

Water Demands in the Rock River Water Supply Planning Region

Draft Report on Water Demand Scenarios

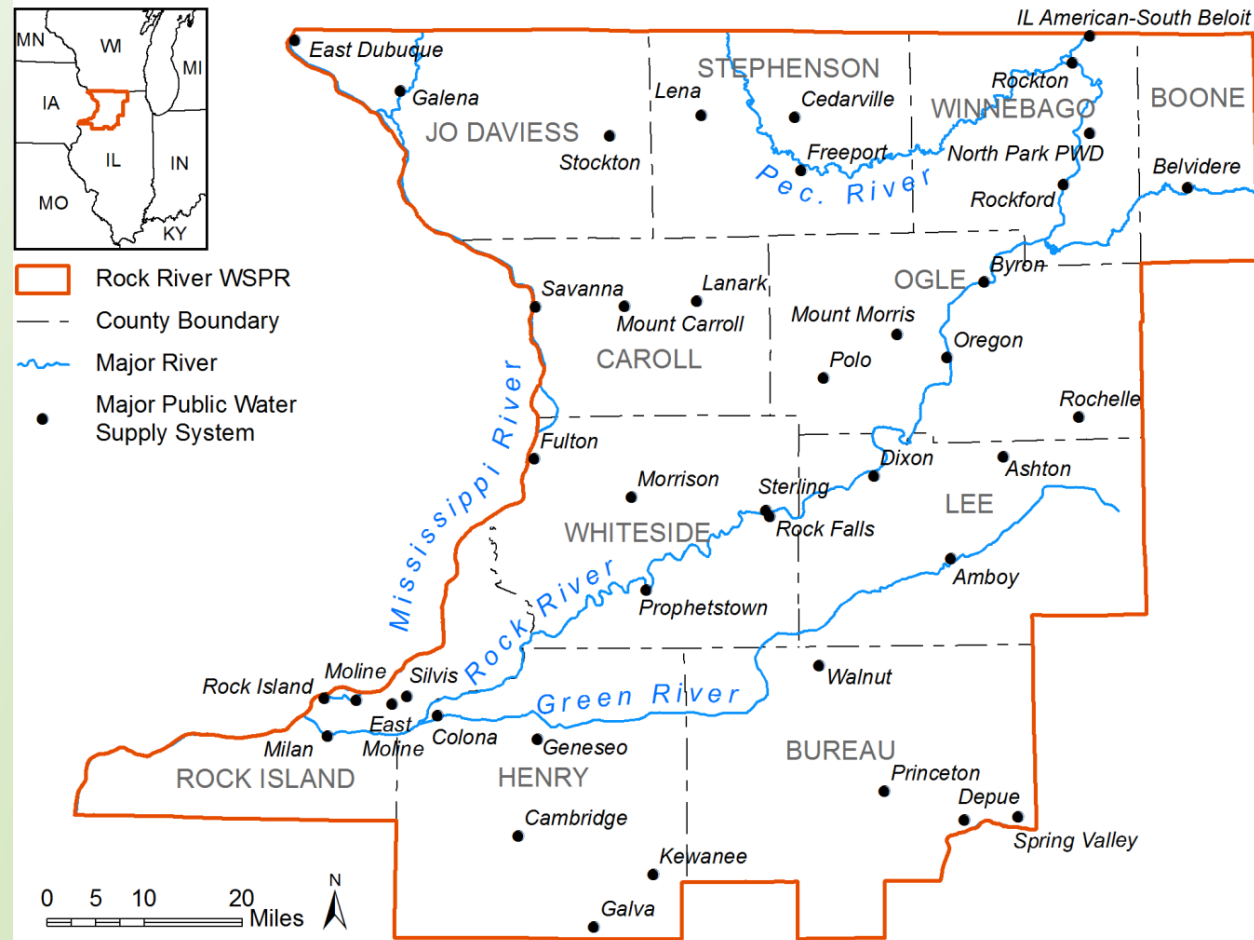
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Middle Illinois Regional Water Supply Planning
Committee

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Project purpose and scope

- ▶ To develop water-demand scenarios (2015-2060) for all major user sectors
Rock River Region

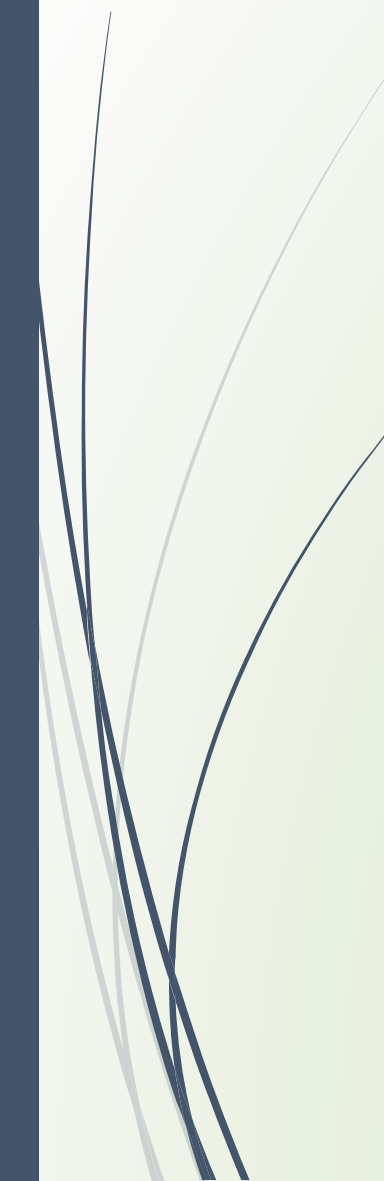


Analytical Approach

- Translate the projections of population and economic (including agricultural) growth into associated water supply needs
- Account for current (2010 base year) and historical water withdrawals within each county
- Water use relationships and coefficients developed from historical data (1990, 1995, 2000, 2005, 2010)
- Future demand scenarios based on assumptions about future values of “drivers” and “explanatory variables”



Five Major Sectors of Water Users

- Public water supply (PWS)
 - Self-supplied domestic (DOM)
 - Thermoelectric power generation (PG)
 - Self-supplied industrial and commercial (IC)
 - Irrigation, livestock, and environmental (ILE)
- 

Data Sets and Levels

- ▶ Water use data from Illinois Water Inventory Program (IWIP) and USGS
- ▶ Historical water use and explanatory variable data for public water supply and at system level
- ▶ Facility-specific data for self-supplied thermoelectric power generation
- ▶ County-level data for self-supplied industrial/commercial, irrigation/livestock/environmental, self-supplied domestic sectors

Illinois Water Inventory Program (IWIP)

- Annual water use reporting program for major water users (> 100,000 gallons per day) in Illinois since 1978
- IWIP collects point source water withdrawals data from 3 sectors:
 1. Public Water Supply
 2. Self-Supplied Industrial-Commercial
 3. Agricultural Irrigation (since 2015)
 4. About 3,200 active facilities
- Prior to 2010, reporting was voluntary; now mandatory
- Periodic summaries of data published

Determinants of PWS Water Demand: (Derived from 1990-2010 data)

Table 2.5

• Median household income	-0.198
• Marginal price of water	+0.122
• Employment/population ratio	+0.503
• Precipitation – growing season	-0.060
• Maximum daily temperature	+1.133
• Conservation trend	-0.004

Other Drivers of Future Demand

- ▶ Strong increasing trend in irrigated cropland
 - ▶ 4.3% per year between 1987 and 2012 (USDA)
- ▶ Projected industrial growth (employment)
- ▶ Median household income expected to grow
- ▶ Retail (real) prices of water are increasing
- ▶ Water efficiency in PWS is improving

Forecast Scenarios

Developed 3 sets of scenario assumptions

➤ Scenario 1:

Baseline scenario (or Current Trends - CT)

➤ Scenario 2:

Low growth (or Less Resource Intensive - LRI)

➤ Scenario 3:

High growth (or More Resource Intensive - MRI)

Scenario Assumptions

Table 1.1

Factor	Scenario 1- Current Trends (CT) or Baseline	Scenario 2- Less Resource Intensive (LRI)	Scenario 3 – More Resource Intensive (MRI)
Total population	IDPH and trend-based projections	IDPH and trend-based projections	IDPH and trend-based projections
Median household income	Existing projections of 1.0 %/year growth	Existing projections of 0.7 %/year growth	Higher growth of 1.2 %/years
Water conservation	50% lower rate than historical trend	Continuation of historical trend	No extension of historical trend
Future water prices	Recent increasing trend (0.8%/year) will continue	Higher future price increases (1.6%/year)	Prices held at 2010 level in real terms
Irrigated land	Constant cropland, increasing golf courses	Decreasing cropland, no increase in golf courses	Constant cropland, increasing golf courses
Livestock	Baseline USDA growth rates	Baseline USDA growth rates	Baseline USDA growth rates
Weather (temperature and precipitation)	30-year normal (1981-2010)	30-year normal (1981-2010)	30-year normal (1981-2010)

Sensitivity to Climate & Drought

- Using average of IPCC models to predict changes in temperature and precipitation in the region by 2035 and 2060:

Table 7.1

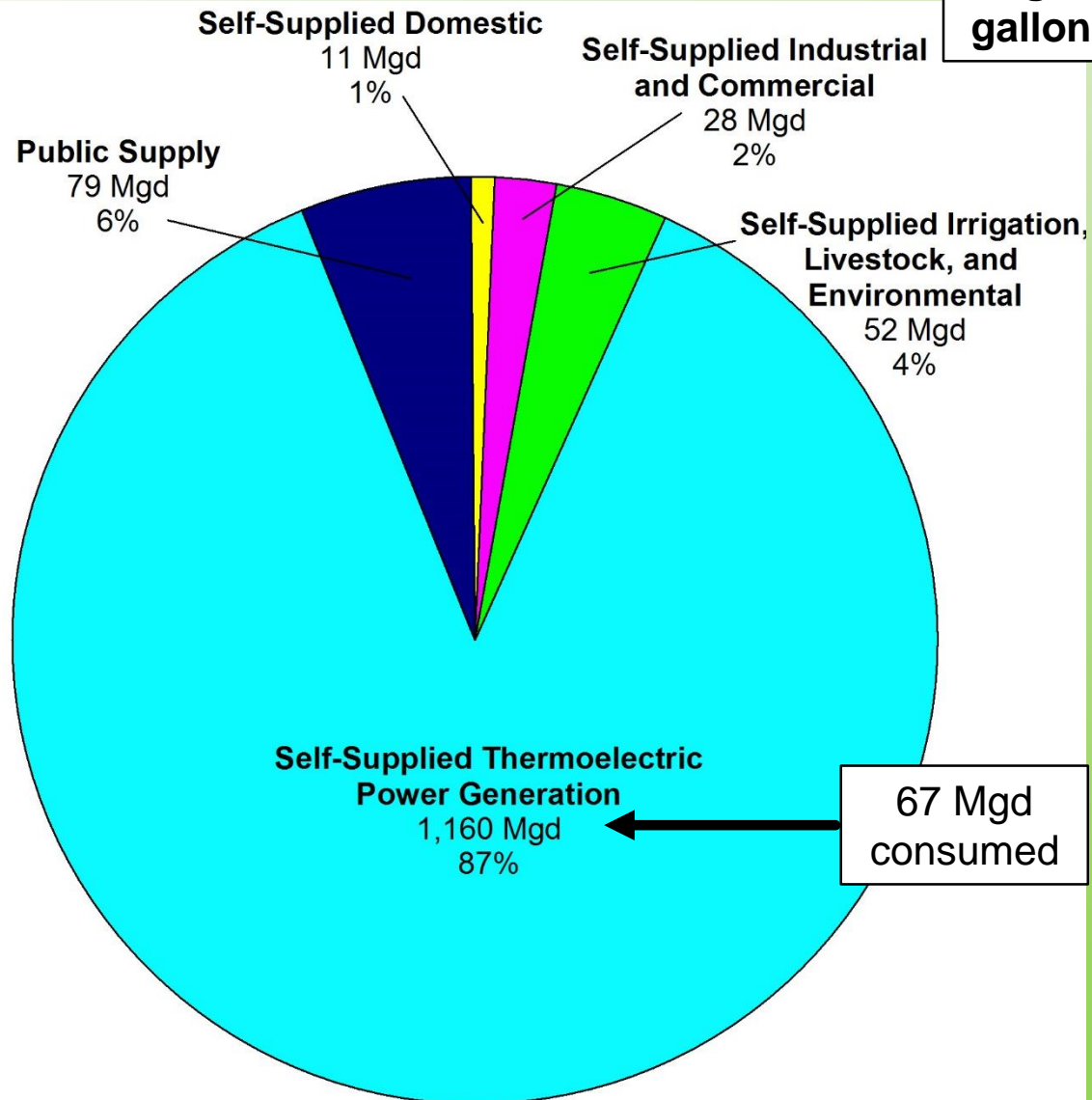
Climate Parameter	2035 Period			2060 Period		
	Hot/Dry	Central	Warm/ Wet	Hot/Dry	Central	Warm/ Wet
Change in Annual Avg. Temperature (°F)	3.4°	2.8°	2.4°	6.6°	5.4°	5.0°
Change in Annual Precipitation (%)	-0.3%	2.7%	5.7%	-0.7%	5.9%	11.0%

- Relative to “normal” values 1971-2000
- Drought defined as 40% deficit in growing season precipitation

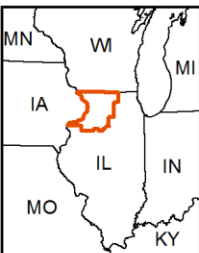
Rock River Water Supply Planning Region Results

2010 Demand: Rock River WSPR

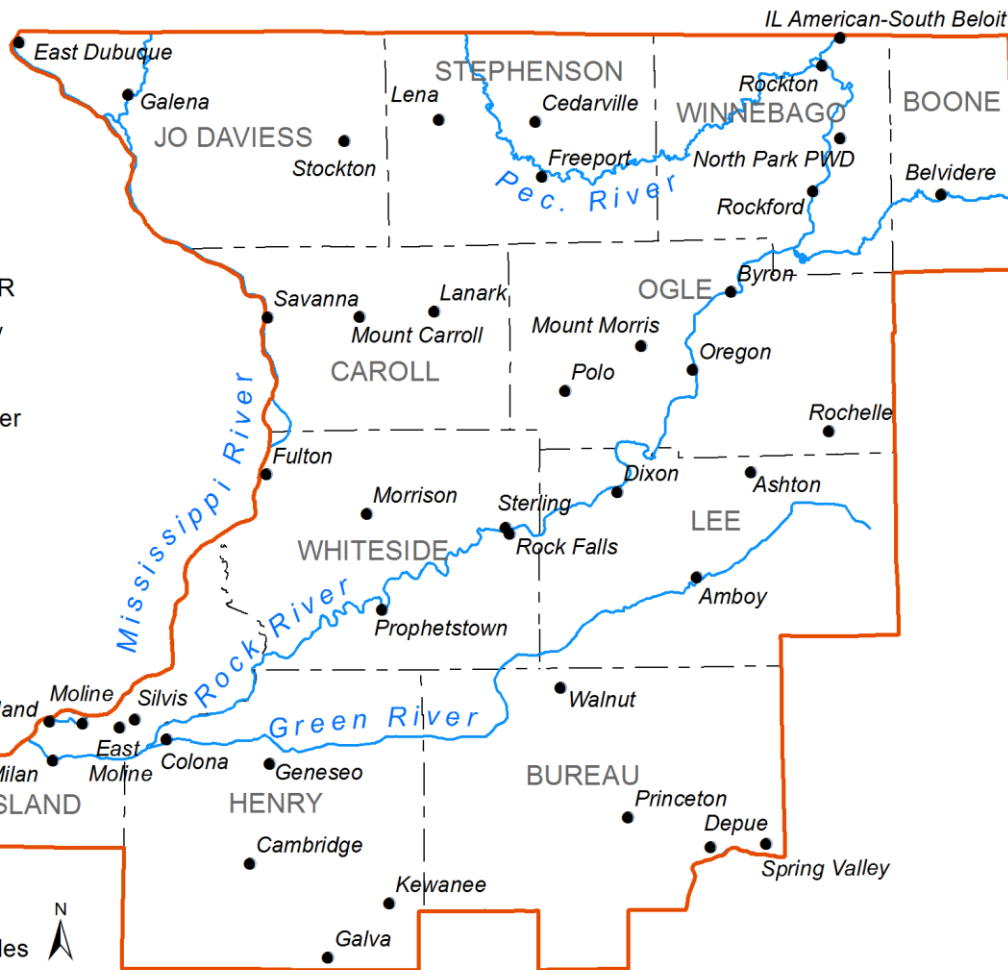
**Mgd = million
gallons per day**



Public Water Supplies



- Rock River WSPR
- County Boundary
- ~~~~~ Major River
- Major Public Water Supply System



0 5 10 20 Miles



- 255 systems
- 679,000 served
- 42 dominant systems
- 137,000 on domestic wells

Public Water Supplies: Source Water

- Surface water (rivers)
 - All in Rock Island County: Mississippi River
 - Major systems: Rock Island, Moline, East Moline
- Remainder on groundwater
 - Shallow sand and gravel aquifers
 - Bedrock aquifers
 - Sandstone
 - Carbonates

Public Water Supplies: Historic Data (example)

Population Served

Table 2.2

Study Area	1990	1995	2000	2005	2010
Winnebago County					
IL American – S. Beloit	4,100	4,200	6,000	4,700	7,800
Loves Park	15,653	17,452	20,040	22,767	24,700
North Park PWD	22,229	24,000	26,000	30,000	34,737
Rockford	140,000	149,000	155,000	156,000	162,296
Rockton	2,928	4,300	4,900	7,875	7,440
Winnebago Co. Residual	15,540	17,886	20,559	23,593	39,300

Water Use (Mgd)

Table 2.3

Study Area	1990	1995	2000	2005	2010
Winnebago County					
IL American – S. Beloit	0.684	0.616	0.569	0.607	0.765
Loves Park	3.112	3.157	2.223	3.424	3.182
North Park PWD	1.848	2.283	2.735	3.651	3.477
Rockford	27.190	26.323	24.575	25.639	20.221
Rockton	0.539	0.715	0.695	0.914	0.807
Winnebago Co. Residual	1.772	3.544	2.211	2.693	2.348

Projected Population

Table 2.8

County	Reported Population	Projected Population			2010-2060 Change	2010-2060 Change (%)
	2010 ¹	2020 ²	2040 ³	2060 ³		
Boone	54,144	61,504	69,084	76,814	22,670	42
Bureau	34,905	33,681	33,681	33,681	-1,224	-4
Carroll	15,364	14,169	14,169	14,169	-1,195	-8
Henry	50,432	48,233	48,233	48,233	-2,199	-4
Jo Daviess	22,660	22,137	22,137	22,137	-523	-2
Lee	35,970	36,066	36,349	36,645	675	2
Ogle	53,448	54,316	56,417	58,521	5,073	9
Rock Island	147,632	147,267	152,651	158,035	10,403	7
Stephenson	47,680	46,242	46,242	46,242	-1,438	-3
Whiteside	58,472	55,267	55,267	55,267	-3,205	-5
Winnebago	295,151	302,258	311,687	321,297	26,146	9
REGIONAL TOTAL	815,858	821,140	845,916	871,040	55,182	7

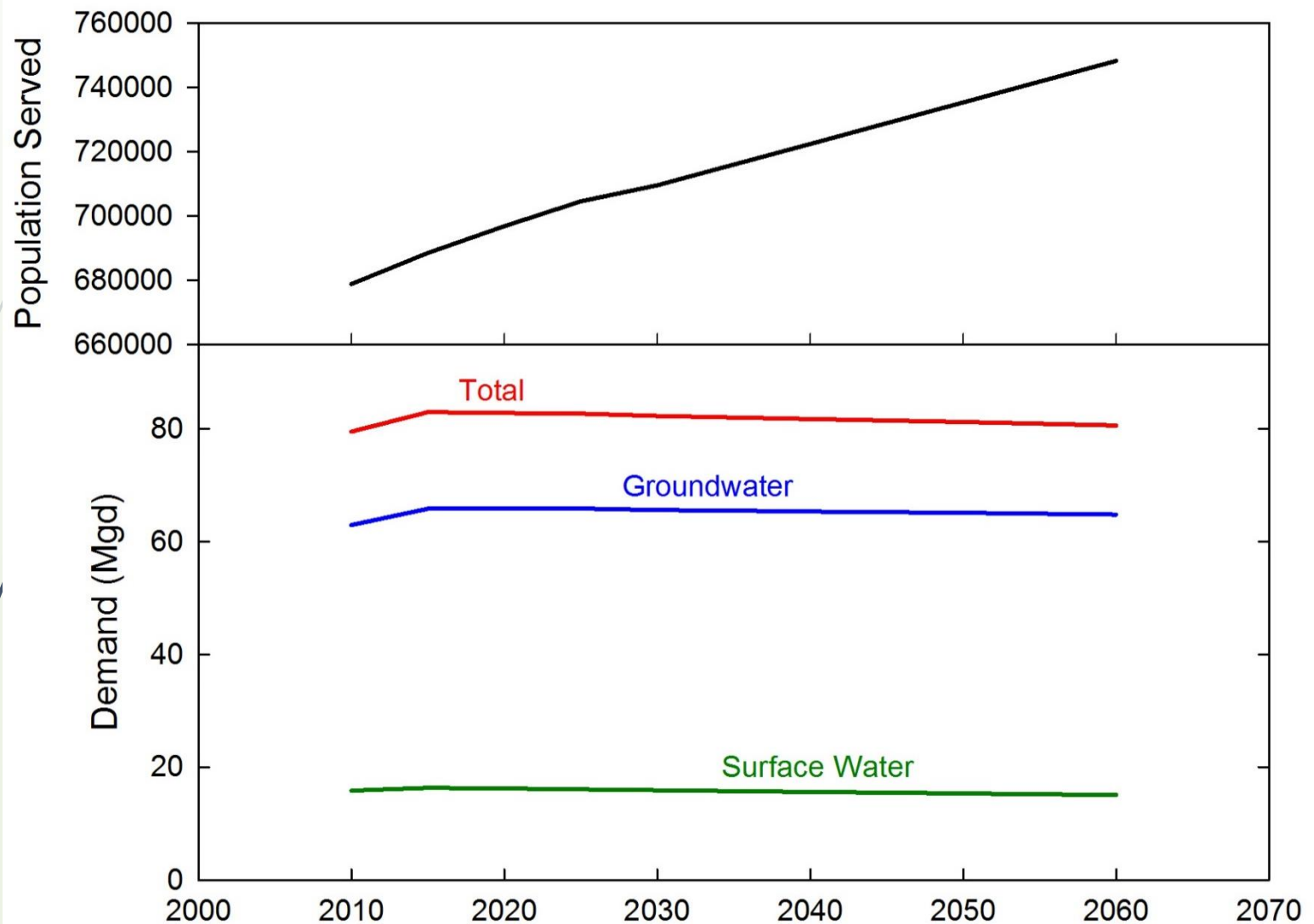
Data from U.S. Census Bureau and Illinois Department of Public Health

PWS Demand Scenario (CT)

Table 2.13

Year	Population Served	Demand		Locally Sourced (Mgd)		Imported (Mgd)
		gpcd	Mgd	Ground Water	Surface Water	
2010	678,746	117.2	79.52	62.93	15.83	0.77
2015	688,454	120.5	82.98	65.84	16.34	0.80
2020	696,742	118.9	82.82	65.83	16.19	0.80
2025	704,514	117.4	82.72	65.87	16.05	0.80
2030	709,471	116.0	82.29	65.60	15.90	0.79
2035	715,935	114.6	82.03	65.48	15.76	0.79
2040	722,399	113.2	81.76	65.36	15.61	0.79
2045	728,862	111.8	81.48	65.23	15.47	0.78
2050	735,326	110.4	81.21	65.10	15.33	0.78
2055	741,789	109.1	80.92	64.96	15.19	0.77
2060	748,254	107.8	80.63	64.81	15.05	0.77
2010-2060 Change	69,508	-9.4	1.11	1.88	-0.77	<0.01
2010-2060 Change (%)	10.2	-8.0	1.4	3.0	-4.9	0.5

PWS Current Trends Scenario



Large Thermoelectric Power Plants in Rock River Region

Modified from Table 4.2

Power Plant	County	Nameplate Capacity (MW)	Gross Generation (2010) (MWh)	Water Demand (2010) (Mgd)	Unit Use Water Demand (2010) (Gal/kWh)
Lee Energy (Natural Gas)	Lee	814	No data	No data	Not determined
Exelon - Byron Station (Nuclear)	Ogle	2,450	20,848,498	55.52	0.973
Cordova Energy (Natural Gas)	Rock Island	611	161,452	0.26	0.592
Exelon - Quad Cities Station (Nuclear)	Rock Island	2,019	14,565,059	1,103.87	27.682
NRG Rockford I & II (Natural Gas)	Winnebago	484	No data	No data	Not determined

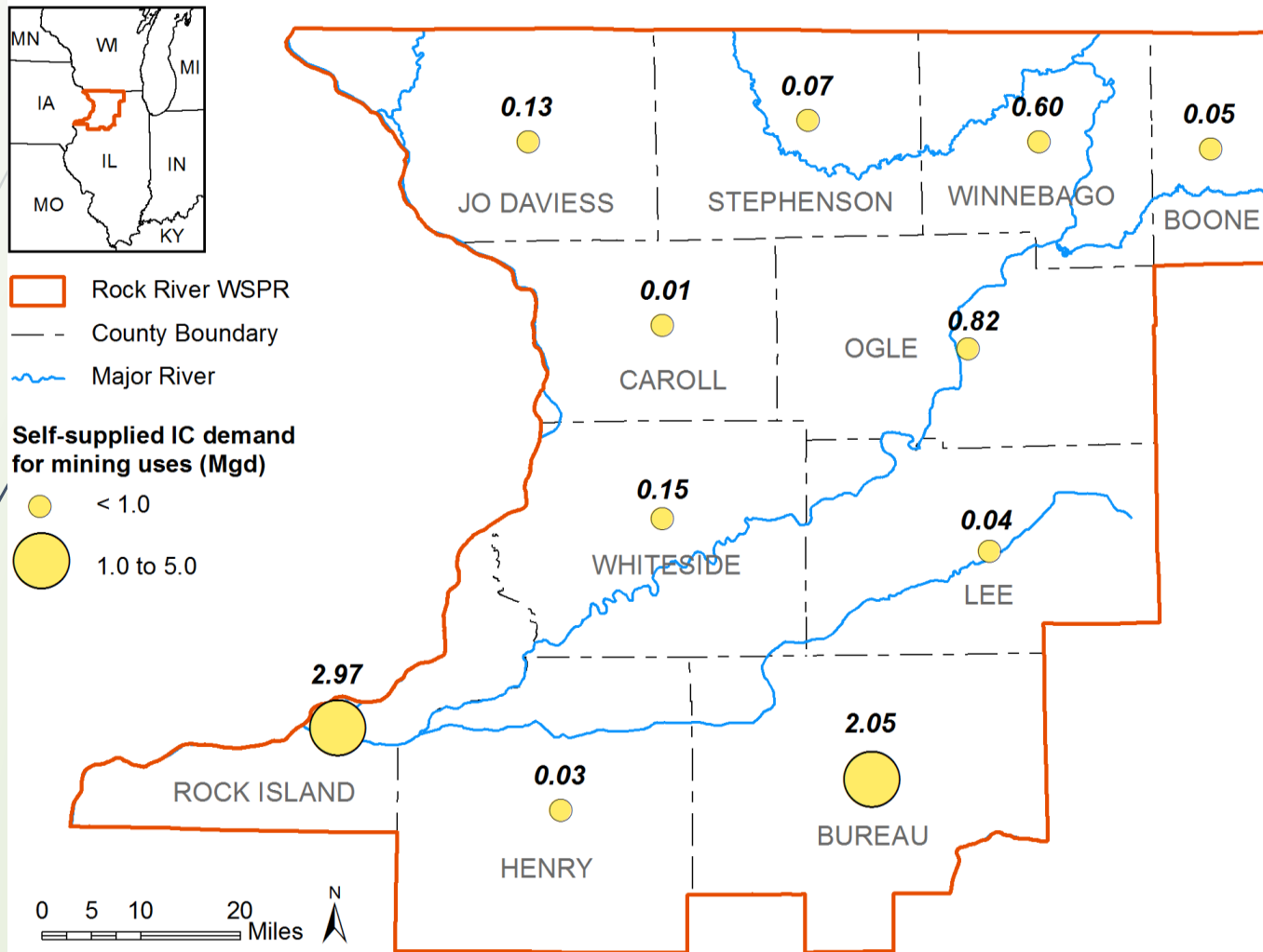
Future Demands for Thermoelectric Plants

- Used unit-coefficient method = gross generation at the plant times the rate of water demand per unit of generated electricity
 - Once-through plants: 29 gallons/kWh
 - Closed loop plants: 1.0 gallon per kWh
- Future electricity demand in region estimated to be 10.14 MWh/capita-year (IL Commerce Commission for 2006)
- Assumptions for CT Scenario
 - Future generation in the existing thermoelectric power plants will continue at 2010 levels of gross generation.
 - No new thermoelectric power plants (with steam turbines that require water-based cooling) will be added through the end of the study period in 2060
- **Water Demand = 1,160 Mgd per year**

Industrial-Commercial Sector

- Self-supplied Mining
 - 6.9 Mgd in 2010
 - About $\frac{3}{4}$ mining use in Bureau and Rock Island Counties

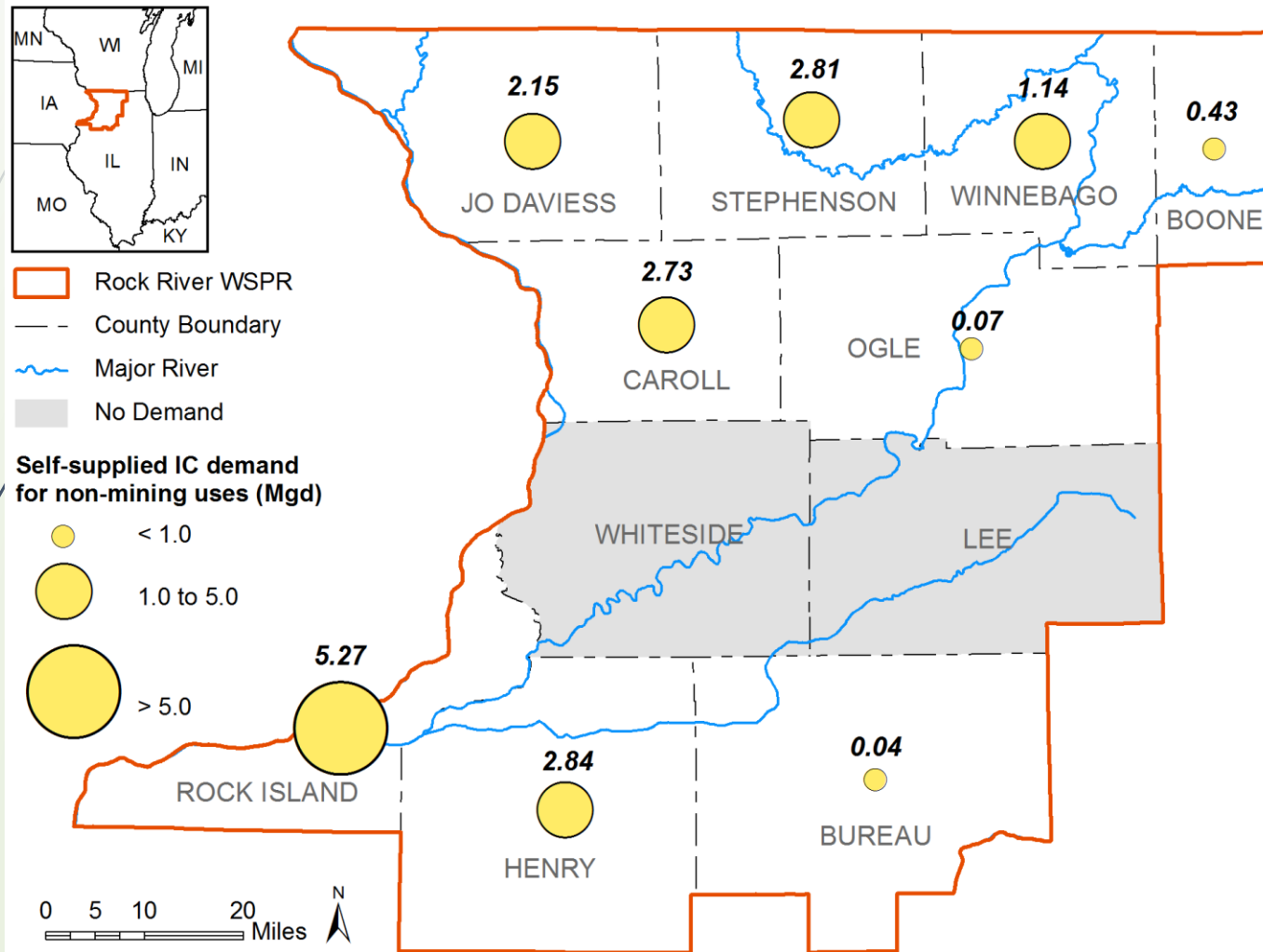
IC Sector: Mining



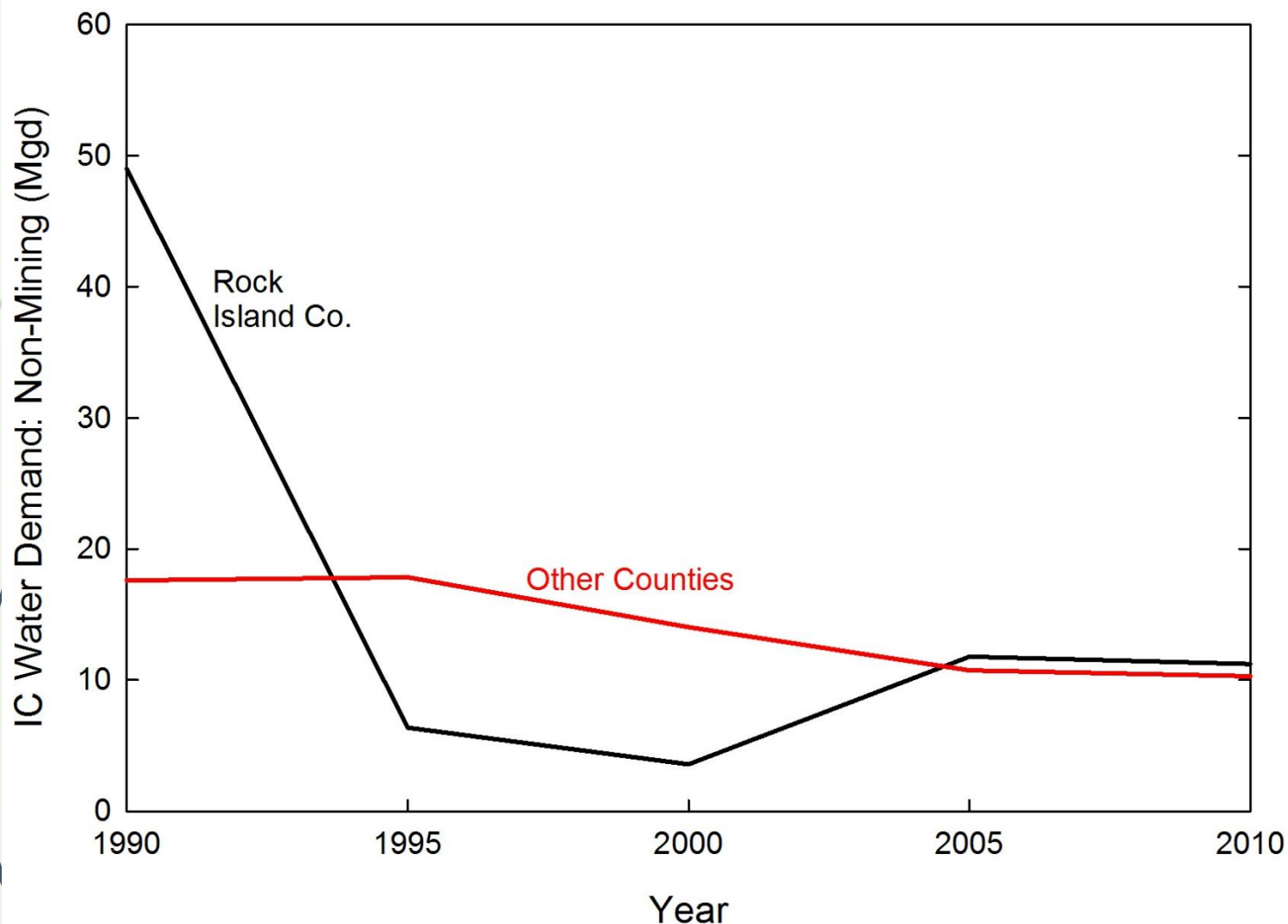
Industrial-Commercial Sector

- Self-supplied Non-mining
 - 21.5 Mgd in 2010
 - Primarily Rock Island County (11.2 Mgd)
 - Carroll (2.2 Mgd) and Stephenson (2.1 Mgd) next most important
- IC Facilities also purchase water from PWSs
 - 25.7 Mgd in 2010
- Because IC encompasses many different types of facilities and water uses, determining demands is a challenge

IC Sector: Non-Mining



Industrial-Commercial Water Use: Non-Mining



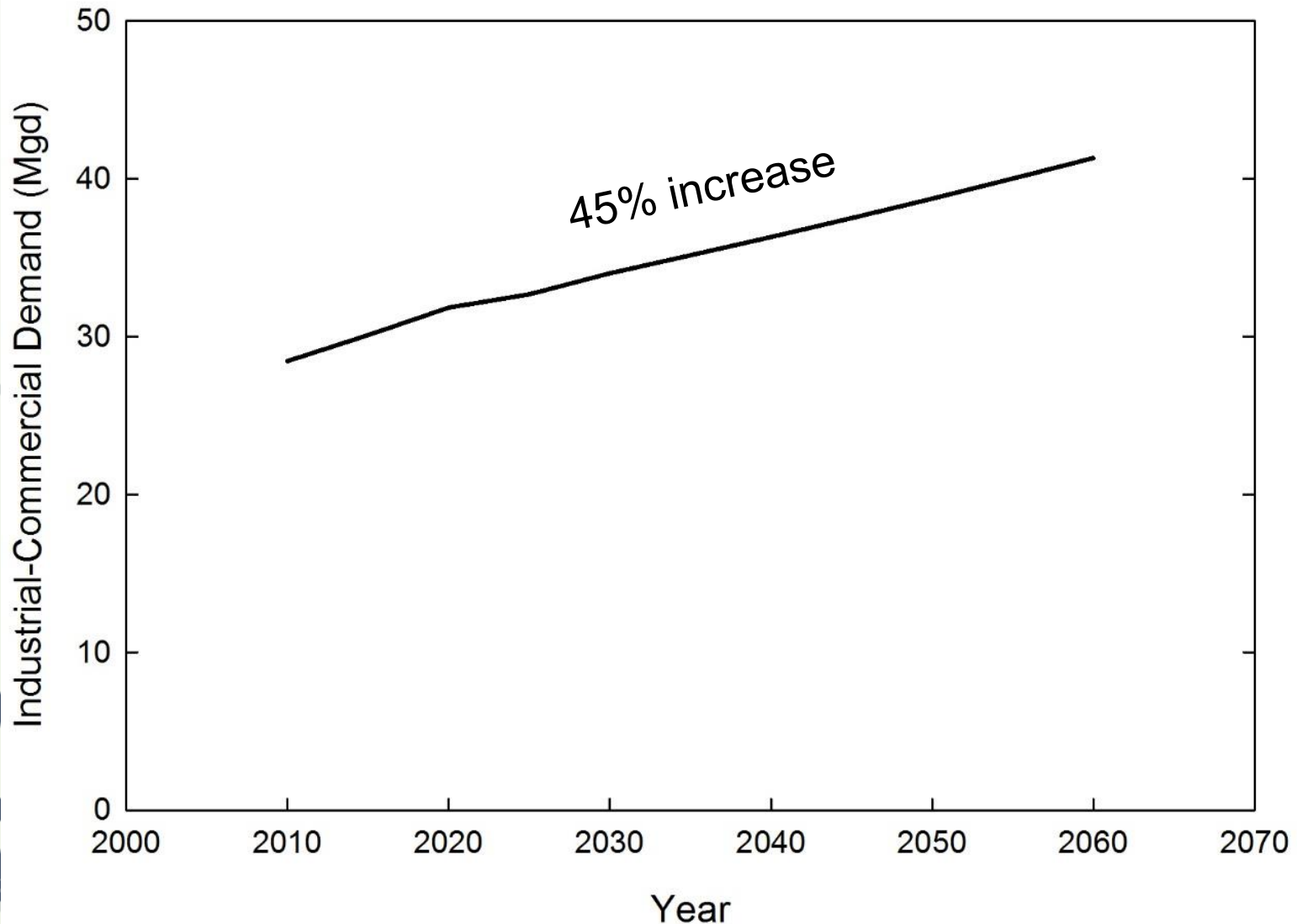
Estimating Future Industrial-Commercial Demands

- ▶ Main driver of future IC water demand assumed to be the future output of goods and services
- ▶ Assumed long-term rates of labor productivity growth to be 1.0 - 1.5 % per year
- ▶ Use projected employment data and labor productivity
 - ▶ IL Dept. Employment Security
 - ▶ U.S. Dept. of Labor Bureau of Statistics

Estimating Future Industrial-Commercial Demands

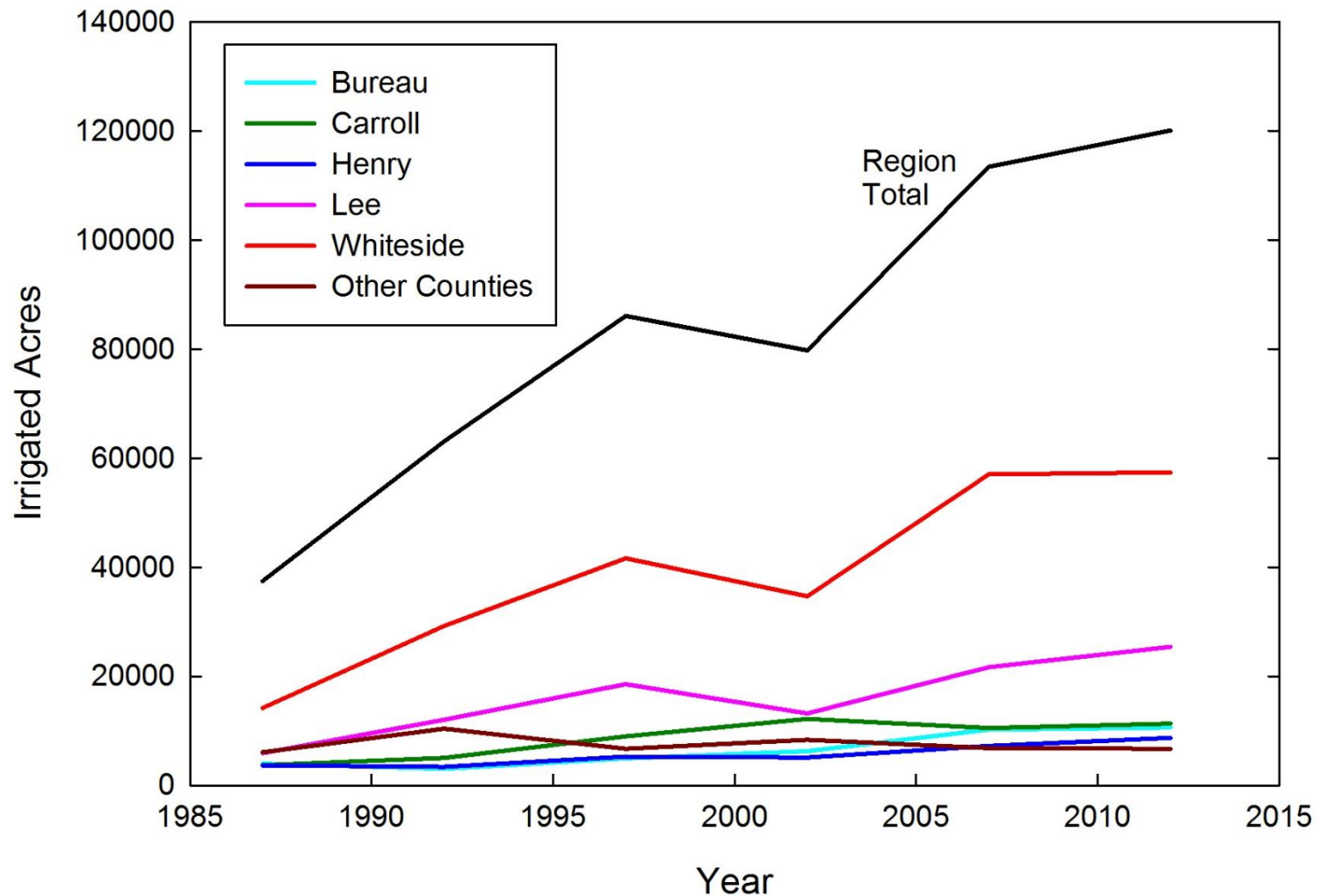
- Assumptions:
 - Total county employment will follow published projections
 - Self-supplied IC demand for each county will remain at percentage computed from 2010 totals
 - Groundwater and surface water proportions will not change
- Major unknown is if water-intensive facilities, such as ethanol and biodiesel plants, are located within the region in the future
 - Not included, but could be simulated

IC Future Demand (CT)

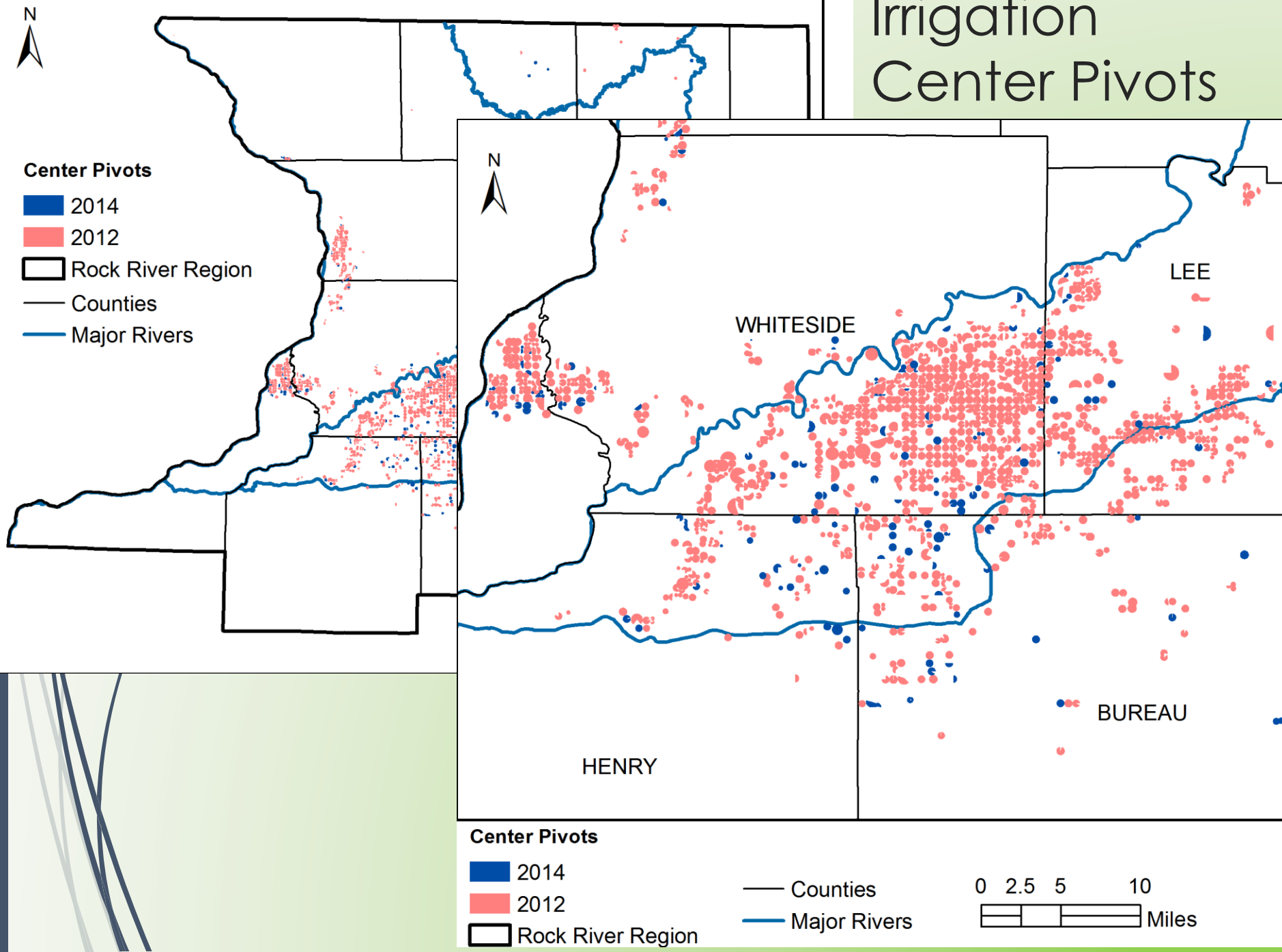


Irrigated Cropland, Acres

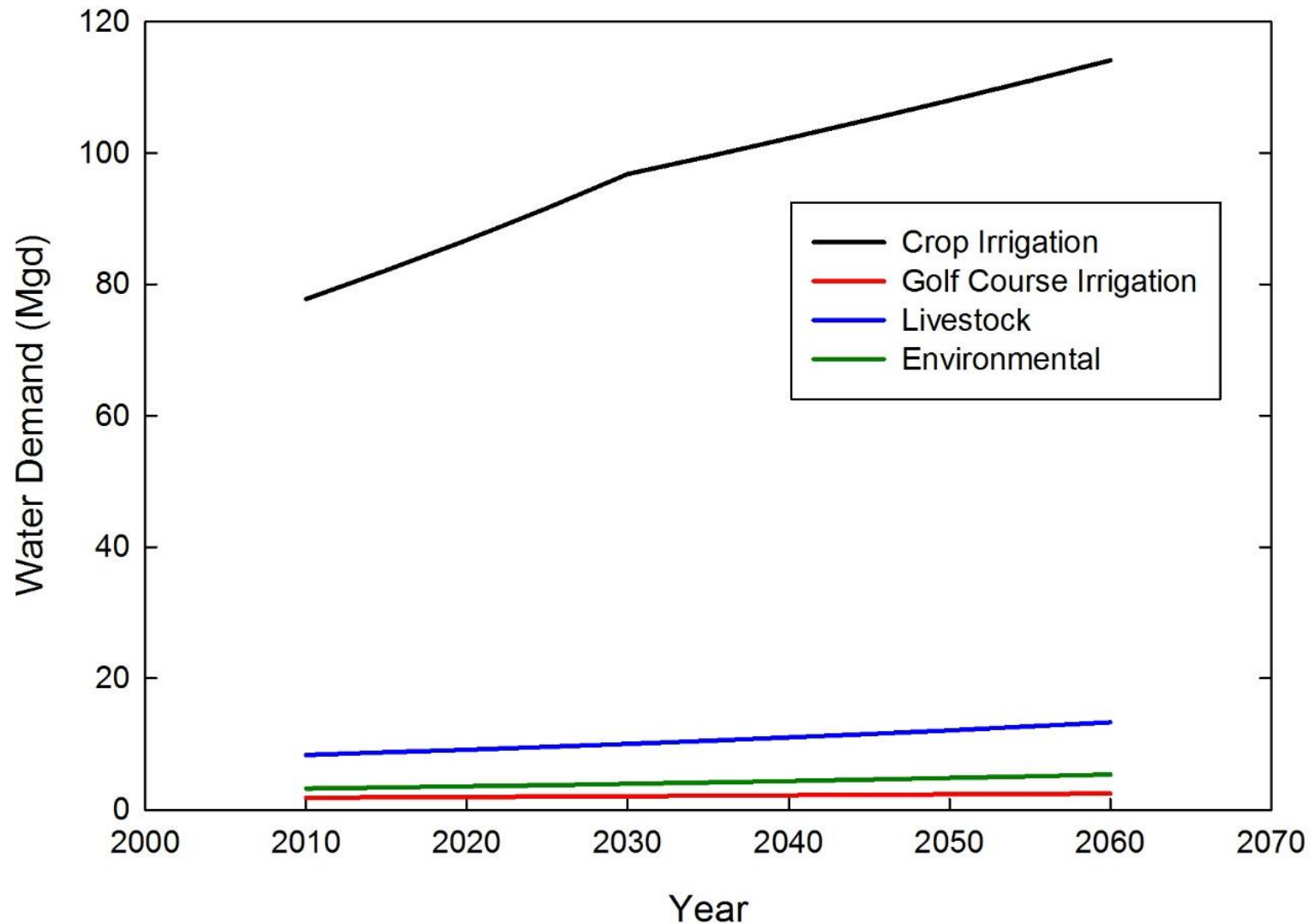
USDA Data



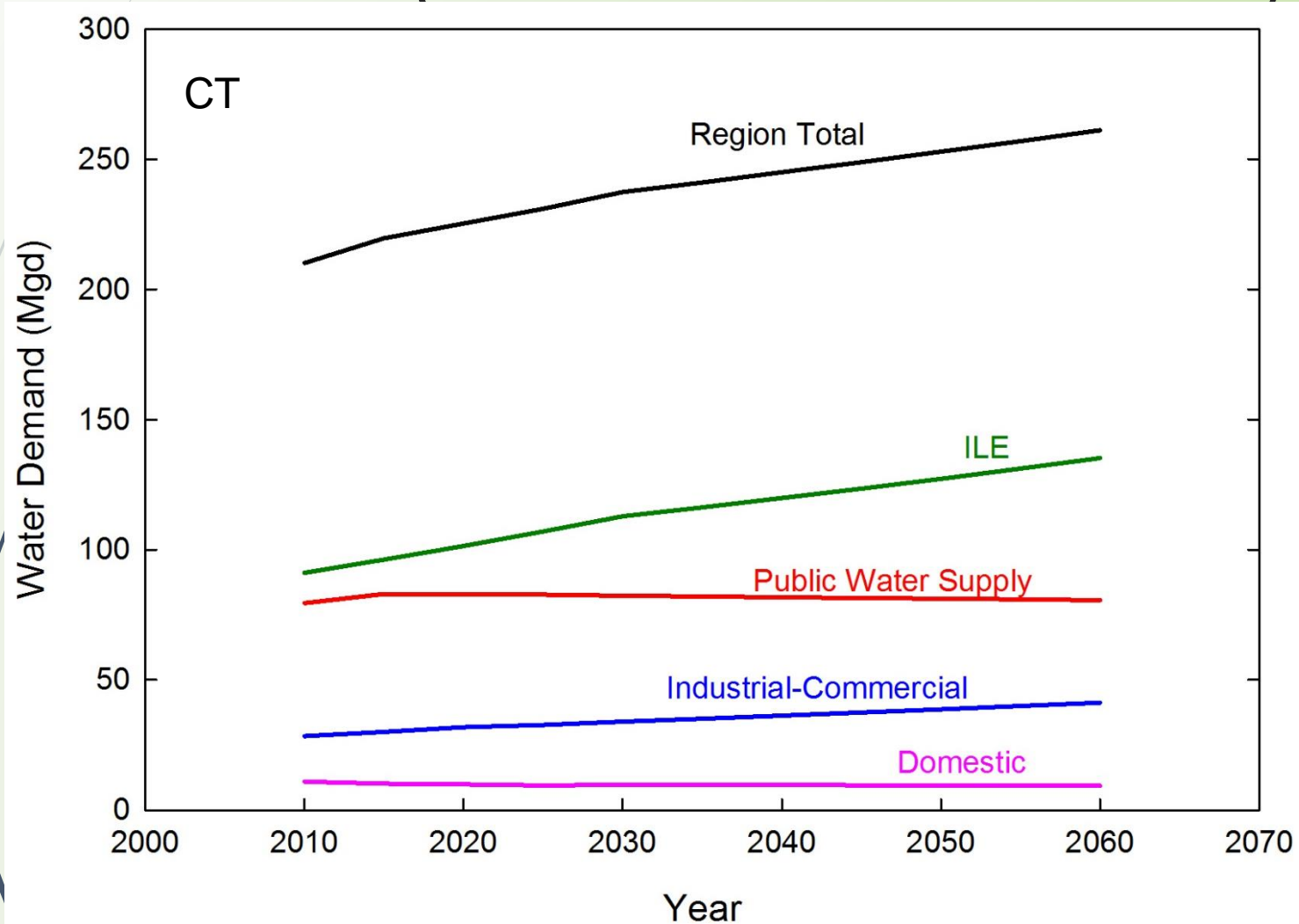
Irrigation Center Pivots



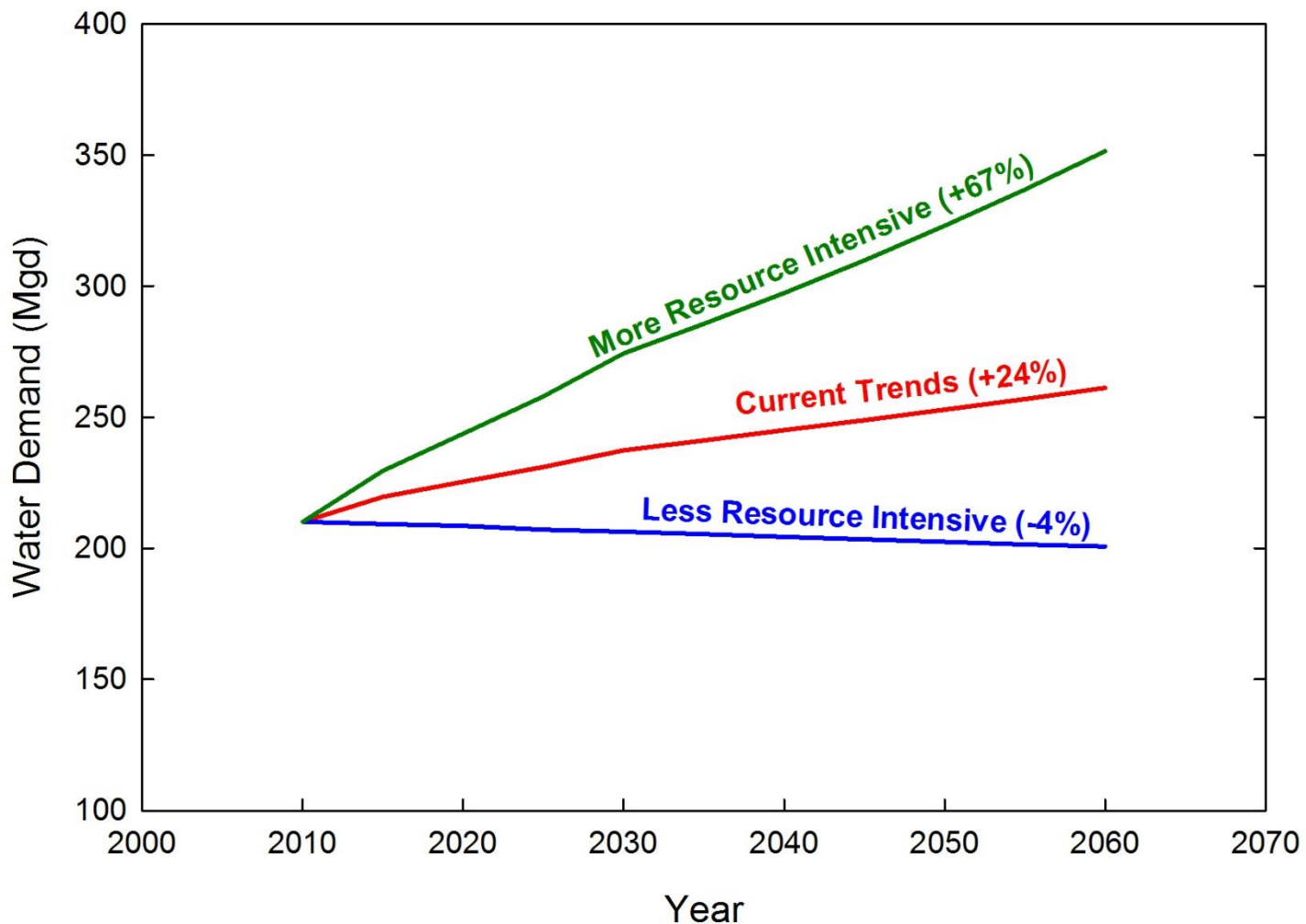
ILE Future Demands (CT)



Demand Scenarios – Rock River (without Thermoelectric)



Demand Scenarios – Middle Illinois (without Thermoelectric)



Changes in Demand due to Climate Change and Drought

- ▶ Hot & Dry climate scenario relative to CT “normal” climate:
 - ▶ Public supply: +8.7%
 - ▶ Self-supplied domestic: +8.8%
 - ▶ Cropland irrigation: +10.1%
- ▶ Drought year with 40% deficit in precipitation:
 - ▶ Public supply: +8.7%
 - ▶ Self-supplied domestic: +9.0%
 - ▶ Cropland irrigation: +34.0%

Summary (1)

Not including Thermoelectric Demand

- Total demand projected to change by 2060 from 210 Mgd (normalized) in 2010 to:
 - 201 Mgd under the LRI scenario, 4% decrease
 - 261 Mgd under the CT scenario, 24% increase
 - 351 Mgd under the MRI scenario, 67% increase
- Under CT scenario, the 2010-2060 increase of 51 Mgd includes:
 - Increase of 1.1 Mgd in PWS demand
 - Decrease of 1.6 Mgd in self-supplied domestic demand
 - Increase of 7.5 Mgd in IC demand
 - Increase of 44.0 Mgd in ILE demand

Summary (2)

- ▶ Projected increase in demand caused by increase in projected employment from 275,269 in 2010 to 324,277 in 2060 (20% increase) mostly in Winnebago County
- ▶ Effects of future climate appear to be modest (<10% increase in demand)
- ▶ Scenario results could be adjusted based on input from Regional Water Supply Planning Committee

Input from the Committee

- Information on:
 - Power generating plants
 - New water-intensive industries
 - Growth in irrigation
 - Mining operation status
- Update water purchase map:

<https://www.isws.illinois.edu/illinois-water-supply-planning/interactive-maps>

Click on:

“Statewide Municipal Water Use and Water Purchase Interactive Map”

Thank you!

