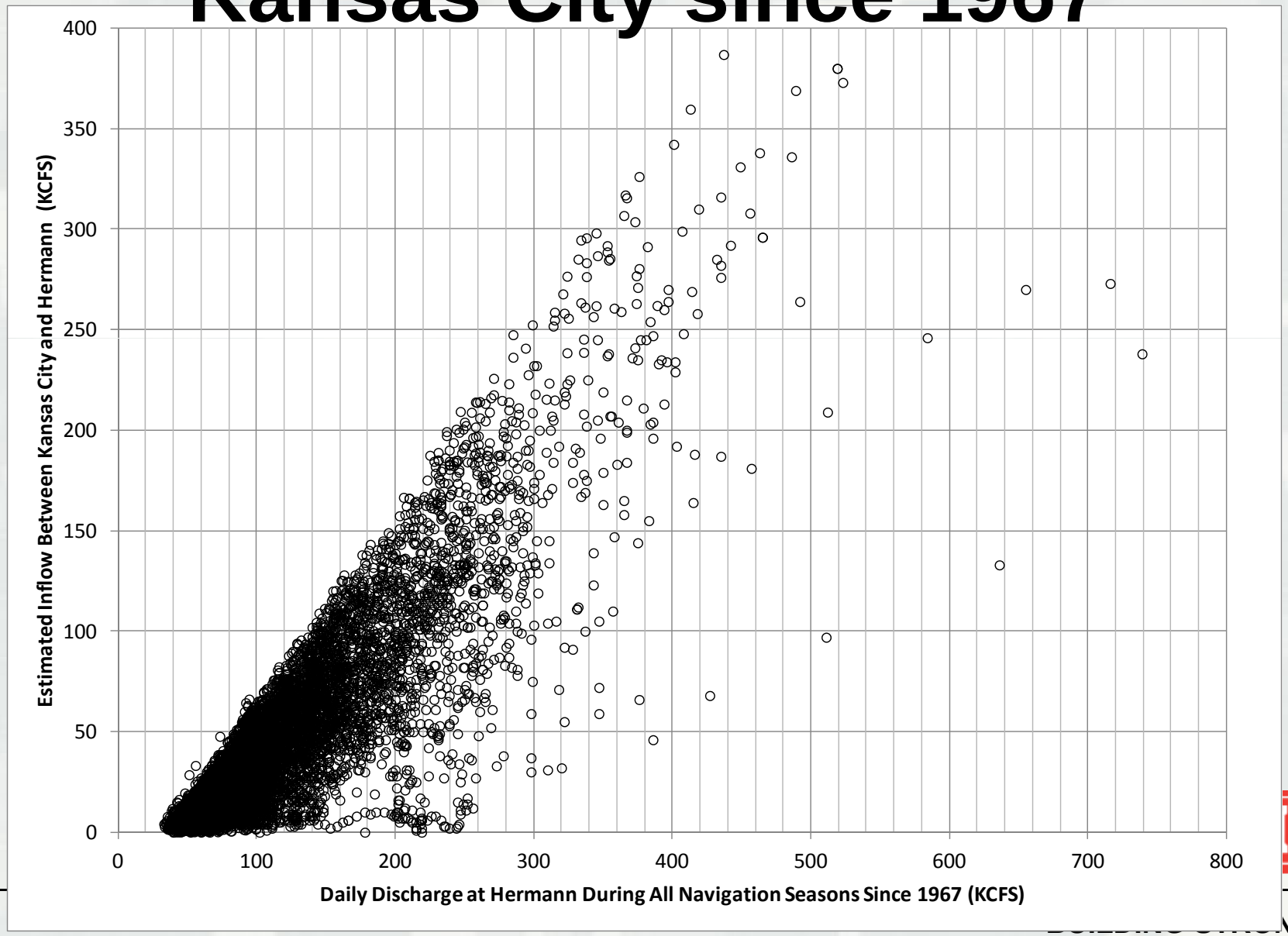
What this is not

I want to be very clear

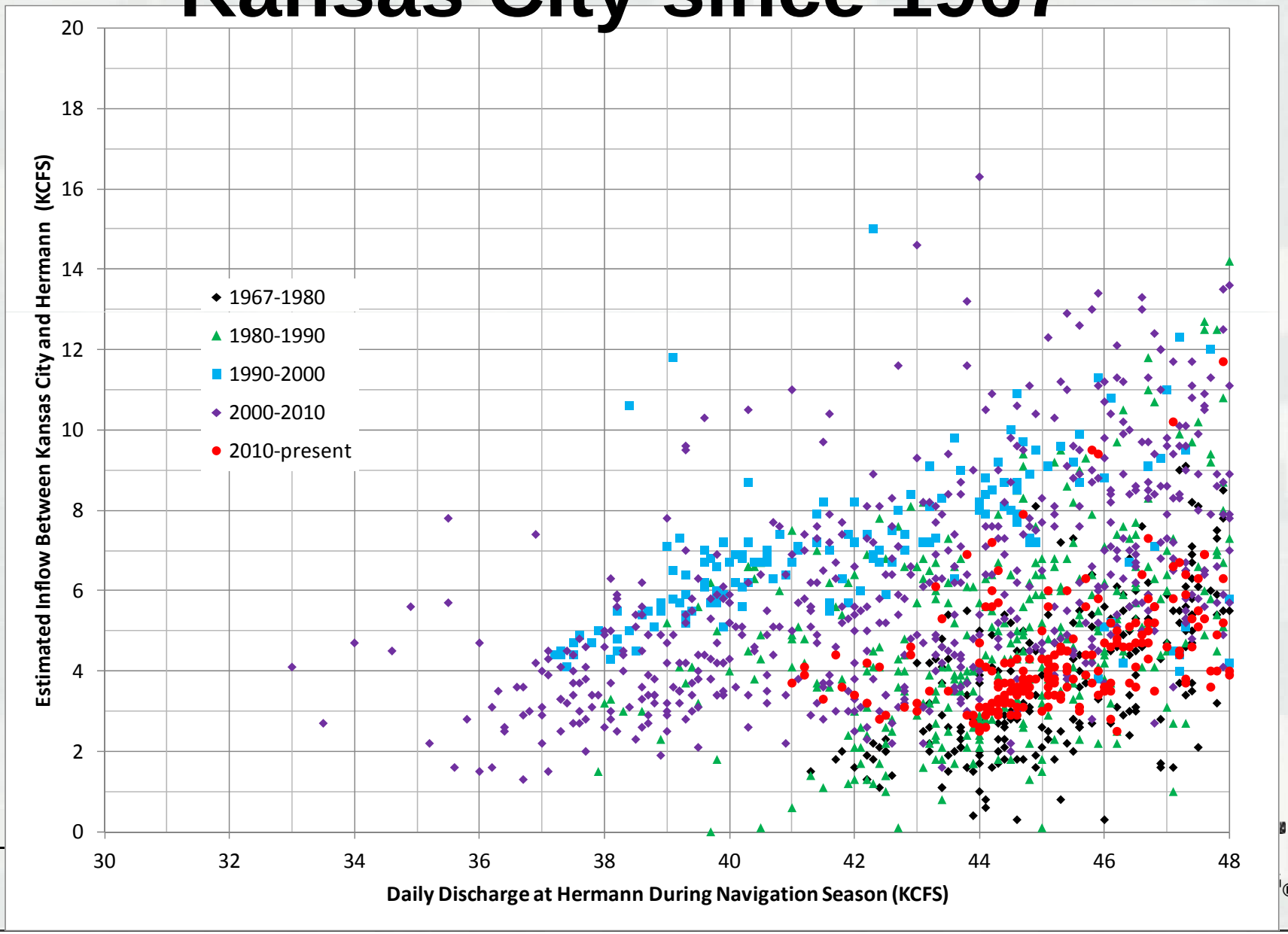
- A briefing to suggest doing anything with the master manual
- A briefing to advocate for another control point on the Missouri River


Daily Discharge Records at USGS Stream Gauges
Discharge (thousands of cubic feet per second)
800
600
400
200
0
1967
1977
1987
1997
2007
2017
Hermann, MO
Kansas City, MO

Tributary inflows downstream of Kansas City since 1967



Tributary inflows downstream of Kansas City since 1967



What were the design discharges?

MISSOURI RIVER NAVIGATION PROJECT
STRUCTURE DESIGN CRITERIA

December 1973

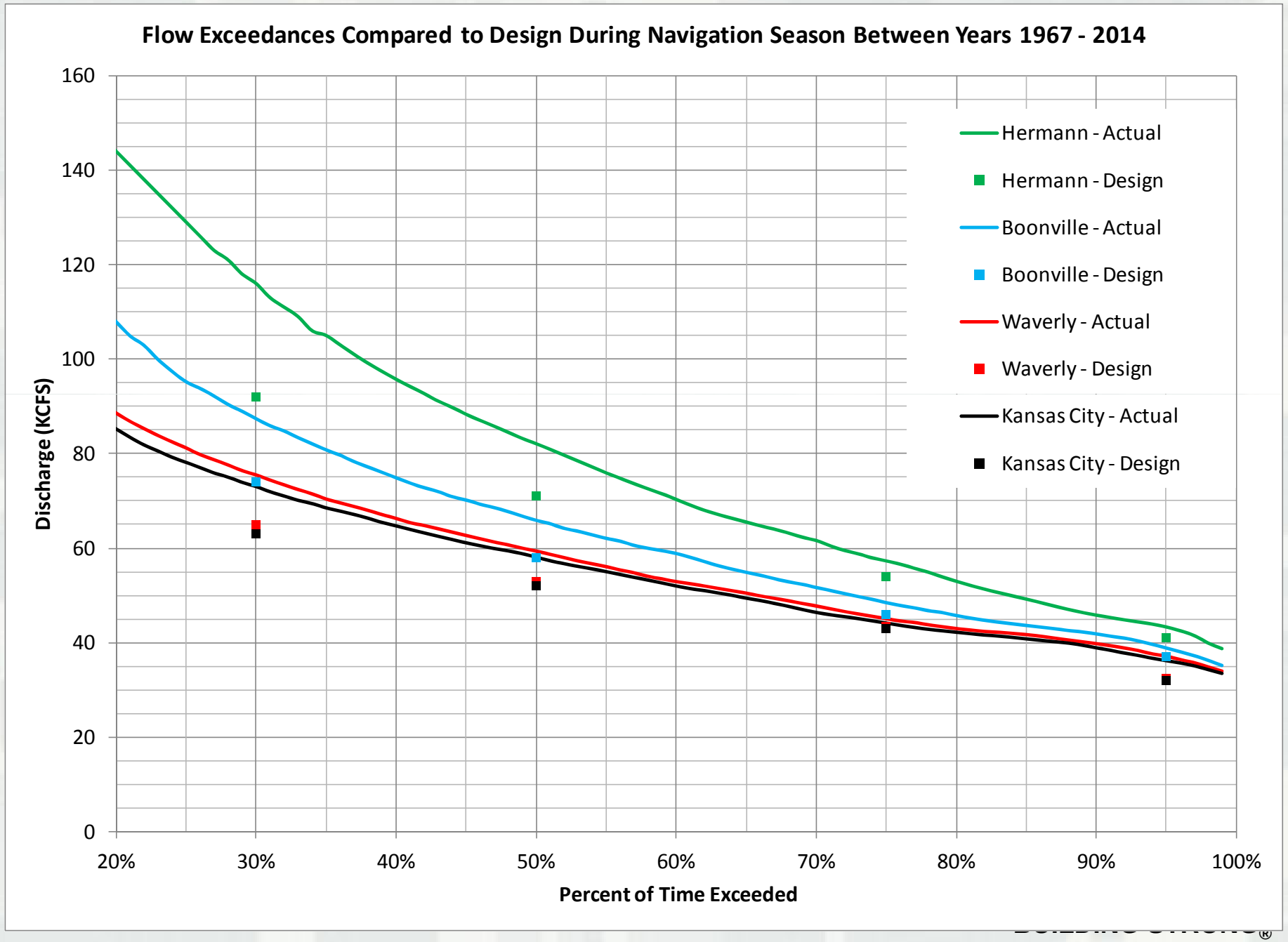
	Channel Width	Channel Width to Sills	Dike Height Concave	Dike Height Convex	Revetment L-Head	Revetment SFR	Sills	Crossing Control Structures
Sioux City-Platte R. (Mile 734 to 594)	600'	500'	+1.0	0	0	+1.0	0 to -5	+2.0
Platte River-Rulo (Mile 594 to 498)	600'	500'	+2.0	+1.0	+1.0	+2.0	0 to -5	+3.0
Rulo-Kansas River (Mile 498 to 367)	800'	550'	+3.0	+1.0	+1.0	+3.0	-2.0	+4.0
Kansas R-Grand River (Mile 367 to 250)	900'	600'	+3.0	+1.0	+1.0	+3.0	-2.0	+4.0
Grand R-Osage River (Mile 250 to 130)	1000'	650'	+4.0	+2.0	+2.0	+4.0	-2.0	+5.0
Osage R-Mouth (Mile 130 to 0)	1100'	750'	+5.0	+3.0	+3.0	+5.0	-1.0	+6.0
Percent of time proposed height criteria is exceeded during the navigation season	--	--	30%	50%	50%	30%	>95%	20%

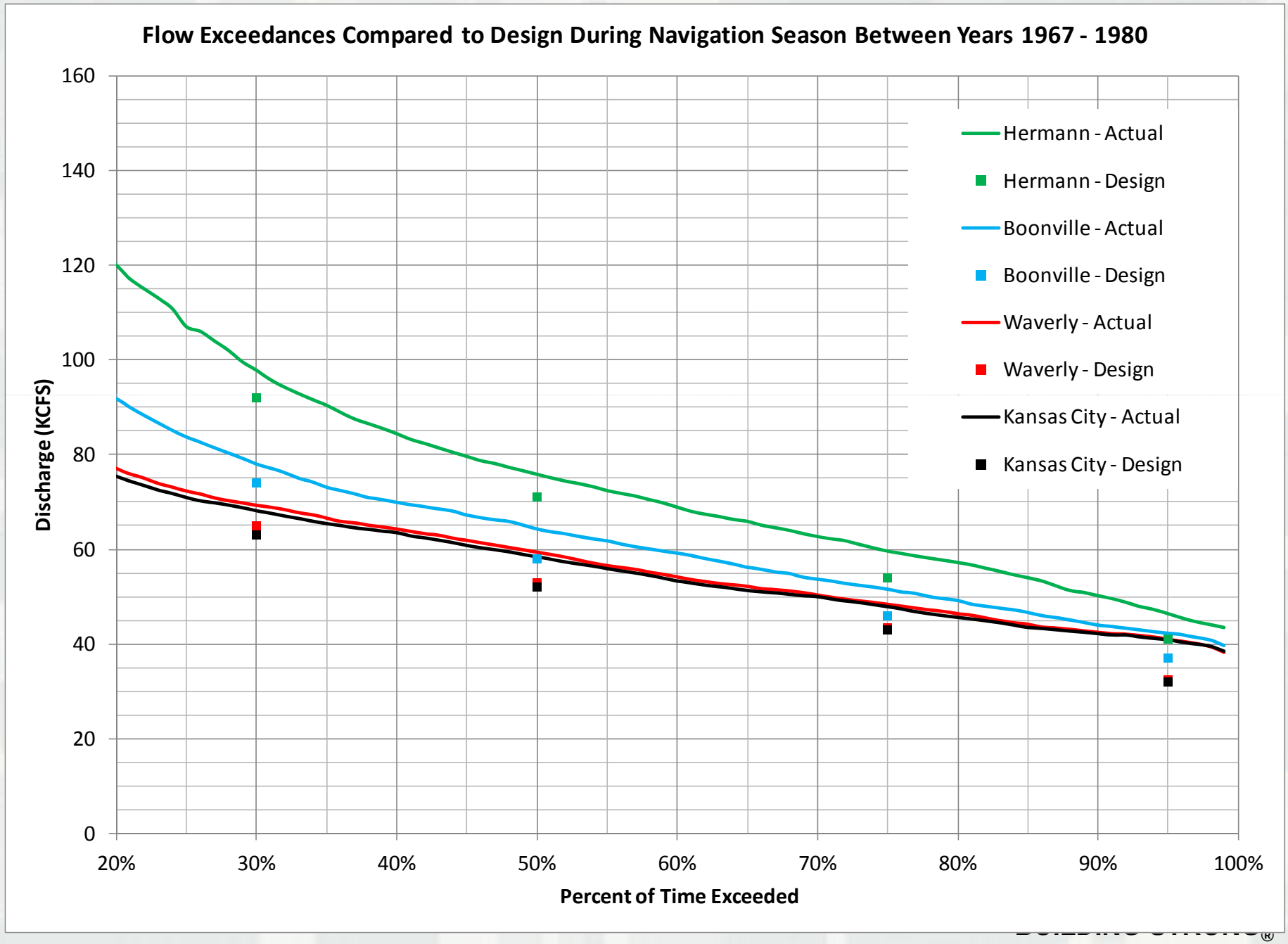
NOTE: The above structure height criteria is referenced to Q_{75} (CRP) as determined from a 1972 Summer Rating Curve. Q_{75} = Discharge occurring 75 percent of time. CRP = Construction Reference Plane (Computed Sloping Plane for referencing structure elevations)

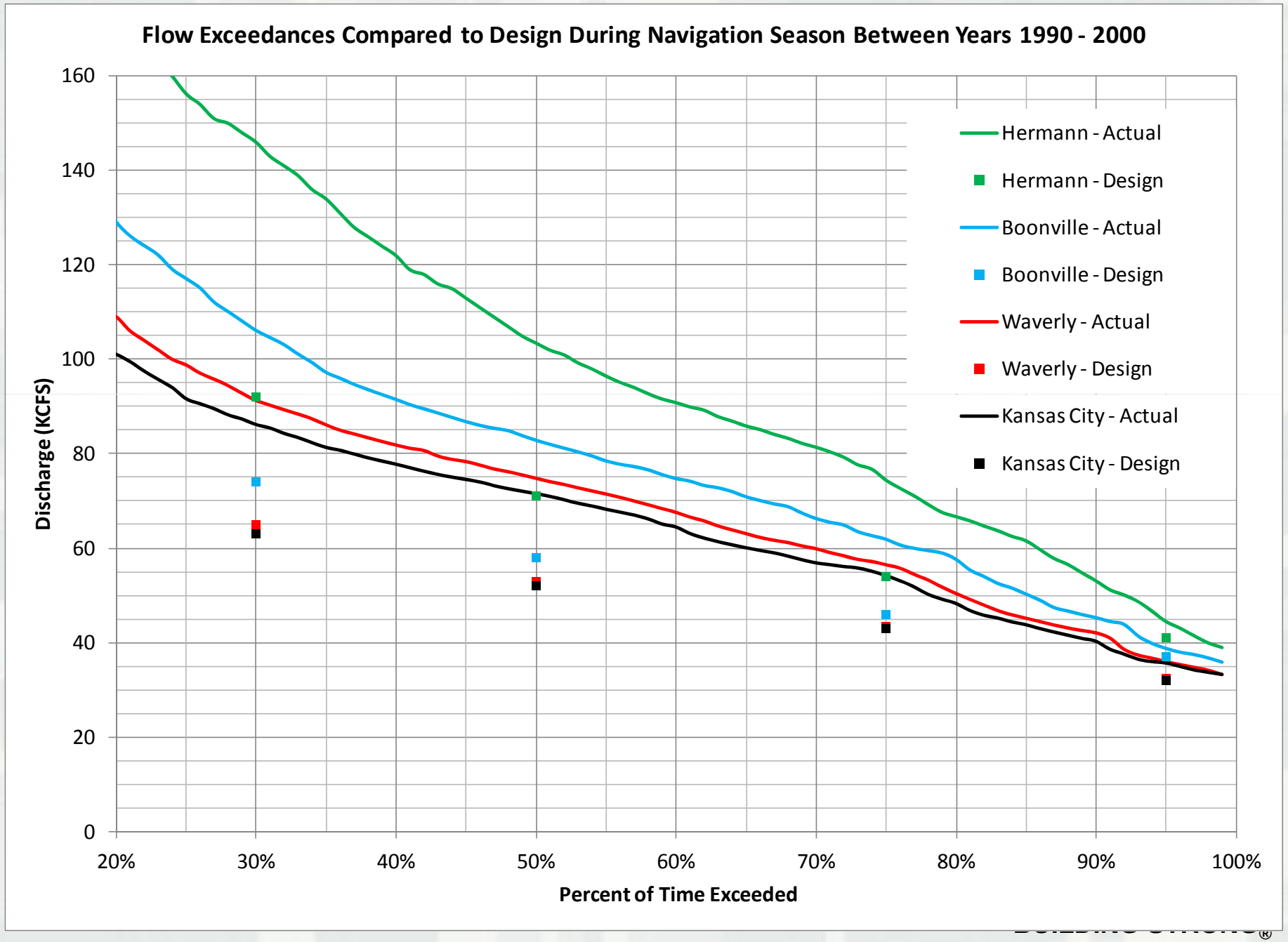
Station	$Q_{75} = Q_{CRP}$	CRP Elev.	Q_{20}	Q_{30}	Q_{50}	$Q_{>95}$
Ponca (754)	30,000	1100.9	37,000	33,000	40,000	25,000
Sioux City (734.8)	30,000	1077.9	37,000	33,000	40,000	25,000
Omaha (615.9)	31,000	964.8	39,000	36,000	43,000	26,000
Rulo (498.0)	36,500	847.9	55,000	50,000	43,000	30,000
St. Joseph (448.2)	37,500	798.4	56,000	52,000	44,000	30,500
Kansas City (366.1)	43,000	721.9	74,000	63,000	52,000	32,000
Waverly (293.4)	43,500	657.0	76,000	65,000	53,000	32,500
Boonville (197.1)	46,000	574.9	88,000	74,000	58,000	37,000
Hermann (97.9)	54,000	489.6	110,000	92,000	71,000	41,000

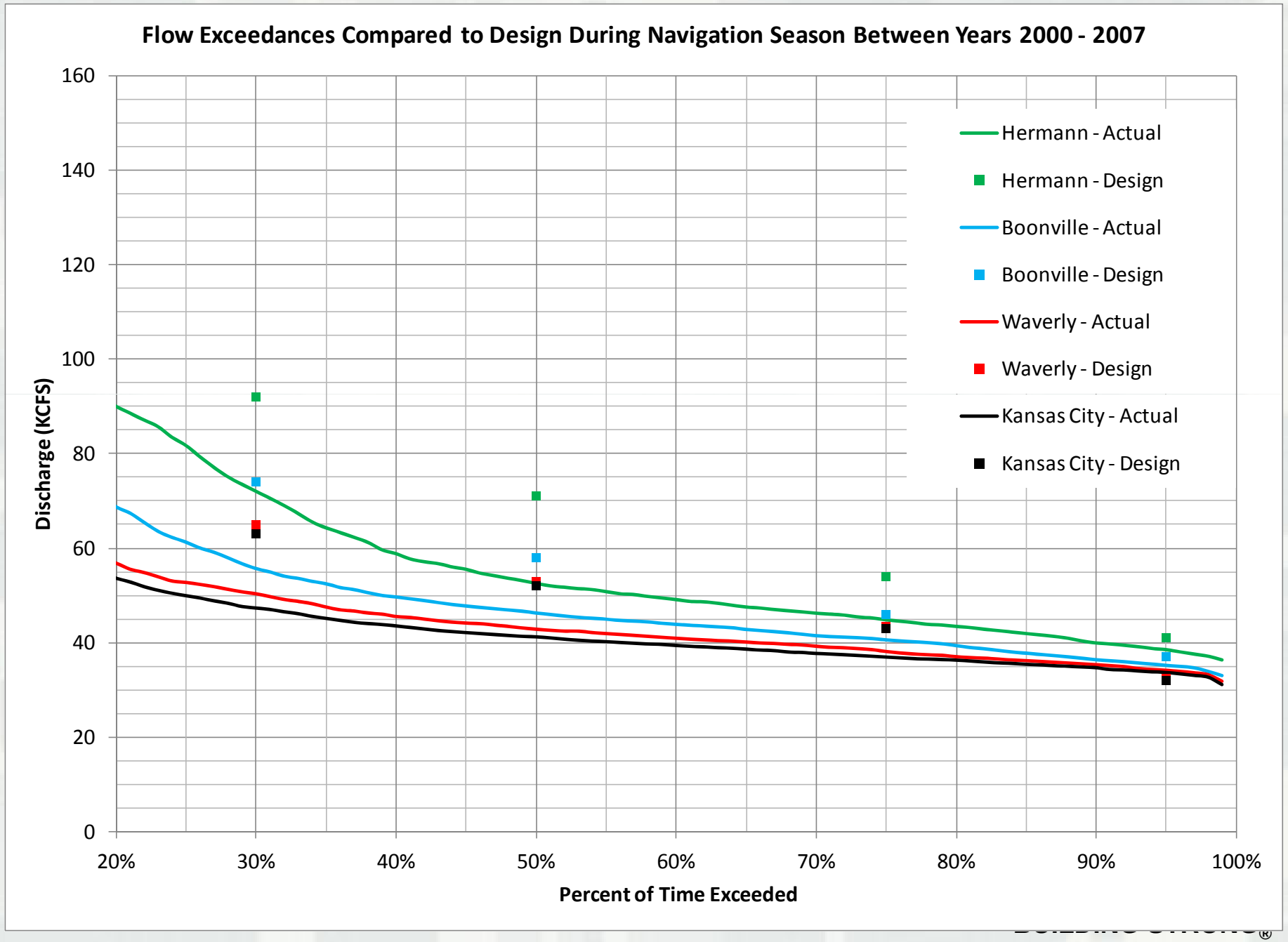
TABLE 8 - STRUCTURE DESIGN CRITERIA (1973)

Excerpts from *Potomology Investigation (Nov 1980) pg*

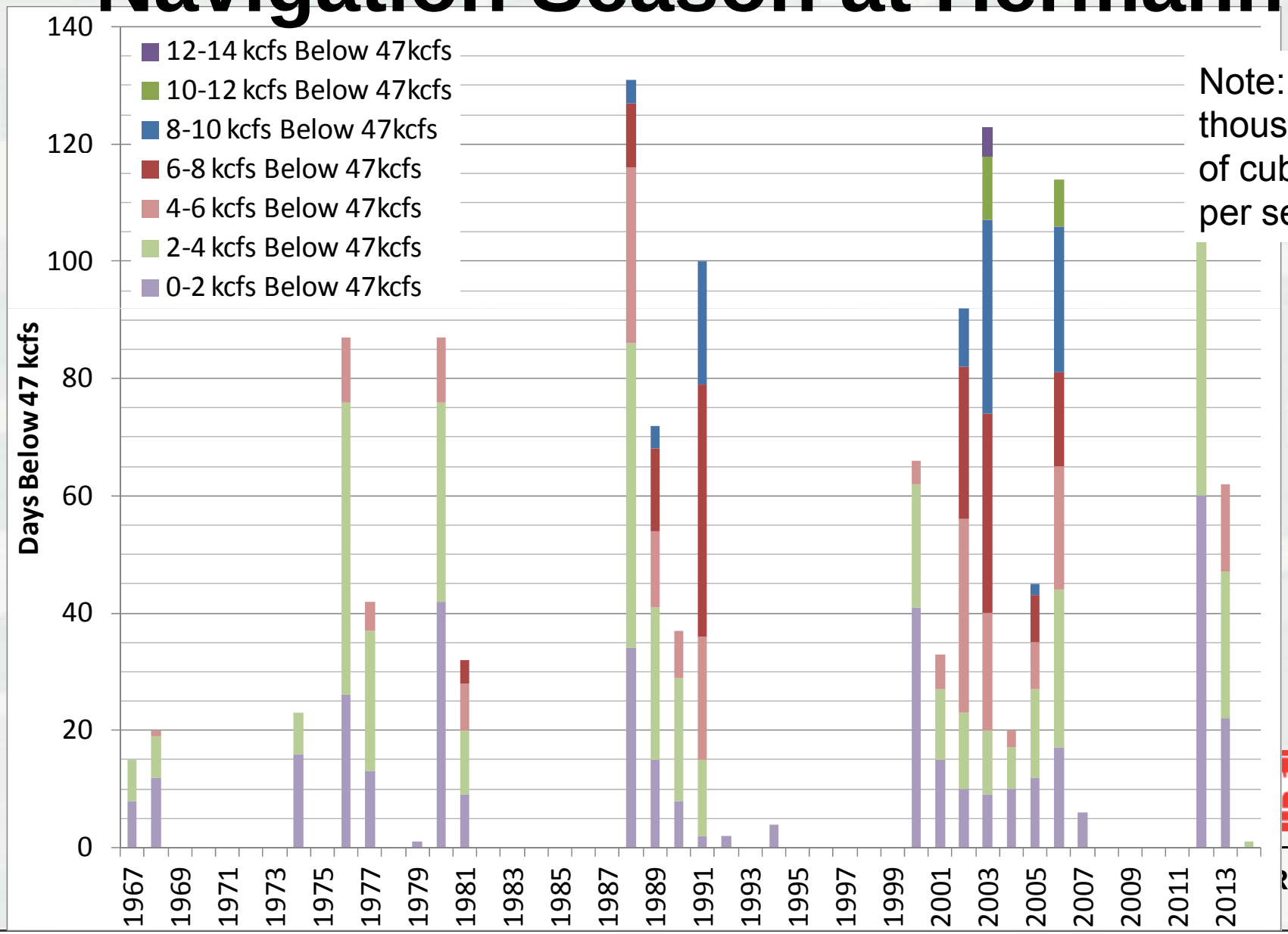

Flow Exceedances Compared to Design During Navigation Season Between Years 1967 - 2014
Discharge (KCFS)
160
140
120
100
80
60
40
20
0
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Exceeded
Hermann - Actual
Hermann - Design
Boonville - Actual
Boonville - Design
Waverly - Actual
Waverly - Design
Kansas City - Actual
Kansas City - Design


Flow Exceedances Compared to Design During Navigation Season Between Years 1967 - 1980
Discharge (KCFS)
160
140
120
100
80
60
40
20
0
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Exceeded
Hermann - Actual
Hermann - Design
Boonville - Actual
Boonville - Design
Waverly - Actual
Waverly - Design
Kansas City - Actual
Kansas City - Design


Flow Exceedances Compared to Design During Navigation Season Between Years 1990 - 2000
Discharge (KCFS)
160
140
120
100
80
60
40
20
0
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Exceeded
Hermann - Actual
Hermann - Design
Boonville - Actual
Boonville - Design
Waverly - Actual
Waverly - Design
Kansas City - Actual
Kansas City - Design


Flow Exceedances Compared to Design During Navigation Season Between Years 2000 - 2007
Discharge (KCFS)
160
140
120
100
80
60
40
20
0
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Exceeded
Hermann - Actual
Hermann - Design
Boonville - Actual
Boonville - Design
Waverly - Actual
Waverly - Design
Kansas City - Actual
Kansas City - Design

Number of Low Flow Days During Navigation Season at Hermann



Note: kcfs is thousands of cubic feet per second

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What's Next

- This issue was more complex than originally anticipated
- Additional analysis/study
  - Continue to review the design criteria to gain better understanding
  - More comprehensive investigation? Missouri River 216 evaluation?