

March 12, 2015

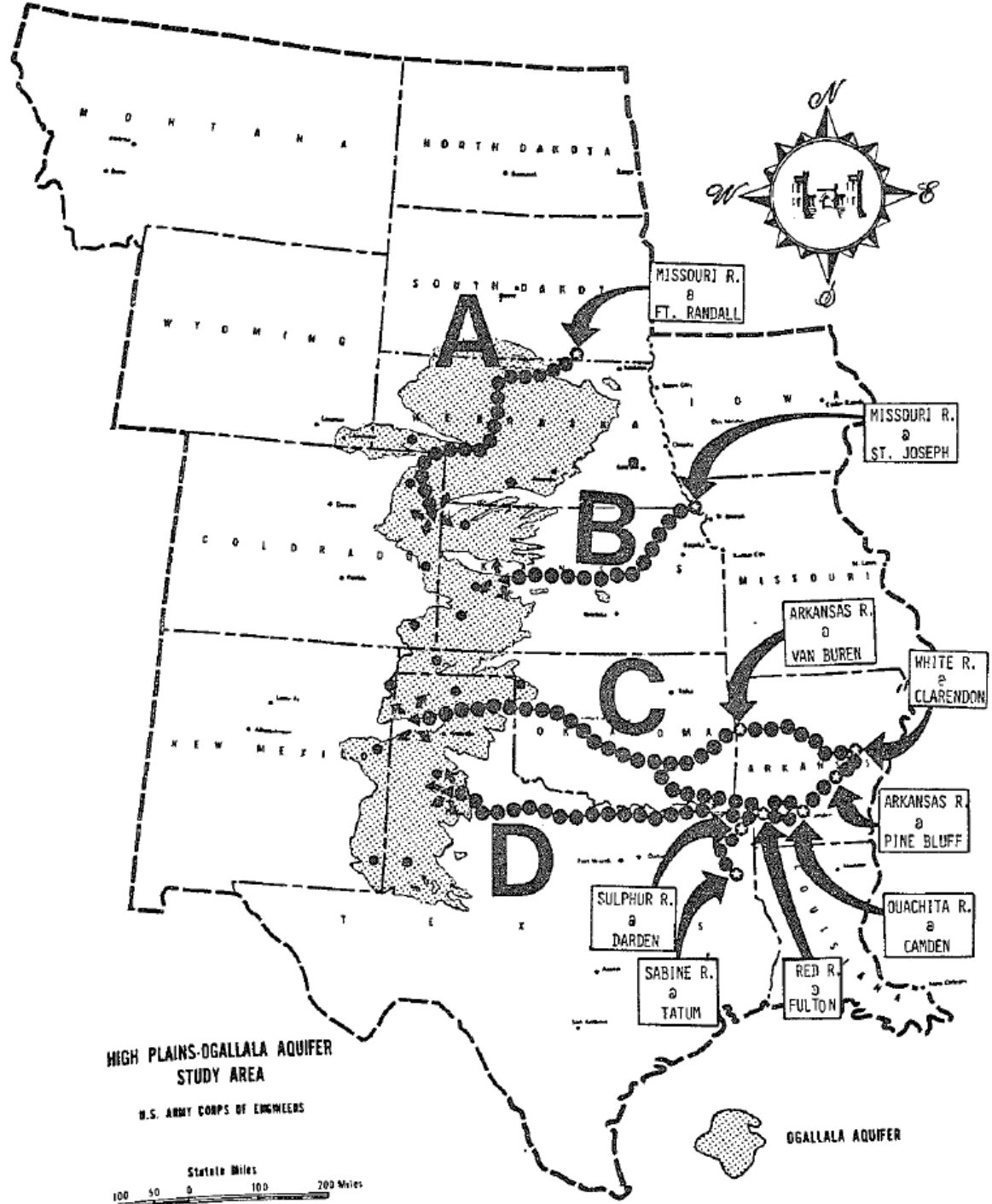
Kansas Aqueduct Study Update

Background – Original Study

- Six-State High Plains-Ogallala Aquifer Regional Resources Study
- US Dept. of Commerce, US Army Corps of Engineers, & States
- Purpose: “Examine feasibility of various alternatives to provide adequate water supplies to assure continued economic growth and vitality of region.”

Original Study Scope

- State-level economic research and projections completed by each state
- Regional economic and policy assessments
- Reconnaissance studies of inter-basin water transfers



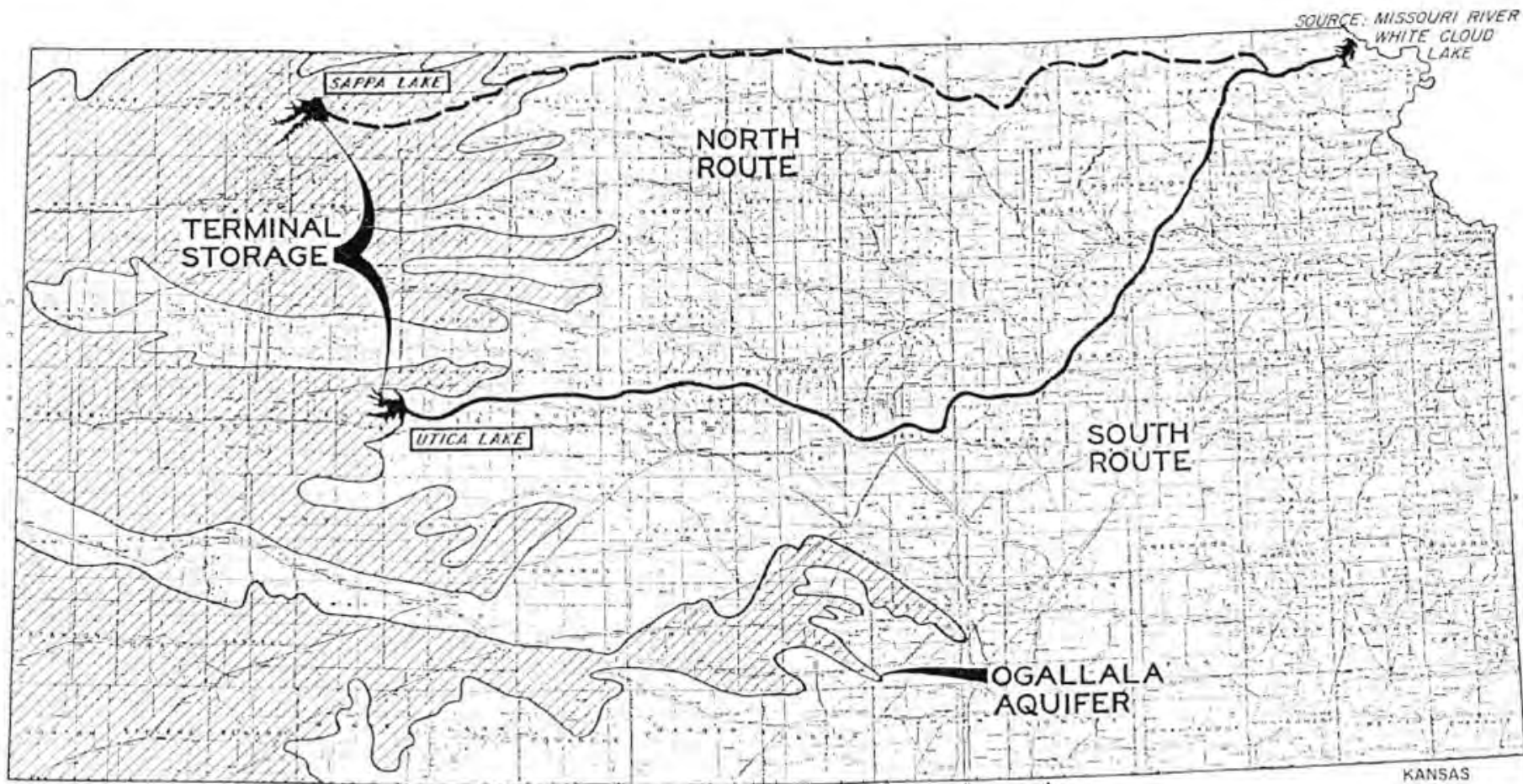


Figure 7
LAYOUT OF TRANSOCO ROUTE
ALTERNATIVE B. (GEO PLANS) STUDY

1982 Alternative Route B Reconnaissance Study

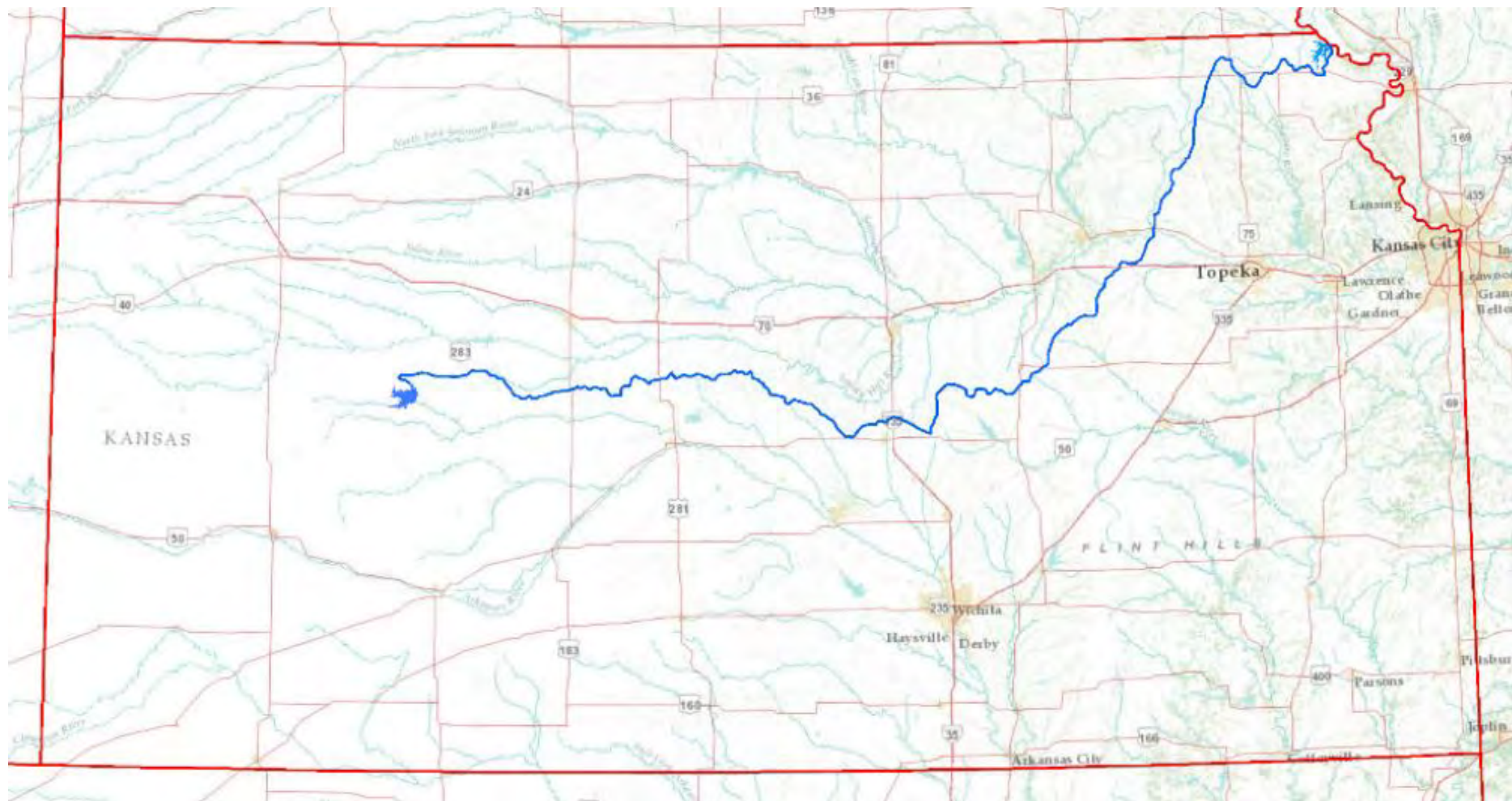


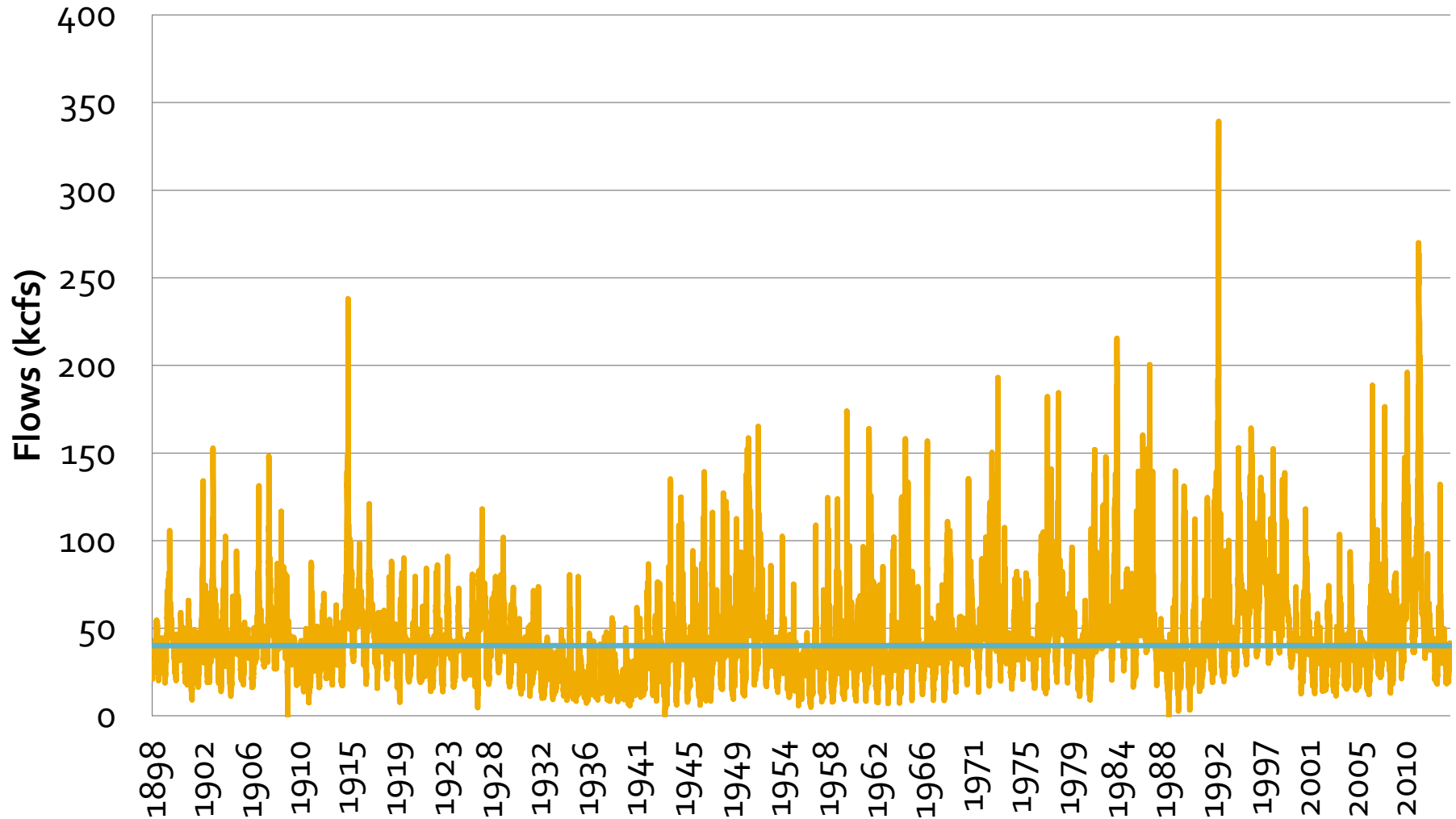
Image courtesy of Southwest Kansas Groundwater Management District



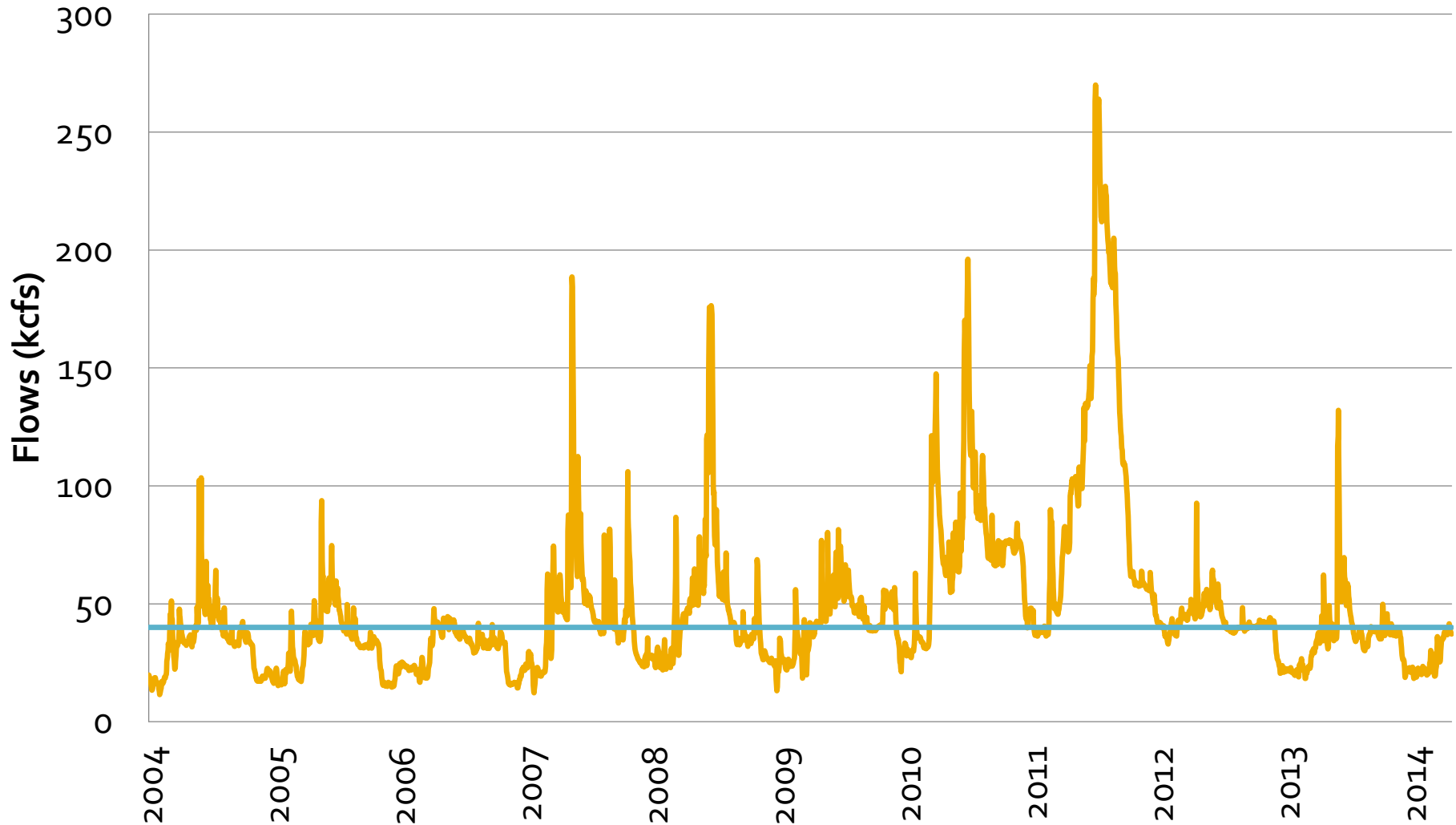
Scope of Study Update

- Water Availability
- Demand Analysis
- Water Transfer System and Alternative Features
- Cost Estimates
- Environmental Constraints
- Legislative and Political Assessment

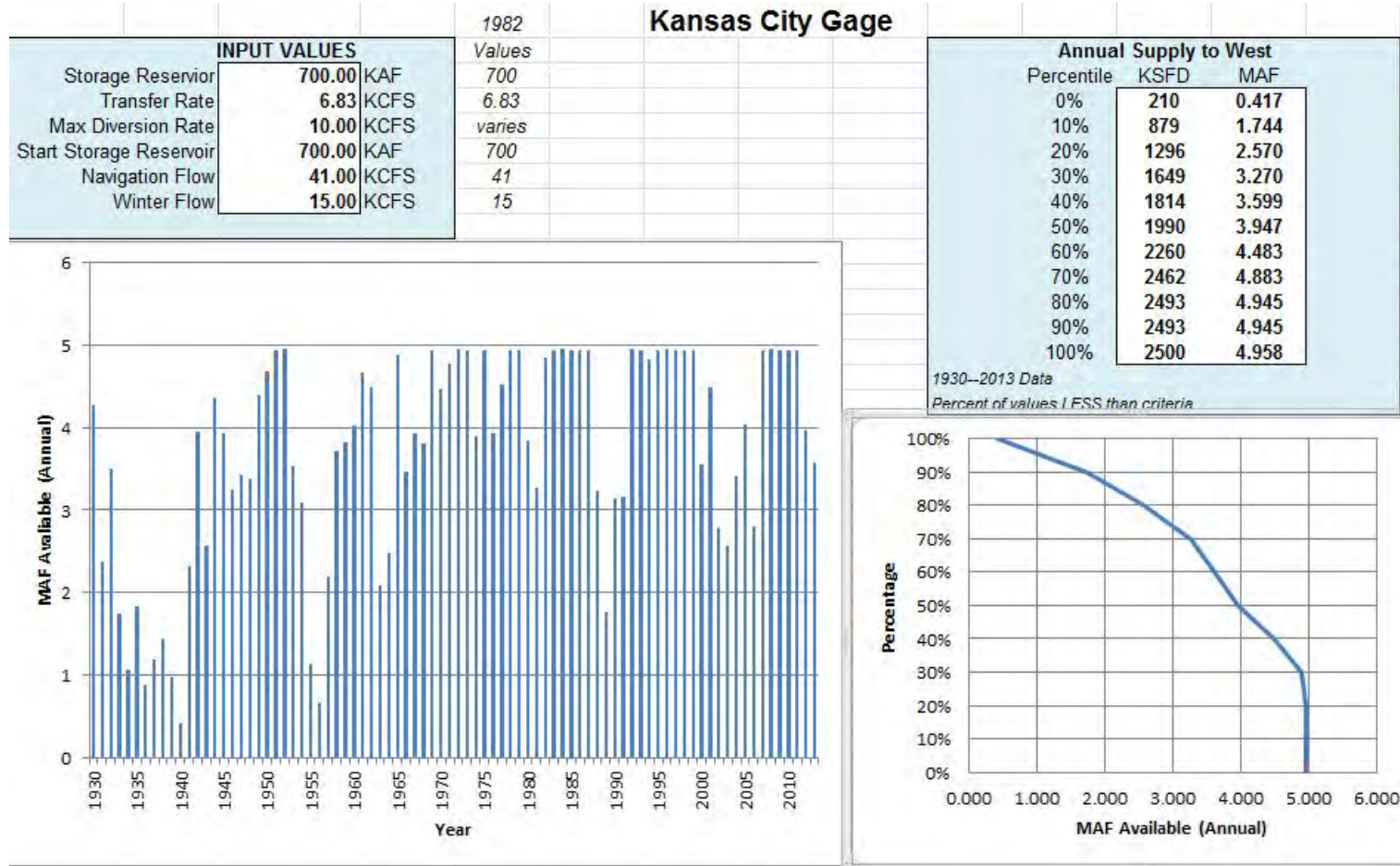
Flows above navigation targets (1898-2014)



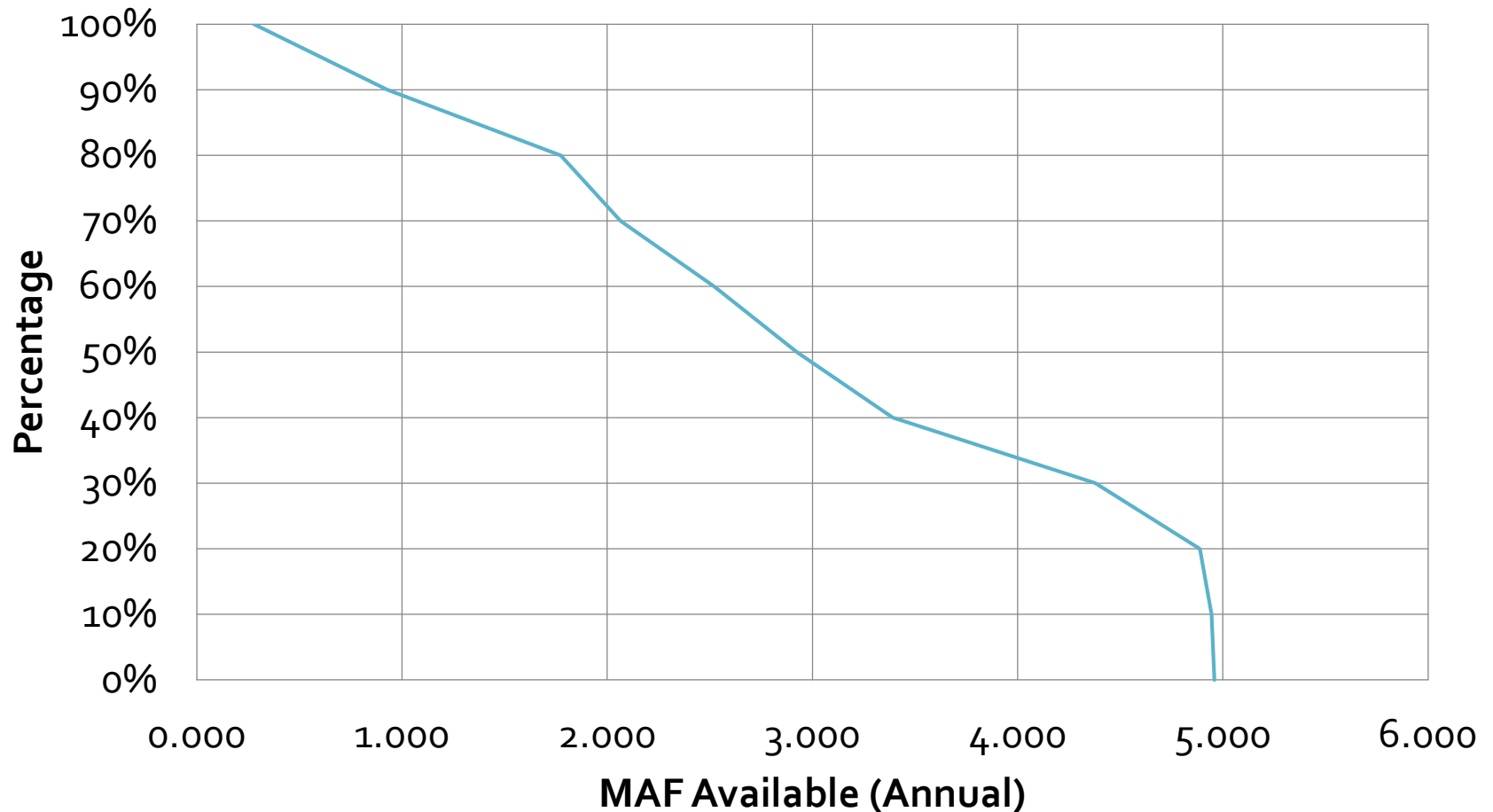
Flows above navigation targets (2004-2014)



Water Availability



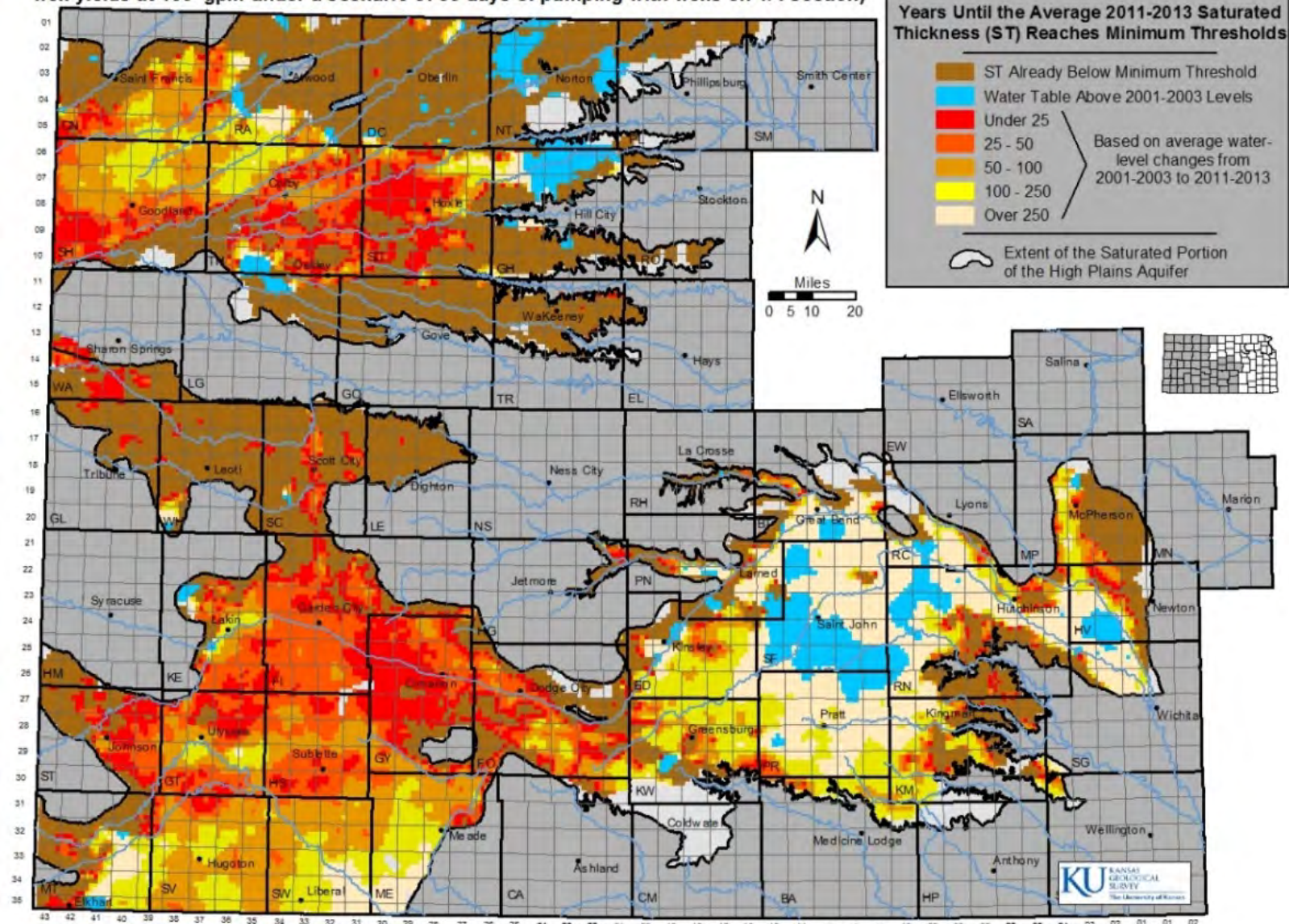
Frequency Distribution



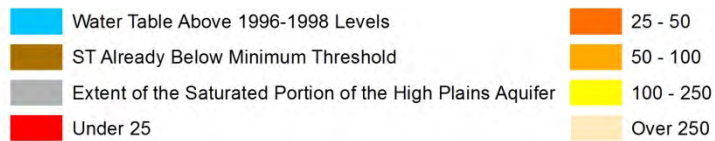
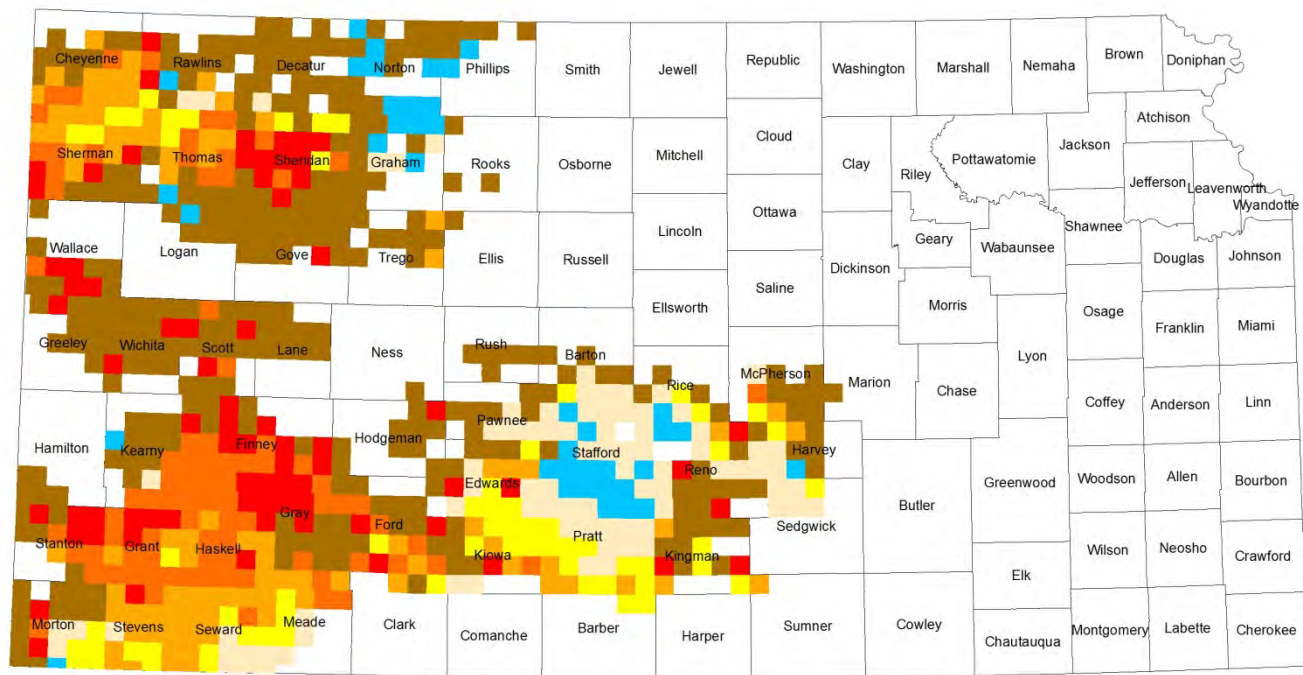
Irrigation Demand Analysis

- Ogallala-High Plains
 - Currently irrigated acres
 - Estimated usable life of aquifer
- Additional demand along aqueduct route
 - Current irrigated acres
 - Current dryland acres

Estimated Usable Lifetime for the High Plains Aquifer in Kansas (Based on ground-water trends from 2001-2003 to 2011-2013 and the minimum saturated thickness required to support well yields at 400 gpm under a scenario of 90 days of pumping with wells on 1/4 section)



Source: Kansas Geological Survey



Average water use 2007-2012 (AF)

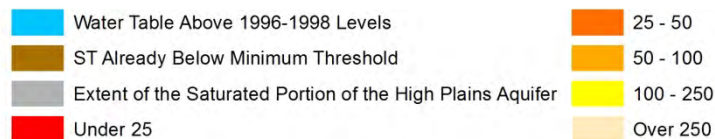
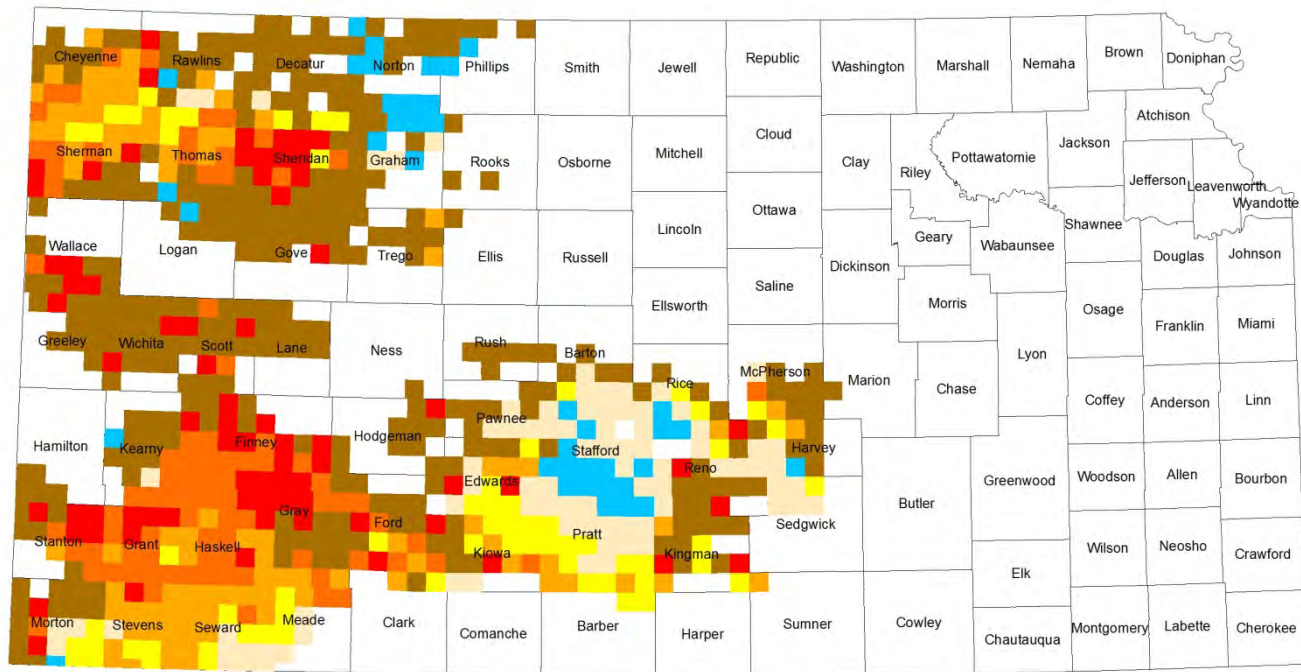


Water Information Management and Analysis System (WIMAS) for the Web

Water Right Information represents conditions as of 07/29/2014.

[WIN](#)

Public Land Survey System:			
Township: Any Township ▼	Range: Any Range ▼	Range Direction: E or W ▼	Section: Any Section ▼
Lat/Long Box (DD, NAD 27):		County Name:	
North Latitude <input type="text"/>		Any County	
West Longitude East Longitude <input type="text"/> <input type="text"/>		Allen Anderson Atchison Barber Barton Bourbon Brown	
South Latitude <input type="text"/>			
Filter By Use Made of Water		Water Right File Number	
<input type="checkbox"/> Domestic <input type="checkbox"/> Municipal		Right Type: <input type="text"/>	
<input type="checkbox"/> Industrial <input type="checkbox"/> Recreation		Vested County Code: <input type="text"/>	
<input type="checkbox"/> Irrigation <input type="checkbox"/> Stockwater		Water Right Number: <input type="text"/>	
		Water Right Qualifier: <input type="text"/>	
		Filter by Source of Water	
		<input checked="" type="radio"/> No Filter	
		<input type="radio"/> Ground	
		<input type="radio"/> Surface	



Years

5

10

25

50

100

Annual AF needed to replace current use

354,420

528,731

1,000,433

1,862,620

2,657,808

Irrigation Demand Analysis

- Ogallala-High Plains
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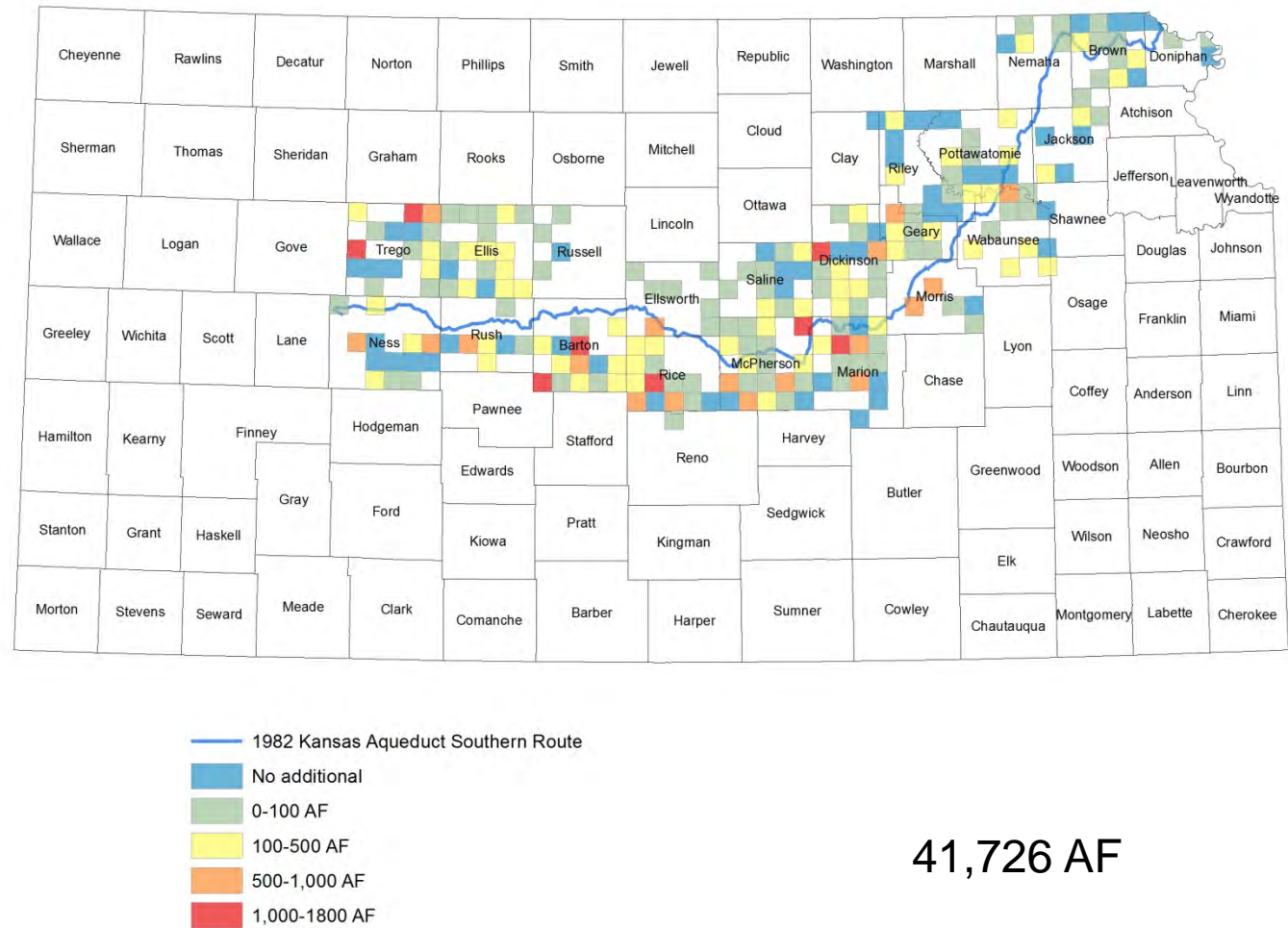
Net Irrigation Requirements

- Water need of specified crop over and above effective rainfall and carryover soil moisture.
- 50 percent chance rainfall (expected to be equaled or exceeded in 5 years out of 10)

K.A.R. 5-5-12. Net irrigation requirements (NIR). The following amounts shall be used as the net irrigation requirements (NIR). County	50% Chance Rainfall
Barton	12.0" = 1.00'
Brown	7.1" = 0.59'
Dickinson	9.4" = 0.78'
Doniphan	7.3" = 0.61'
Ellis	12.2" = 1.02'
Ellsworth	11.5" = 0.96'
Geary	8.4" = 0.70'
Jackson	7.4" = 0.62'
Marion	9.6" = 0.80'
McPherson	10.8" = 0.90'
Morris	8.5" = 0.71'
Nemaha	7.8" = 0.65'
Ness	13.3" = 1.11'
Pottawatomie	8.1" = 0.68'
Rice	11.5" = 0.96'
Riley	8.5" = 0.71'
Rush	12.6" = 1.05'
Russell	11.3" = 0.94'
Saline	10.8" = 0.90'
Trego	12.9" = 1.08'
Wabaunsee	7.8" = 0.65'

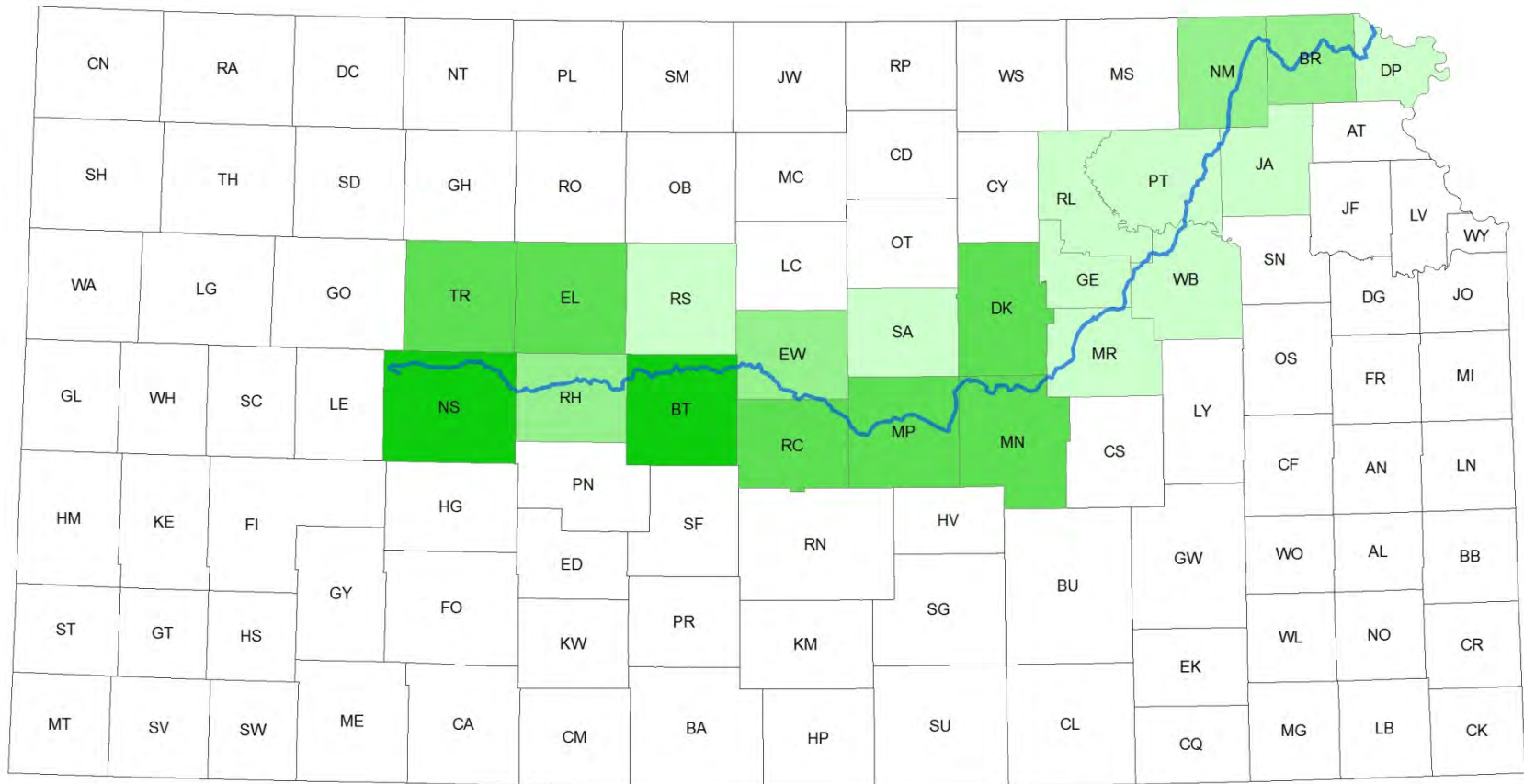
County	Deficit between AVG Use and NIR (AF)
Brown	857
Barton	5,430
Dickinson	3,175
Doniphan	47
Ellis	2,431
Ellsworth	1,203
Geary	1,640
Jackson	747
Marion	3,808
McPherson	4,562
Morris	1,246
Nemaha	245
Ness	2,021
Pottawatomie	1,355
Rice	4,460
Rush	1,323
Riley	405
Russell	145
Saline	848
Trego	4,552
Wabaunsee	1,226

Net difference between NIR requirements and current irrigation application



41,726 AF

NIR Applied to 2012 Dryland Acres



— 1982 Kansas Aqueduct Southern Route

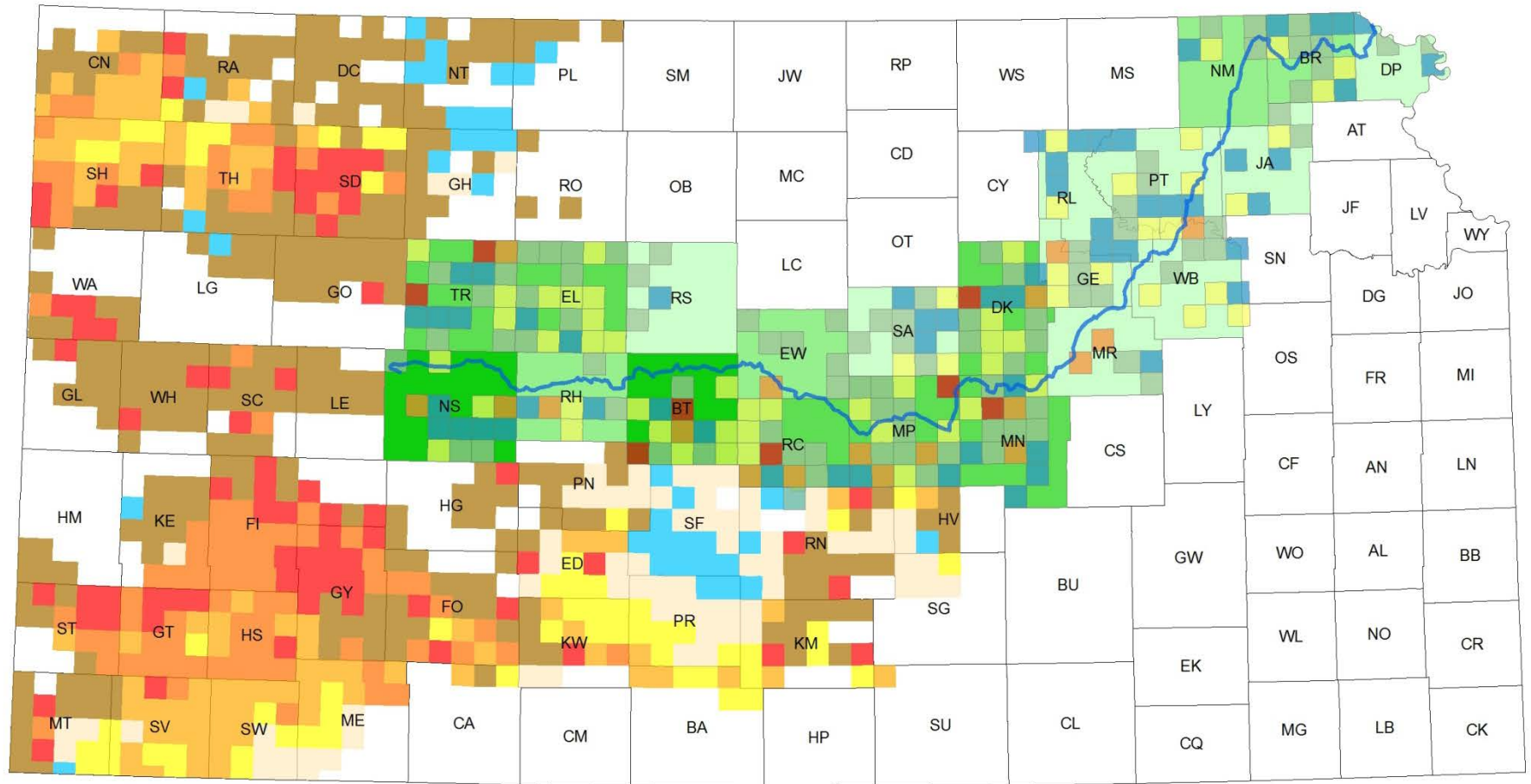
Potential Demand from Added Irrigation



3,791,603 AF

Source: National Agriculture Statistics Service, 2012 Census of Agriculture

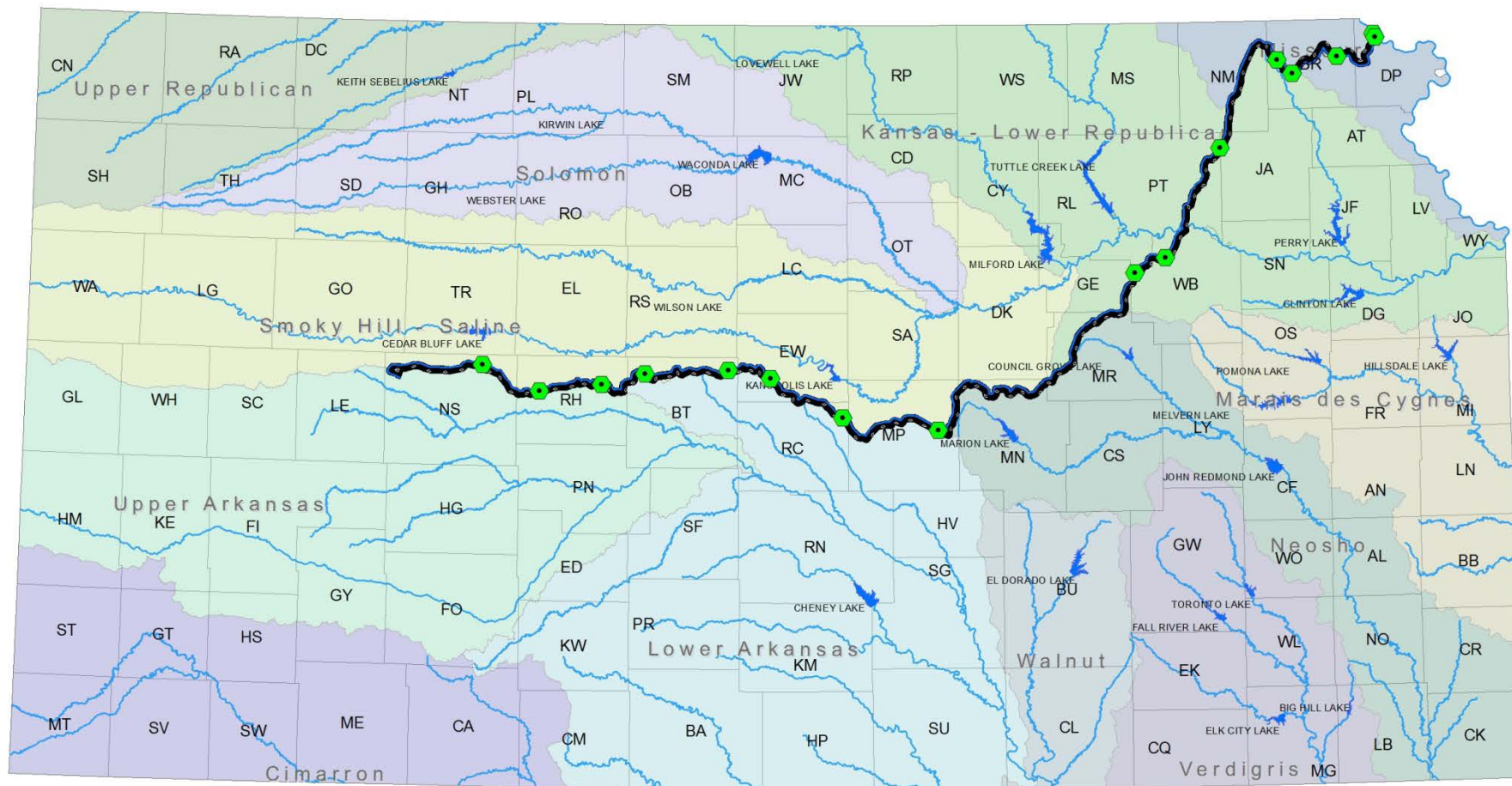
Total Irrigation Demand



Total demand ranges from 4.2-6.5 MAF.

Municipal Demand

- Counties along aqueduct route
 - Population projection trends
 - Average gallon per capita day (GPCD)
- Large municipalities
 - Wichita
 - Hays
 - McPherson
- Drought vulnerable suppliers



- | | | | |
|--|---|---|--|
|  Approximate Pump Locations |  Cimarron |  Missouri |  Upper Arkansas |
|  1982 Route |  Kansas - Lower Republican |  Neosho |  Upper Republican |
|  Federal PWS Reservoirs |  Lower Arkansas |  Smoky Hill - Saline |  Verdigris |
|  Rivers |  Marais des Cygnes |  Solomon |  Walnut |

Kansas Aqueduct Schematic

(Maximum Demand Sizing From 1982 Study)

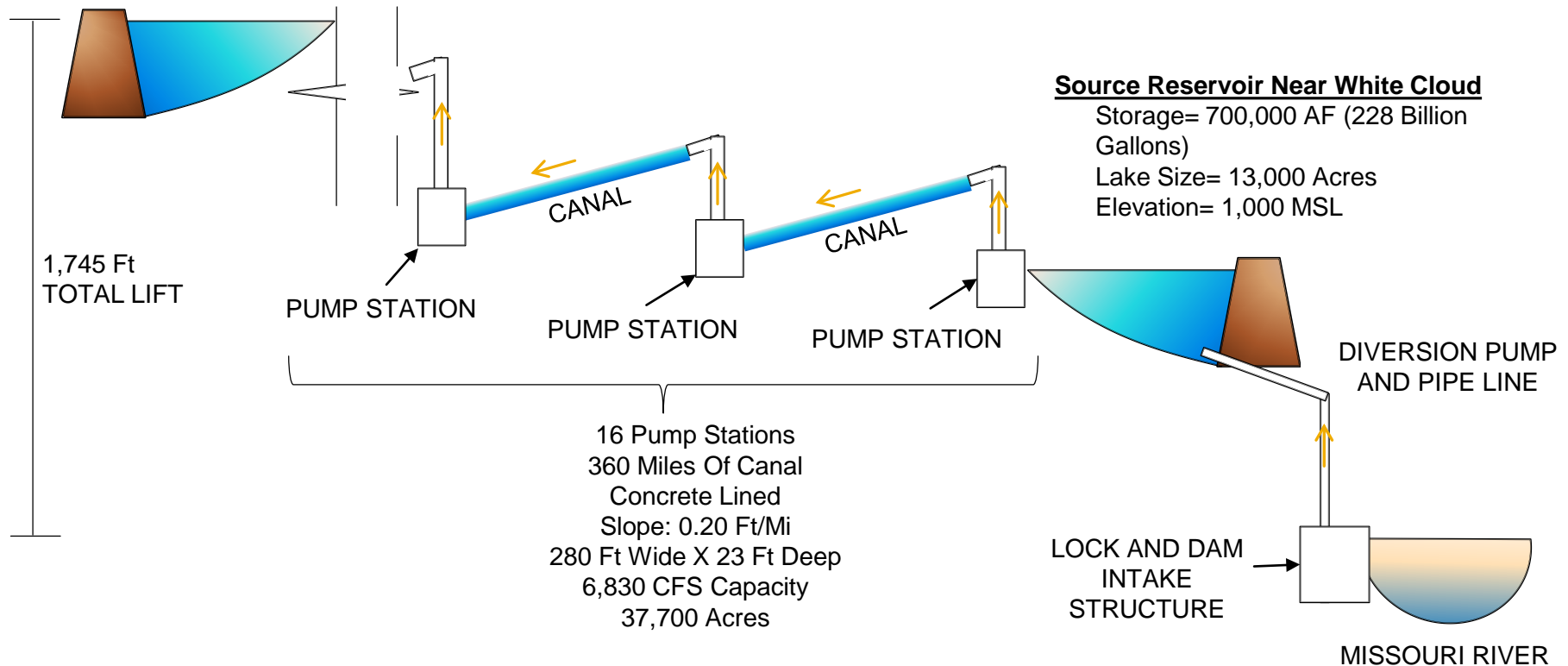
Terminal Reservoir Near Utica

Storage= 1,586,000 AF (517 Billion Gallons)

Lake Size= 25,000 Acres

Elevation= 2,610 MSL

Delivery= 3.4 Million Acre Feet per Year

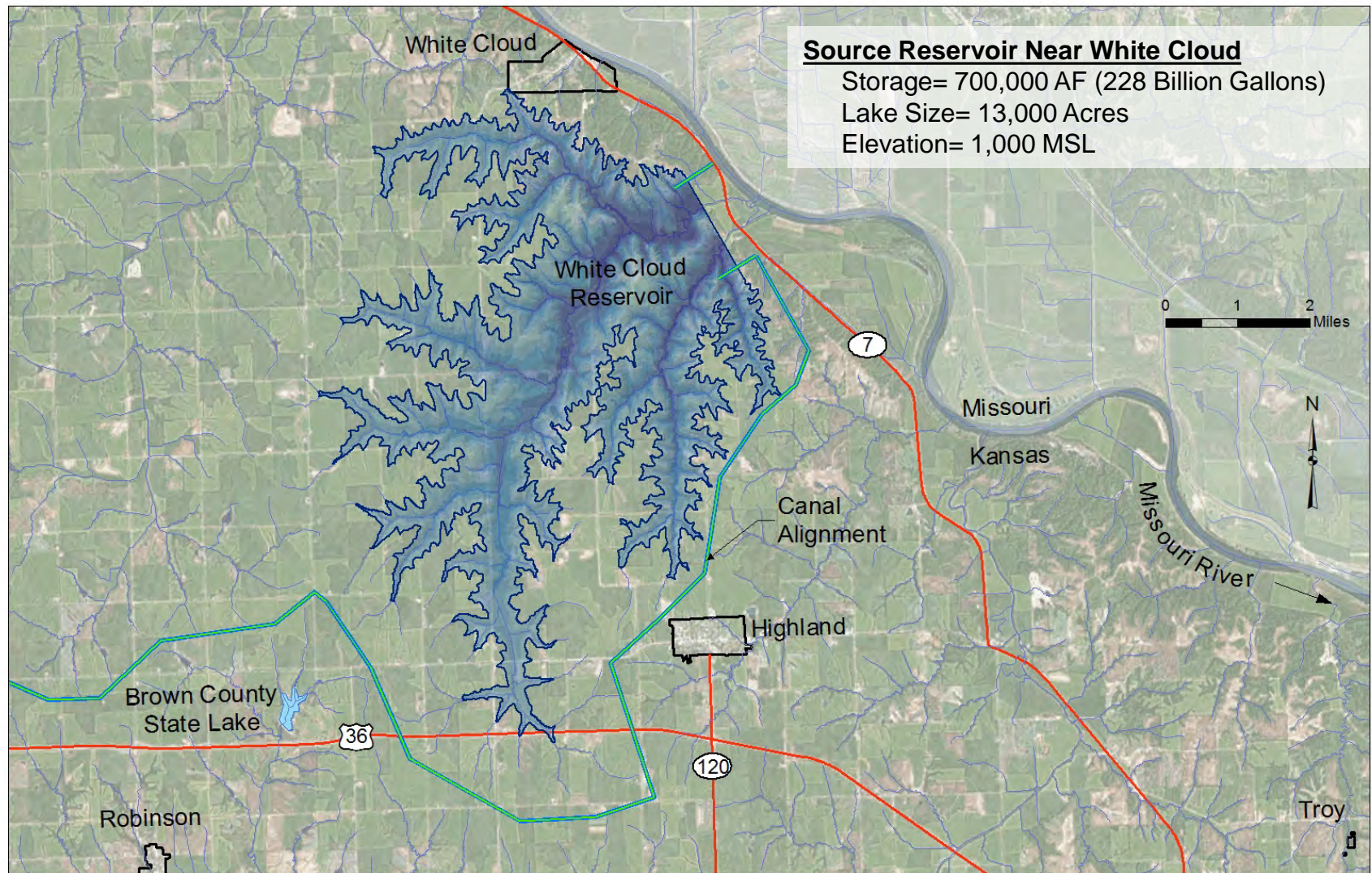


Example Lock & Dam



Lock & Dam 9, Mississippi River
Lynxville, Wisconsin

1982 Source Reservoir Location

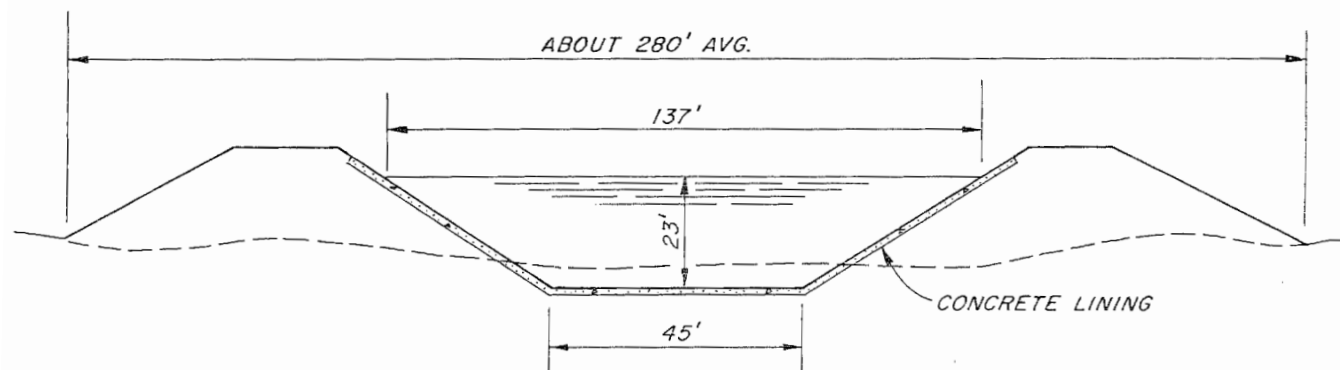


Canal System



PHOTO: CAP Aqueduct

Kansas Aqueduct Canal Sizing



6,830 C.F.S. CANAL

Capacity cfs	Top Width ft	Bottom Width ft	Depth ft
2,000	60	24	12
6,000	126	42	21
10,000	158	54	26

Pumping Plant Example



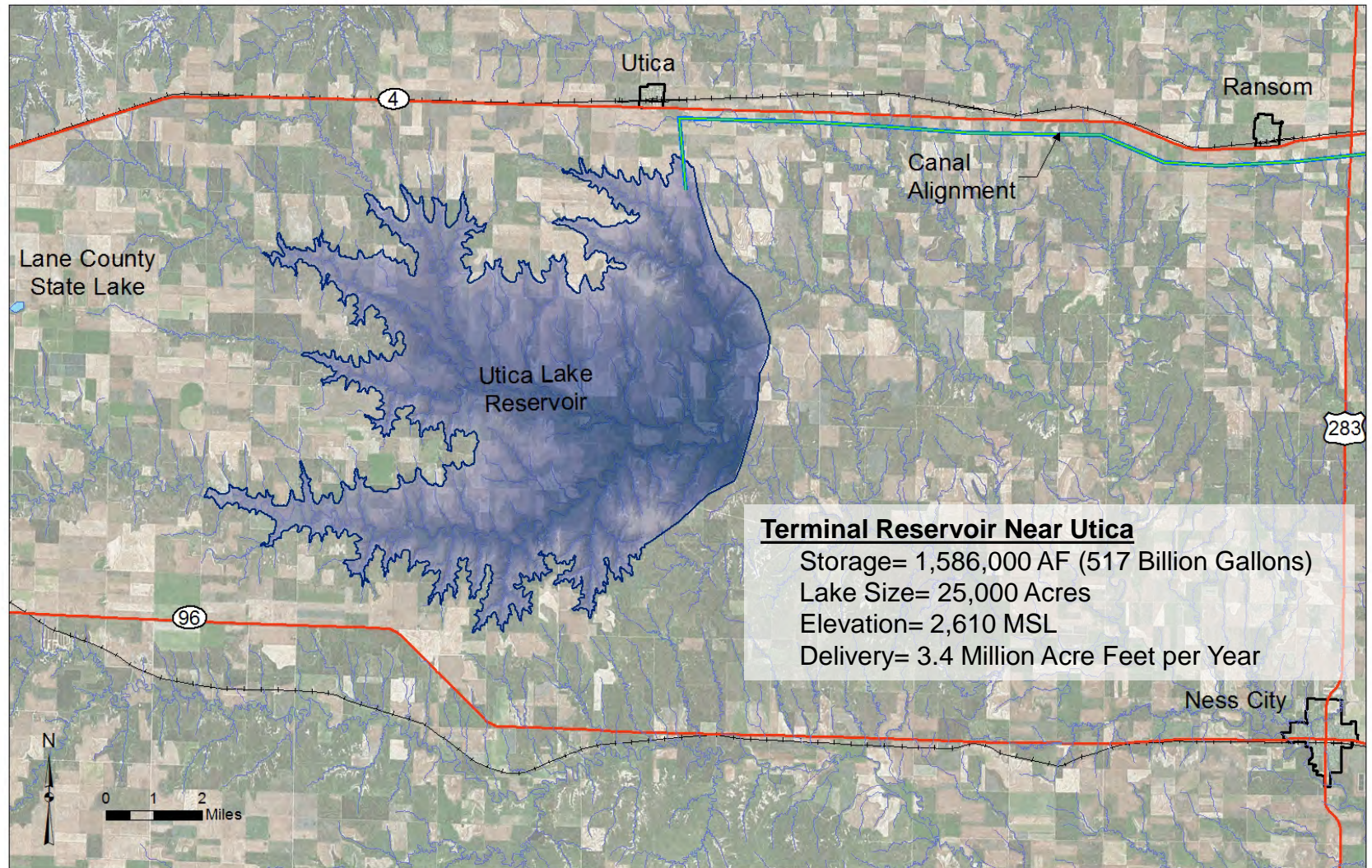
Central Arizona Project

Pumping Plant Example



Central Arizona Project, Mark Wilmer Pumping Plant 1

1982 Terminal Reservoir Location



Preliminary Water Supply Findings

1982 Study Canal Sizing

Transfer Canal Capacity ⁽³⁾	Missouri River Diversion	Average Annual Volume of Water Available ⁽¹⁾	Average Annual Volume of Water Available Including Storage and Canal Limits ⁽²⁾	Average Annual Volume to Farm Headgate ⁽⁴⁾	Annual Volume to Farm Headgate 3 out of 4 years
cfs	cfs	MAF	MAF	MAF	MAF
2,000	10,000	3.7	1.4	1.0	1.0
6,000	20,000	5.8	3.4	2.4	1.8
10,000	30,000	6.9	4.5	3.2	3.1

1) Assumes no limitation on canal transfer or storage and Missouri River flow data from 1898-2013 (POR).

2) Includes source reservoir storage limits (700,000 ac-ft), Missouri River diversion limits and transfer canal limits.

3) Includes 15% down time for maintenance and weather impacts.

4) Includes 10% seepage and evaporation transmission loss from the source reservoir to the terminal storage, 5% evaporation at the source and terminal reservoir and 10% seepage and evaporation from the terminal storage the farm headgate.

Year 2014 Cost Base Projected Investment Costs for Route B Water Transfer System

ITEM DESCRIPTION	ITEM COSTS FOR WATER TRANSFER SYSTEM SIZE		
	2,000 cfs	6,000 cfs	10,000 cfs
Lock & Dam	\$ 0	\$ 269,000,000	\$ 269,000,000
Source Reservoir	\$ 295,000,000	\$ 295,000,000	\$ 295,000,000
Pumping Stations and Power Plant	\$ 1,066,000,000	\$ 4,262,000,000	\$ 8,161,000,000
Canals	\$ 2,325,000,000	\$ 3,905,000,000	\$ 4,993,000,000
Pipelines (conduit)	\$ 551,000,000	\$ 1,380,000,000	\$ 2,262,000,000
Terminal Reservoir	\$ 180,000,000	\$ 459,000,000	\$ 843,000,000
Route Relocations	\$ 351,000,000	\$ 374,000,000	\$ 393,000,000
Automation & Communication	\$ 75,000,000	\$ 75,000,000	\$ 75,000,000
SUBTOTAL CONSTRUCTION	\$ 4,843,000,000	\$ 11,019,000,000	\$ 17,291,000,000
EDSA (@ 11%)	\$ 533,000,000	\$,212,000,000	\$ 1,902,000,000
TOTAL FIRST COSTS	\$ 5,376,000,000	\$ 12,231,000,000	\$ 19,193,000,000
Interest During Construction (20 years)	\$ 2,544,000,000	\$ 5,788,000,000	\$ 9,083,000,000
TOTAL INVESTMENT COSTS	\$ 7,919,000,000	\$ 18,019,000,000	\$ 28,276,000,000

Year 2014 Delivered Water Projected Costs (\$/AF) for Route B Water Transfer System

ANNUAL COST ITEMS	WATER TRANSFER SYSTEM SIZE		
	2,000 cfs	6,000 cfs	10,000 cfs
OMRR&R	\$ 26,626,000	\$ 37,161,000	\$ 44,753,000
Energy Costs	\$ 176,000,000	\$ 395,000,000	\$ 522,000,000
Interest & Amortization	\$ 87,000,000	\$ 652,000,000	\$ 1,024,000,000
TOTAL ANNUAL COSTS	\$489,626,000	\$ 1,084,161,000	\$ 1,590,753,000
Annual Acre-Feet Delivered	1,000,000	2,400,000	3,200,000
TOTAL DELIVERED WATER COSTS (\$/AF)	\$ 490	\$ 452	\$ 497

Legal Issues in obtaining water at the source:

- Missouri River: Compacts between some States; no overall Mo River water allocation
- 28 Tribes - Federal Reserved Water Rights
- States and Tribes allocate in accordance with their laws and rights
- 1944 FCA and Pick Sloan Program

Legal Issues in obtaining water at the source:

- KS Water Appropriation Act:
- KS Water Transfer Act: Extra-ordinary process
- Alternative is some new form of water reservation right

Legal Issues in Transporting and use of water:

- KS Stream Obstruction Act - permitting of dams and stream crossings
- KS Levee Law - requires approval of floodplain fills and modification of levees
- USACE permits needed, Section 10 & CWA 404
- Road, Railroad, Pipeline, & Transmission Line Crossings

Institutional Issues:

- Public entity may be needed to finance, construct, operate and maintain
- Hold water rights and contract with water users for delivery of water
- Bonding, taxing authority and power to purchase or condemn land
- Kansas Turnpike Authority may serve as a conceptual example

General Political Assessment:

- Extensive interstate coordination and public education will be necessary and ongoing
- Opposition may occur from other States and Tribes due to the amount of water involved
- Local or regional opposition in the source/terminal areas
- Landowner opposition if land is taken for reservoir sites and aqueduct right of way
- Opportunities may exist for municipal and industrial, wildlife, recreation and other uses from the project

Environmental Constraints

- NEPA Process
 - Environmental Impact Statement
- Stream Mitigation
- Threatened and Endangered Species
- Water Quality
- Invasive Species

Stream & Wetland Mitigation

- Section 404 of the Clean Water Act requires entities to evaluate impacts to streams and wetlands
- Permittee responsible, mitigation banking, or in-lieu fee
- Recent projects completed in KS- mitigation costs represented anywhere from half to exceeding total construction costs

Threatened & Endangered Species

- Federally listed endangered species on the Missouri River
 - Pallid Sturgeon
 - Piping Plover
 - Least Tern
- Threatened Species in source, terminal, along route:
 - Arkansas Darter
 - Lesser Prairie Chicken

Cultural, Historical & Tribal Resources

- Historic Tribal lands, remains, or cultural objects
- National Historic Preservation Act & Kansas Preservation Act
 - requires State Historic Preservation Office (SHPO) to review projects for potential effects on state's historic and archeological resources

Questions?