

# North Central Planning Region

## REGIONAL DESCRIPTION

Garfield, Grant, Kay, Kingfisher, Lincoln, Logan, Noble, Pawnee and Payne County comprise the North Central Planning Region (Figure 25). Covering 7,689 square miles, the region is drained by the Cimarron, Chikaskia, Salt Fork of the Arkansas and the Arkansas Rivers. The topography of this region ranges from the densely forested east to the sand hills of the western portion of the region. Elevations range from 850 to 1,100 feet above mean sea level.

This region encompasses 10.8 percent of the total land area of the state, with approximately one-half of the region consisting of pastureland or cropland. The region's climate is moist and subhumid with a mean annual temperature ranging from 60 to 61 degrees. Annual lake evaporation, which exceeds precipitation, ranges from 62 inches in the west to 55 inches in the east. Rainfall peaks in the spring and fall with May being the wettest month of the year. Annual precipitation ranges from 28 inches in the west to 36 inches in the east portion of the region, including an average annual snowfall of 14 inches. Frequent droughts cause severe crop damage while severe flooding occurs as a result of concentrated, heavy precipitation. Thunderstorms -- accompanied by high winds, hail and heavy rain -- increase the likelihood of flash flooding and emphasize the need for watershed protection and flood prevention projects.

## WATER RESOURCES

### *Stream Water*

Table 16 summarizes the stream water sources of the North Central Planning Region. The three major stream systems in this region are the Cimarron, Salt Fork of the Arkansas and Arkansas Rivers. Water quality in these streams is generally of poor quality and unsuitable for most uses, a factor which has limited surface water development in the region.

The Salt Fork of the Arkansas River and Cimarron River Basins include areas containing large gypsum deposits. Natural brine seeps and springs, which are found throughout the region, contribute large

quantities of chlorides to streams and make the water unsuitable for irrigation, industrial and commercial purposes. Water in both rivers is very hard with high pH levels, dissolved oxygen levels near saturation, and moderate turbidity. In the Salt Fork of the Arkansas River, levels of heavy metals (i.e., chromium, lead and mercury) exceed allowable standards. The Cimarron River contains elevated levels of iron, manganese, lead, silver, cadmium and arsenic.

The quality of the Arkansas River, which forms part of the eastern boundary of the region, is affected by highly mineralized water from major tributaries and by oilfield activities, agriculture and municipal wastewater discharges. Downstream of Keystone Lake, chemical pollutants -- such as pesticides, organic compounds and pathogenic indicators -- have been detected.

### *MAJOR RESERVOIRS*

There are two major impoundments in the North Central Planning Region. The largest is Keystone Lake, located on the mainstem of the Arkansas River, approximately 15 miles west of Tulsa. Completed by the Corps in 1964, Keystone Lake has a drainage area of 74,506 square miles and is authorized for flood control, water supply, hydroelectric power, navigation, and fish and wildlife purposes. The lake contains 1,167,232 ac-ft of flood control storage, 267,122 ac-ft of power storage, and 20,000 ac-ft of water supply storage. The water supply yield is 22,400 af/yr (19.94 mgd). The two 35,000-kW power generating units became operational in May 1968 and produce an energy output of 228,000,000 kWh annually. Water is released for power generation and at other intervals to aid navigation on the McClellan-Kerr Arkansas River Navigation System. Poor water quality in Keystone limits beneficial uses, although the lake is an important recreational facility for residents and tourists in the North Central Region.

Kaw Lake is also located on the mainstem of the Arkansas River, approximately eight miles east of Ponca City, in Kay County. This Corps project, completed in 1976, has a drainage area of 46,530 square miles and is authorized for flood control, water supply, water quality, recreation, and fish and wildlife purposes. A powerhouse substructure, intake mono-

lith and penstock were incorporated into the spillway even though power is not an authorized purpose. The generating facilities were completed and power generation began in August 1989. The lake contains 867,310 ac-ft of flood control storage and 203,000 ac-ft of water supply and water quality storage. The water supply yield, including water quality storage, is 230,720 af/yr (205.34 mgd). Water quality in the reservoir is fair and suitable for most uses.

### *MAJOR MUNICIPAL LAKES*

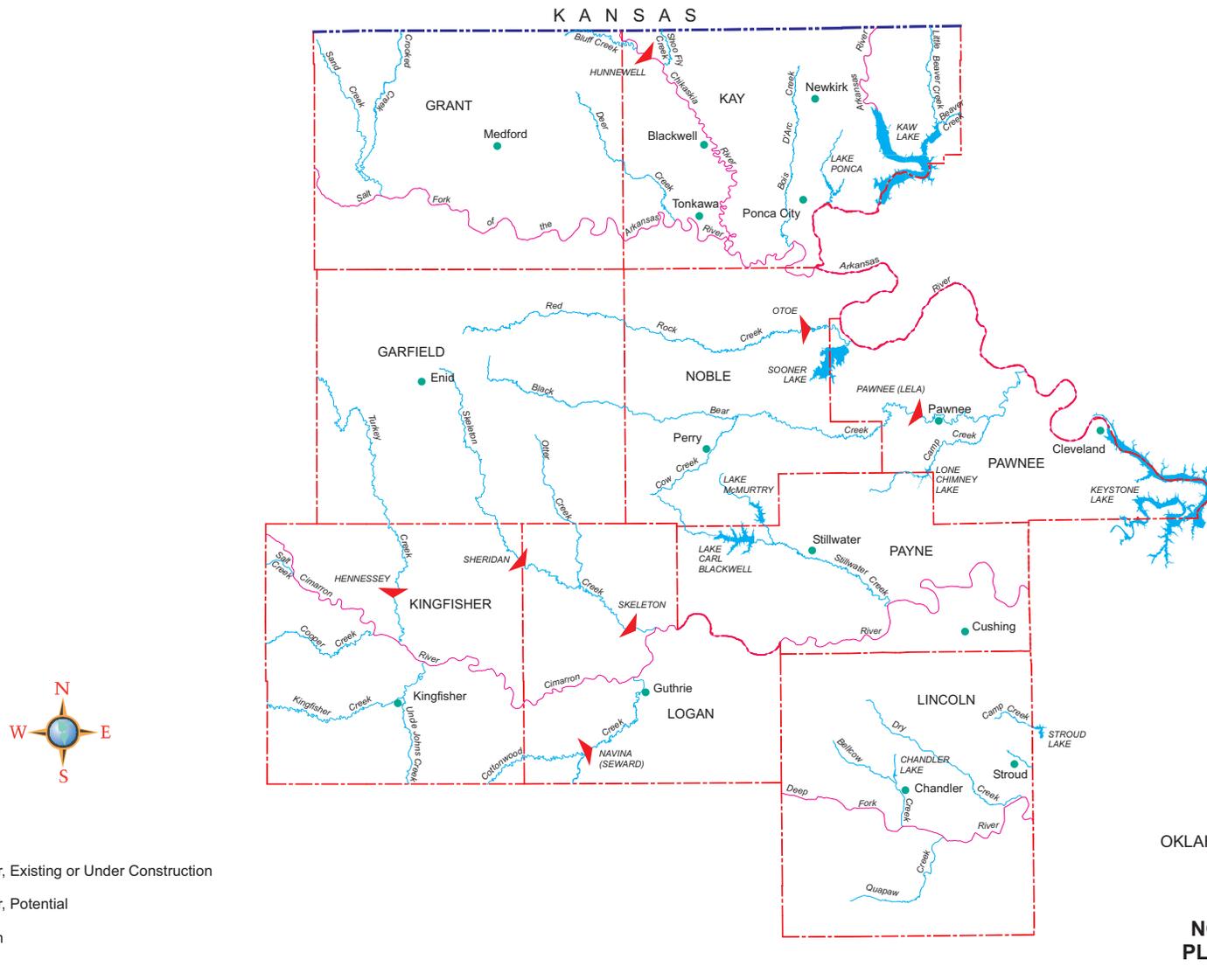
Lake Carl Blackwell, a water supply and recreation lake completed in 1937, is located on Stillwater Creek in Payne and Noble Counties. It is owned and operated by Oklahoma State University and contains 61,500 ac-ft of water supply storage with an annual yield of 7,000 ac-ft (6.23 mgd). OSU uses water supply from the lake and sells water to the City of Stillwater for municipal and industrial uses.

Chandler Lake (SCS Site 1M) is a water supply and recreation lake completed in 1954. It is owned and operated by the City of Chandler in Lincoln County. The lake is located on Bellcalf Creek and contains 2,778 ac-ft of water supply storage with a yield of 4,558 af/yr (4.06 mgd).

Lone Chimney Lake (Lower Black Bear Creek Site 19M) is owned and operated by Tri-County Development Authority. Constructed for water supply, flood control and recreation, the lake was completed in 1984. Lone Chimney Lake is located on Camp Creek in Pawnee and Payne Counties and contains 6,200 ac-ft of water supply storage with a yield of 2,509 af/yr (2.23 mgd).

Lake McMurtry (Stillwater Creek Site 40), a water supply, flood control and recreation lake completed in 1971, is owned and operated by the City of Stillwater. The lake is located on North Stillwater Creek in Noble County and contains 5,000 ac-ft of flood control storage and 13,500 ac-ft of water supply storage. The water supply yield is 3,002 af/yr (2.67 mgd).

Lake Ponca is a water supply and recreation lake owned and operated by the City of Ponca City. The lake was constructed in 1935 on Big and Little Turkey Creeks in Kay County. Lake Ponca contains 14,400 ac-ft of water supply storage with a yield of 9,000 af/yr (8.01 mgd). The City of Ponca City combines lake water with groundwater to meet the city's water supply needs.



OKLAHOMA COMPREHENSIVE WATER PLAN

**Figure 25  
NORTH CENTRAL  
PLANNING REGION**

Sooner Reservoir, a cooling water lake completed in 1972, is owned and operated by Oklahoma Gas and Electric Company. The lake is located on Greasy Creek in Pawnee County and contains 47,500 ac-ft of flood control storage and 149,000 ac-ft of water supply storage. The water supply yield of 3,600 af/yr (3.20 mgd) could be developed from the drainage basin. Releases from Kaw Reservoir are diverted into Sooner Lake for additional cooling water.

Stroud Lake (Salt-Camp Creek Site 12) is owned and operated by the City of Stroud. Completed in 1968, authorized uses include water supply, flood control and recreation. The lake is located on Camp Creek in Creek and Lincoln Counties and has a water supply yield of 1,299 af/yr (1.16 mgd).

**OTHER IMPOUNDMENTS**

Other significant municipal lakes include Liberty Lake (2,740 ac-ft of approx-

imate conservation storage), Guthrie Lake (3,875 ac-ft), Boomer Lake (3,200 ac-ft), Cushing Municipal Lake (3,304 ac-ft), Meeker Lake (1,818 ac-ft), Perry Lake (6,892 ac-ft), Pawnee Lake (3,855 ac-ft) and Cleveland City Lake (2,200 ac-ft). Other small municipal and private lakes also exist in the North Central Planning Region. The NRCS has 28 impoundments in this region for watershed protection and flood prevention.

**AUTHORIZED DEVELOPMENT**

There are no major authorized water supply projects in the North Central Planning Region.

**POTENTIAL DEVELOPMENT**

The potential for stream water development within this region is generally limited to tributary streams due to the poor water quality of the region's major streams. Seven potential sites have been previously identified.

Hennessey Lake is a potential impoundment on Turkey Creek, in Kingfisher County, and is anticipated to supply a combination of agricultural and M&I uses. The project would encompass a drainage area of 291 square miles with a conservation pool of 7,700 acres. It would contain 82,000 ac-ft of flood storage, 130,000 ac-ft of conservation storage, and have a water supply yield of 18,800 af/yr (16.8 mgd). The water quality in this impoundment should be suitable for all uses.

Navina Lake (sometimes called Seward) is proposed on Cottonwood Creek in Logan County. Much of the interest in this impoundment comes from other planning regions. Potential users of this project include Oklahoma City, Kingfisher and Okarche. Navina would encompass a drainage area of 229 square miles with a conservation pool of 7,000 acres. It would contain 111,846 ac-ft of conservation storage with a yield of 34,600 af/yr (30.9 mgd). The quality of water in this impound-

Table 16  
STREAM WATER DEVELOPMENT  
North Central Planning Region

PROJECT	STREAM	PURPOSE*	FLOOD CONTROL STORAGE (acre-feet)	WATER SUPPLY STORAGE (acre-feet)	WATER SUPPLY YIELD (ac-ft/year)
<b>EXISTING OR UNDER CONSTRUCTION</b>					
Carl Blackwell	Stillwater Creek	ws, r	---	61,500	7,000
Chandler (SCS-1M)	Bellcalf Creek	ws, r	---	2,778	4,558
Kaw	Arkansas River	ws, fc, wq, r, fw	867,310	203,000 <sup>1</sup>	230,720 <sup>1</sup>
Keystone	Arkansas River	ws, fc, p, fw, n	1,167,232	20,000 <sup>2</sup>	---- <sup>3</sup>
Lone Chimney (SCS-19M)	Camp Creek	ws, r	---	6,200	2,509
McMurtry (SCS-40)	North Stillwater Creek	ws, fc, r	5,000	13,500	3,002
Ponca	Big and Little Turkey Creeks	ws, r	---	14,440	9,000
Sooner	Greasy Creek	fc, p, r	47,500	149,000	3,600 <sup>4</sup>
Stroud	Camp Creek	ws, r	---	---	1,299
<b>TOTAL</b>			<b>2,087,042</b>	<b>470,418</b>	<b>261,688</b>
<b>POTENTIAL</b>					
Hennessey	Turkey Creek	ws, r, fw, i	82,000	130,000	18,800
Hunnewell	Chikaskia River	ws, fc, r, i	112,000	473,400	54,700
Navina (Seward)	Cottonwood Creek	ws, fc, r	---	111,846	34,600
Otoe	Red Rock Creek	ws, fc, r, i	142,000	403,300	46,000
Pawnee (Lela)	Black Bear Creek	ws, fc, r	190,000	210,350	48,200
Sheridan	Skeleton Creek	ws, fc, r, i	92,500	127,600	23,500
Skeleton	Skeleton Creek	ws, fc	72,100	250,000	41,500
<b>TOTAL</b>			<b>618,500</b>	<b>1,456,496</b>	<b>267,300</b>
<b>TOTAL YIELD</b>					<b>528,988</b>

\*ws-municipal water supply, fc-flood control, wq-water quality, p-power, r-recreation, fw-fish and wildlife, i-irrigation, n-navigation.

<sup>1</sup> Includes 31,800 ac-ft for water quality control storage which yields 43,680 af/yr and 171,000 ac-ft for water supply.

<sup>2</sup> Does not include 267,122 ac-ft of power storage.

<sup>3</sup> Water supply yield of 22,400 af/yr allocated to Northeast Planning Region.

<sup>4</sup> Includes 128,000 ac-ft of inactive storage which is utilized as a heat sink for cooling by Oklahoma Gas & Electric's generating station. Listed yield is developed locally from Greasy Creek Basin and does not include releases from Kaw Lake.

ment should be suitable for all uses.

Pawnee Reservoir (or Lela) is a potential lake on Black Bear Creek in Pawnee County. The project is anticipated to encompass a drainage area of 545 square miles with a conservation pool of 10,000 acres. It would contain 190,000 ac-ft of flood control storage and 210,350 ac-ft of conservation storage with a water supply yield of 48,200 af/yr (43 mgd). Although chloride concentrations in Black Bear Creek have typically exceeded EPA criteria by about 20 percent, water quality in this impoundment should be suitable for all uses.

Sheridan Lake is a proposed reservoir in Kingfisher County that has been studied as a municipal and industrial supply. The project encompasses a drainage area of 299 acres with a conservation pool of 9,100 acres. It would contain flood control storage of 92,500 ac-ft, conservation storage of 127,600 ac-ft, and a water supply yield of 23,520 af/yr (21 mgd). Water quality in this impoundment would probably meet most raw water criteria. However, petroleum-related quality problems have occurred in the area and agricultural runoff (fertilizers) may cause algal

blooms, affecting taste and odor.

Skeleton Lake, proposed on Skeleton Creek in Logan County, has been studied as a municipal and industrial water supply. The project encompasses a drainage area of 547 square miles with a conservation pool of 14,000 acres. It would contain 72,100 ac-ft of flood control storage, 250,000 ac-ft of conservation storage, and a water supply yield of 41,500 af/yr (37 mgd).

Hunnell, in northwest Kay County, and Otoe, in Noble County, are the other potential lake sites identified within the North Central Region. While these sites remain as potential reservoir candidates, recent evaluations have discounted their likelihood due to an anticipated lack of water demand in the immediate vicinity and problems related to dependable yield, available storage, relocation costs and water quality.

### STREAM WATER RIGHTS

As of June 1994, the OWRB had issued stream water allocation permits totaling 268,596 ac-ft per year from lakes, rivers and streams within the North Central Planning Region (Table 17).

## Groundwater

Groundwater is the major water supply source for much of the region. The North Central Planning Region overlies two major groundwater basins, the Ada-Vamoosa and Garber-Wellington Formations, along with alluvial and terrace deposits of the Cimarron River and Salt Fork of the Arkansas River. The Ada-Vamoosa Aquifer is a fine- to very fine-grained sandstone with siltstone, shale and conglomerate. It has a maximum thickness of 550 feet with a saturated thickness of 100 to 200 feet. Well depths are generally 100 to 500 feet and wells commonly yield 100 to 300 gpm from the formation, but may exceed 500 gpm in some locations. Water from the aquifer is generally of a sodium bicarbonate or sodium calcium bicarbonate type. Dissolved solids are usually less than 500 mg/L. Water quality in the upper part of the aquifer is generally suitable for all uses but becomes increasingly saline near the interface between potable and saline water in the deeper confined part of the aquifer.

The Garber-Wellington Aquifer is

Table 17  
WATER RIGHTS  
North Central Planning Region

<b>STREAM WATER ALLOCATIONS</b>								
<i>(acre-feet)</i>								
COUNTY	Municipal	Industrial	Agricultural	Commercial	Rec, F&W	Power	Other	TOTAL
Garfield	179	70	1,148	---	448	---	---	1,845
Grant	---	941	302	5	15	---	---	1,263
Kay	61,368	14,280	1,583	---	---	---	---	77,231
Kingfisher	---	107	2,411	---	189	---	---	2,707
Lincoln	5,747	40	5,112	---	744	---	---	11,643
Logan	4,660	1,783	4,035	---	323	---	---	10,801
Noble	5,471	5	1,258	---	179	---	---	6,913
Pawnee	3,734	4	315	120	---	76,600	---	80,773
Payne	62,635	---	1,795	---	9,825	1,165	---	75,420
<b>TOTAL</b>	<b>143,794</b>	<b>17,230</b>	<b>17,959</b>	<b>125</b>	<b>11,723</b>	<b>77,765</b>	<b>---</b>	<b>268,596</b>

<b>GROUNDWATER ALLOCATIONS</b>								
<i>(acre-feet)</i>								
COUNTY	Municipal	Industrial	Agricultural	Commercial	Rec, F&W	Power	Other	TOTAL
Garfield	8,865	1,151	3,747	191	232	---	---	14,186
Grant	27,101	90	9,231	---	---	---	---	36,422
Kay	6,341	4,523	11,510	4	40	171	25	22,614
Kingfisher	4,948	2,023	46,532	---	---	---	3	53,506
Lincoln	1,799	820	924	1	20	---	---	3,564
Logan	4,426	1,365	6,884	321	2	---	---	12,998
Noble	352	20	4,506	---	---	---	---	4,878
Pawnee	3,094	211	980	298	---	---	1	4,584
Payne	6,145	1,904	4,966	148	---	---	---	13,163
<b>TOTAL</b>	<b>63,070</b>	<b>12,107</b>	<b>89,280</b>	<b>963</b>	<b>294</b>	<b>171</b>	<b>29</b>	<b>165,914</b>

Note: Agricultural allocations include Irrigation. Mining included in Industrial.  
Source of data: Oklahoma Water Resource Board printout, June 23, 1994.

composed of finely-grained sandstone with shale and siltstone. The maximum thickness of the formation is about 900 feet with a saturated thickness ranging from 150 to 650 feet. The aquifer is generally unconfined to partly confined with well depths of 100 to 200 feet and yields of 100 to 300 gpm in the unconfined portions, although yields generally decrease in the Logan County area. Water quality is generally suitable for all uses, although excessive pumping may cause upswelling of the underlying saltwater in some areas.

Alluvial and terrace deposits are found along the major rivers in all counties of the region. Along the Cimarron River, the formation consists of silt and clay in the upper portion grading downward to sandy clay, sand and fine gravel with a maximum thickness of about 80 feet. Terrace deposits are typically overlain by dune sand as much as 100 feet thick. The aquifer is generally unconfined with well depths of 50 to 100 feet and yields of 200 to 500 gpm in the alluvium and 100 to 200 gpm in the terrace. The water is

typically of a calcium magnesium bicarbonate type and very hard.

Along the Salt Fork of the Arkansas River, alluvium deposits have a maximum thickness of 60 feet while terrace deposits have a maximum thickness of 150 feet. The formations are typically clay and silt in the upper portion, changing into fine to coarse sand with local lenses of fine gravel. The aquifer is generally unconfined with well depths of 50 to 150 feet and yields of 100 to 200 gpm in the alluvium portion and 100 to 500 gpm in the terrace. The water is very hard and generally of a calcium magnesium bicarbonate type; dissolved solids are typically less than 500 mg/L.

#### GROUNDWATER DEVELOPMENT

The lack of widespread high quality surface water in the region dictates a heavy reliance upon groundwater sources. Many small and medium-sized communities receive their water supply from wells, primarily from the Vamoosa Formation which is regarded as having the greatest development potential in the region.

#### GROUNDWATER RIGHTS

As of June 1994, the OWRB had issued groundwater allocation permits totaling 165,914 ac-ft per year from aquifers in the North Central Planning Region (Table 17).

### SUPPLY AND DEMAND ANALYSIS

The long-range projection of M&I water demand in the North Central Region in the year 2050 is 100,100 ac-ft (approximately 46 percent of the total 2050 demand for the entire region). Table 18 indicates that the region currently has a surplus of unallocated water, primarily from Kaw Reservoir. As shown in Table 19, 2050 demands could be met with current supplies without causing a deficit condition.

Table 18  
SURPLUS WATER AVAILABILITY  
North Central Planning Region  
(1,000 ACRE-FEET/YEAR)

SOURCE	TOTAL YIELD	LOCAL ALLOCATION	OUT OF REGION ALLOCATION	POTENTIAL SURPLUS
Kaw	230.7	197.1	---	33.6
SCS & Municipal Lakes	18.6	18.6	---	---
Groundwater	76.5	76.5	---	---
<b>TOTAL</b>	<b>325.8</b>	<b>292.2</b>	<b>---</b>	<b>33.6</b>
<b>Other Potential Sources</b>				
Hennessey	18.8	---	---	18.8
Hunnewell	54.7	---	---	54.7
Navia (Seward)	34.6	---	---	34.6
Otoe	46.0	---	---	46.0
Pawnee (Lela)	48.2	---	---	48.2
Sheridan	23.5	---	---	23.5
Skeleton	41.5	---	---	41.5
<b>TOTAL</b>	<b>267.3</b>	<b>---</b>	<b>---</b>	<b>267.3</b>
<b>TOTAL SURPLUS WATER AVAILABILITY</b>	<b>593.1</b>	<b>292.2</b>	<b>---</b>	<b>300.9</b>

Table 19  
**SUPPLY AND DEMAND ANALYSIS**  
 North Central Planning Region  
 (1,000 ACRE-FEET/YEAR)

SOURCE	COUNTY									TOTAL
	Garfield	Grant	Kay	Kingfisher	Lincoln	Logan	Noble	Pawnee	Payne	
<b>MUNICIPAL AND INDUSTRIAL COMPONENT</b>										
Carl Blackwell	---	---	---	---	---	---	---	---	7.0	7.0
Chandler	---	---	---	---	4.6	---	---	---	---	4.6
Kaw	25.0	---	42.9	---	---	---	---	---	56.2	124.1
Lone Chimney	---	---	---	---	---	---	---	2.5	---	2.5
McMurtry	---	---	---	---	---	---	---	---	3.0	3.0
Ponca	---	---	9.0	---	---	---	---	---	---	9.0
Sooner	---	---	---	---	---	---	---	---	---	---
Stroud	---	---	---	---	1.3	---	---	---	---	1.3
SCS & Municipal Lakes	---	---	0.2	---	1.1	6.7	3.4	3.9	3.1	18.6
Groundwater	10.4	27.2	10.9	7.0	2.6	6.1	0.4	3.6	8.2	76.5
<b>M &amp; I Supply</b>	<b>35.4</b>	<b>27.2</b>	<b>63.0</b>	<b>7.0</b>	<b>9.6</b>	<b>12.9</b>	<b>3.8</b>	<b>10.0</b>	<b>77.5</b>	<b>246.5</b>
<b>2050 M &amp; I Demand</b>	<b>25.1</b>	<b>2.2</b>	<b>22.0</b>	<b>3.8</b>	<b>8.6</b>	<b>9.7</b>	<b>2.1</b>	<b>5.2</b>	<b>21.4</b>	<b>100.1</b>
<b>M &amp; I Surplus/(Deficit)</b>	<b>10.3</b>	<b>25.0</b>	<b>41.0</b>	<b>3.2</b>	<b>1.0</b>	<b>3.2</b>	<b>1.7</b>	<b>4.8</b>	<b>56.1</b>	<b>146.4</b>
<b>AGRICULTURAL COMPONENT</b>										
SCS & Municipal Lakes	8.7	0.2	2.4	3.1	9.4	7.5	10.9	3.1	4.0	49.1
Groundwater	3.7	9.2	11.5	46.5	0.9	6.9	4.5	1.0	5.0	89.2
<b>Agricultural Supply</b>	<b>12.4</b>	<b>9.4</b>	<b>13.9</b>	<b>49.6</b>	<b>10.3</b>	<b>14.4</b>	<b>15.4</b>	<b>4.1</b>	<b>9.0</b>	<b>138.4</b>
<b>2050 Agricultural Demand</b>	<b>3.5</b>	<b>3.3</b>	<b>2.3</b>	<b>22.3</b>	<b>1.4</b>	<b>4.9</b>	<b>1.9</b>	<b>3.3</b>	<b>1.9</b>	<b>44.8</b>
<b>Agricultural Surplus/(Deficit)</b>	<b>8.9</b>	<b>6.1</b>	<b>11.6</b>	<b>27.3</b>	<b>8.9</b>	<b>9.5</b>	<b>13.5</b>	<b>0.8</b>	<b>7.1</b>	<b>93.6</b>
<b>POWER COMPONENT</b>										
Kaw	---	---	---	---	---	---	---	73.0	---	73.0
Sooner	---	---	---	---	---	---	---	3.6	---	3.6
Groundwater	---	---	---	0.2	---	---	---	---	---	0.2
<b>Power Supply</b>	---	---	---	<b>0.2</b>	---	---	---	<b>76.6</b>	---	<b>76.8</b>
<b>2050 Power Demand</b>	---	---	---	---	---	---	---	<b>74.4</b>	---	<b>74.4</b>
<b>Power Surplus/(Deficit)</b>	---	---	---	<b>0.2</b>	---	---	---	<b>2.2</b>	---	<b>2.4</b>
<b>TOTALS</b>										
<b>Total Local Supply</b>	<b>47.8</b>	<b>36.6</b>	<b>76.9</b>	<b>56.8</b>	<b>19.9</b>	<b>27.2</b>	<b>19.2</b>	<b>90.7</b>	<b>86.5</b>	<b>461.7</b>
<b>Total 2050 Demand</b>	<b>28.6</b>	<b>5.5</b>	<b>24.3</b>	<b>26.1</b>	<b>10.0</b>	<b>14.6</b>	<b>4.0</b>	<b>82.9</b>	<b>23.3</b>	<b>219.3</b>
<b>Total Surplus/(Deficit)</b>	<b>19.2</b>	<b>31.1</b>	<b>52.6</b>	<b>30.7</b>	<b>9.9</b>	<b>12.6</b>	<b>15.2</b>	<b>7.8</b>	<b>63.2</b>	<b>242.4</b>