Kankakee Basin Regional Water Study

The Kankakee River flowing through Kankakee River State Park

Prepared By:

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December 2025

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APPENDIX A

Additional Geologic and Hydrogeologic Background Information

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Kankakee Basin Regional Water Study

Appendix A – Additional Geologic and Hydrogeologic Information

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ABBREVIATIONS

IDNR	Indiana Department of Natural Resources
USGS	U.S. Geological Survey

Appendix A Additional Geologic and Hydrogeologic Information

A.1 Hydrogeology

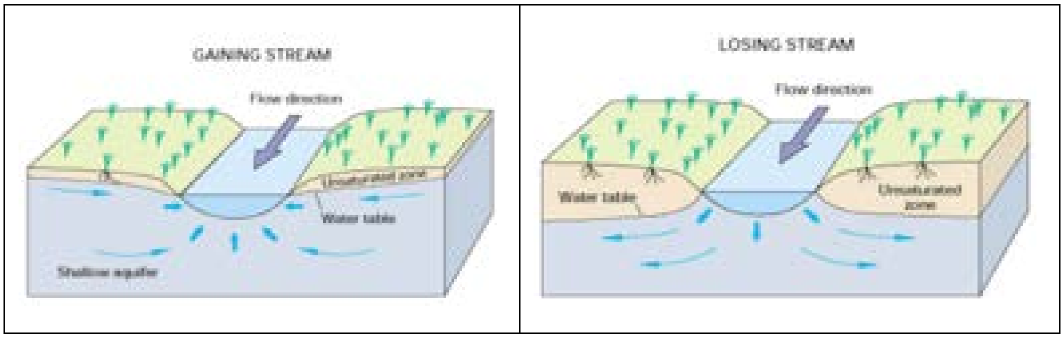
The Indiana Department of Natural Resources (IDNR) and the U.S. Geological Survey (USGS) have collected groundwater level data in Indiana since 1935 (IDNR 2025). The state's observation-well network currently consists of 35 wells located throughout the state. In addition to these wells, IDNR monitors wells through the Voluntary Groundwater Level Monitoring Program. The program incorporates privately owned wells to complement the network of existing monitoring stations used to track groundwater elevations throughout Indiana. The program is a collaboration between the IDNR Division of Water and the USGS and was used to display highly productive areas and aquifers in this report.

A.2 Baseflow

Baseflow represents the portion of streamflow derived from groundwater discharge that sustains flow between precipitation events. It provides a critical link between surface water and groundwater systems, maintaining ecological habitats, and reliable water supply during dry periods. In the Kankakee Basin, baseflow primarily originates from shallow unconsolidated aquifers composed of sand and gravel, as well as localized bedrock aquifers within valley bottoms and riparian zones. Precipitation infiltrates through the soil and recharges these aquifers, which subsequently release water to streams over time (Ward and Trimble 2003). Stream–groundwater interactions occur in three fundamental ways:

- Gaining streams, where groundwater discharges into the channel through the streambed (Figure A1).
- Losing streams, where surface water infiltrates downward into the underlying aquifer (Figure A1).
- Intermittent systems, where a stream alternates between gaining and losing reaches depending on season or hydrologic conditions.

These processes are illustrated conceptually in Figure A1. Groundwater contributes to streamflow (i.e., acts as baseflow) when the local water-table elevation exceeds the stream-water surface elevation, allowing groundwater to flow laterally into the channel (Winter et al. 1998). The rate and magnitude of this exchange depend on soil and geologic properties, including the presence of macropores, fractures, and hydraulic connectivity within the shallow aquifer. Recharge processes such as infiltration following rainfall or snowmelt enhance baseflow, while evapotranspiration by vegetation during the growing season can substantially reduce it (Bierman and Montgomery 2013).

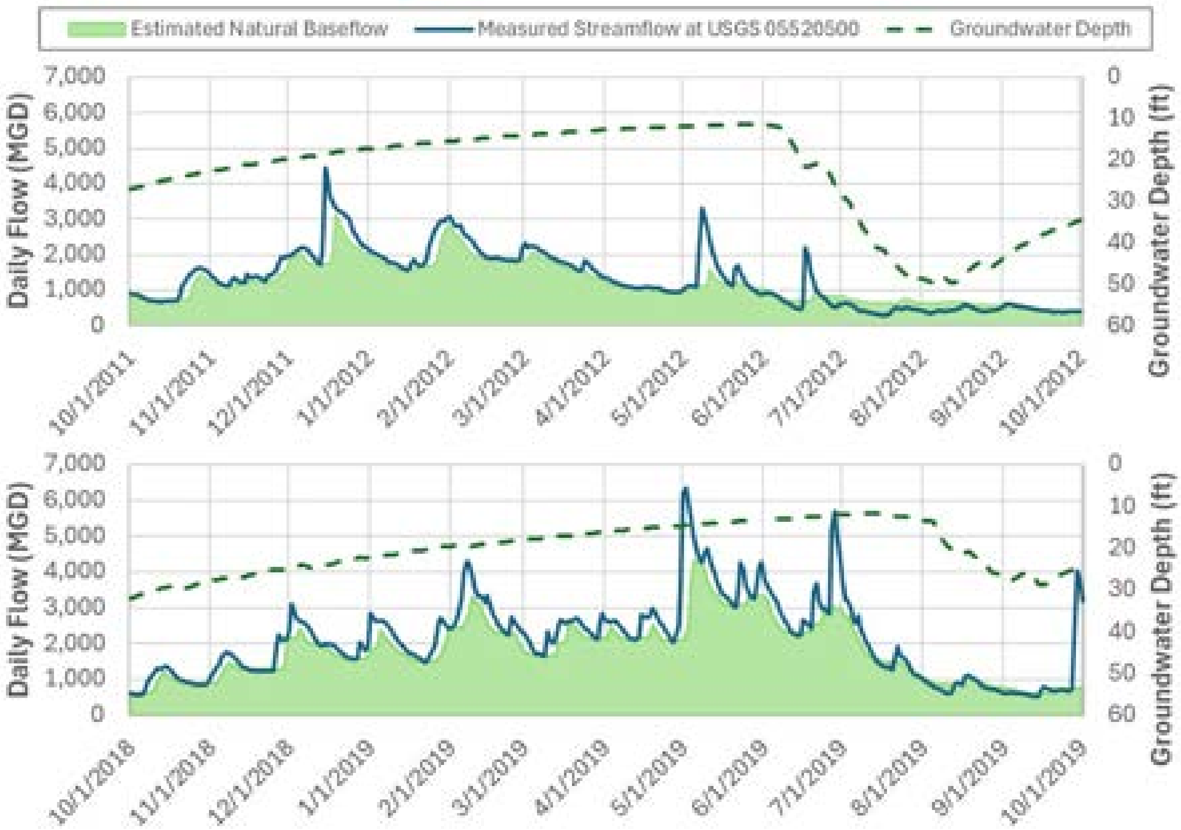


Source Winter et al. 1998

Figure A1. Conceptual Diagrams of Gaining and Losing Streams from Baseflow

Baseflow contributions are highly seasonal and event driven. During the winter and early spring, when evapotranspiration is low and soils are saturated, infiltration and recharge are greatest, leading to higher groundwater levels and increased baseflow. In contrast, during summer and early fall, much of the incoming precipitation is consumed by vegetation or lost to evaporation before it can recharge the aquifer, resulting in reduced baseflow.

As discussed in more detail in Section 5.6, the baseflow portion of streamflow can be quantified using a baseflow separation mathematical method. These dynamics are illustrated in Figure A2, which shows measured and estimated baseflow at USGS 05520500 (Kankakee River at Momence, IL) and groundwater elevations at USGS monitoring well 410428087231501 (Newton 8), a nearby well completed in Silurian-Devonian aquifers. The upper hydrograph represents a relatively dry year (2012), while the lower plot depicts a relatively wet year (2019). In both cases, the steady, low-flow component of the hydrograph reflects groundwater-derived baseflow, whereas the sharp flow peaks correspond to surface-runoff events from rainfall or snowmelt. During wet periods (e.g., winter 2011-spring 2012), groundwater recharge is evident as rising groundwater elevations accompany increased streamflow. In contrast, during extended dry periods (e.g., late summer through fall 2012), streamflow declines and groundwater levels fall sharply, indicating limited recharge and dominance of discharge from groundwater storage. This pattern demonstrates that, throughout much of Indiana, groundwater recharge occurs mainly during the cool months, while baseflow during summer and fall is sustained by earlier recharge stored within the aquifer system.



Source USGS 2025

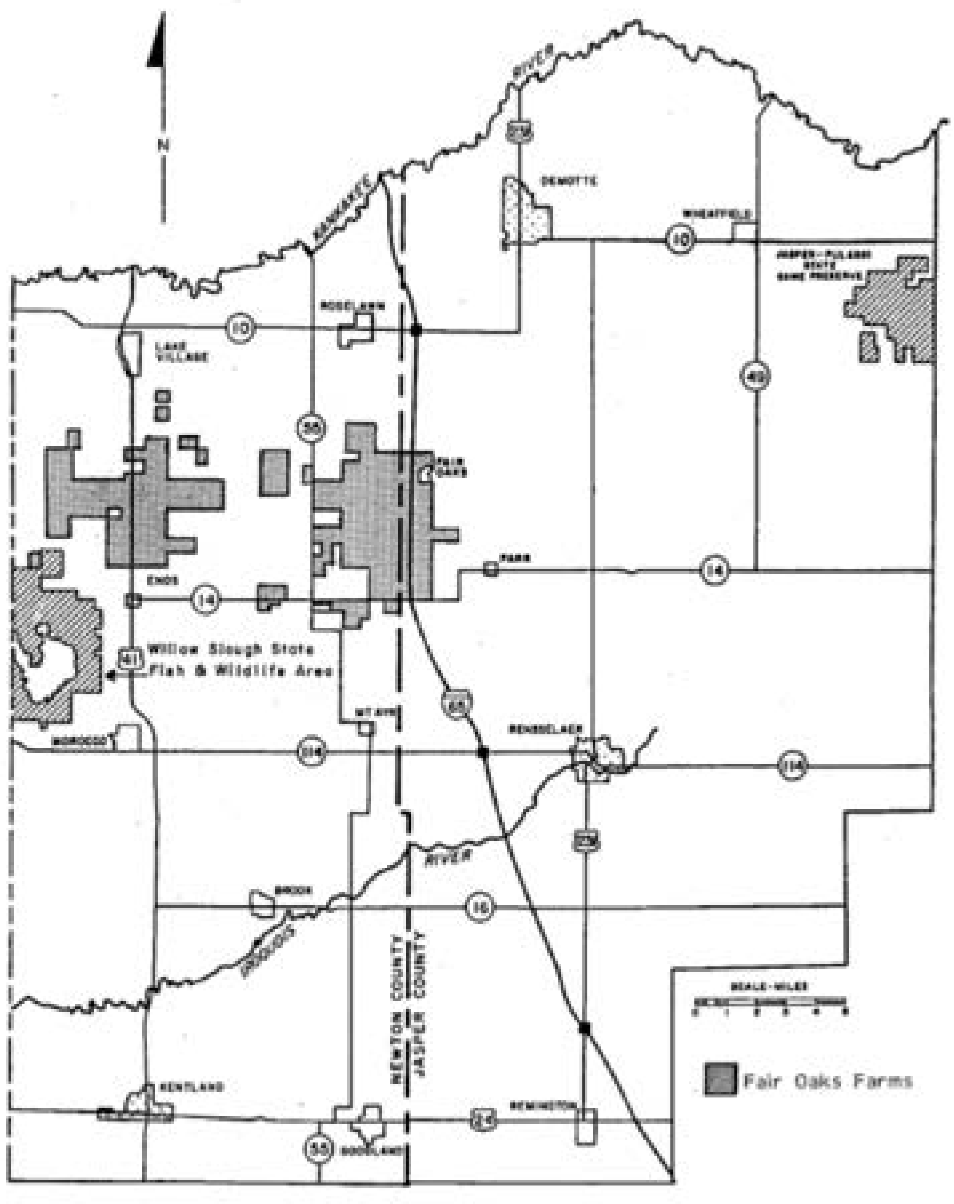
Note: USGS 410428087231501 is a groundwater well located a few miles south of the Kankakee River on US Highway 41 and was completed in "Silurian-Devonian aquifers" based on the National Aquifer Code and "Silurian System" based on the local aquifer code. This groundwater monitoring located in Newton County, IN and near Momence, IL, and is taken to be generally representative of groundwater elevations in the floodplain-connected aquifer near Momence, IL. Also, estimated natural baseflow obtained using HYSEP sliding interval method (additional details are provided in Section 5.6)

Key:
ft = feet
MGD = million gallons per day
USGS = U.S. Geological Survey

Figure A2. Measured Streamflow and Estimated Baseflow at USGS 05520500 Kankakee River at Momence, IL and Groundwater Elevation at USGS 410428087231501 for a Relatively Dry Year (2012, top) and a Relatively Wet Year (2019, bottom)

A.3 Prior Irrigation Water Use Conflicts

In 1980, an agricultural complex known as Fair Oaks Farms was bought by the Prudential Insurance Company of America. According to Basch and Funkhouser (1985), 32 center-pivot irrigation systems were installed after the purchase. The irrigation systems primarily sourced their water from 34 deep Silurian-Devonian Carbonate Aquifer wells, but also pulled water from nearby drainage ditches and two sand and gravel wells in the Kankakee Aquifer. From 1981 through 1989, more than 225 complaints were made by individuals in Jasper and Newton Counties concerning well and water system issues who source their water from the same Carbonate and Kankakee Aquifers as Fair Oak Farms. The location of Fair Oaks Farms is depicted below in Figure A3.



Source: Basch and Funkhouser, 1985

Figure A3. Location of Prudential's Fair Oaks Farms in Jasper and Newton Counties, Indiana

Hydrographs from 1981 through 1984 were analyzed along with considerations of the Kankakee and Carbonate Aquifers' hydrologic properties to assess whether individual wells had been adversely affected by the increase in irrigation activity at Prudential's Fair Oaks Farms properties. In the summer of 1981, 40 bedrock wells were reported as being impacted by groundwater-level reductions. As a result, individuals had to either lower their existing pumps, purchase new pumps capable of lifting water from greater depths, or drill deeper wells. Most of the wells in these complaints were located near or in the town of Parr, while only ten were located near the Fair Oaks Farms, which made it difficult to accurately assess the magnitude and extent of the water-level reductions in the carbonate aquifer other than through records obtained from individuals who reported well issues.

In 1982, new legislation gave IDNR the authority to control and restrict groundwater withdrawal when certain conditions were met. In response to this new legislation and increased public awareness of reduced water levels, the IDNR upgraded its well monitoring program to include an additional 25 observation wells in Jasper and Newton Counties. The summer of 1982 resulted in 42 well-complaint reports from individuals to the IDNR. An investigation by the IDNR revealed that all 42 wells involved in the reports did not meet the well-construction guidelines according to Indiana Code 13-2-2.5-5. Individuals who had updated their wells to conform to Indiana Code did not experience significant groundwater-level reductions in the summer of 1982.

During the summer of 1983, 22 residents of Jasper and Newton Counties reported well or pump issues. Of the 22 reports, the IDNR found that 19 of the complaints involved limestone wells impacted by irrigation-induced drawdowns in the Carbonate Aquifer. None of these 19 wells met the I.C. 13-2-2.5-5 well-construction guidelines. The remaining four complaints pertained to the sand and gravel units of the Kankakee Aquifer where water-level reductions were likely due to the abnormally dry summer of 1983.

In an effort to improve the water supply during the drought summer of 1983, Prudential's Fair Oaks Farms removed over 1,000 acres of previously irrigated cropland. This helped offset the high water demand needed for crops, but the water use for the year 1983 was still nearly double that of 1982.

In the summer of 1984, 30 well-issue complaints were filed to the IDNR in areas that had not previously experienced extensive groundwater-level reductions. Wells in the Sumava Resorts community along the Kankakee River experienced water-level reductions up to 25 feet during late August. Individuals south of Fair Oaks Farms near Enos and Mount Ayr saw water levels drop up to 40 feet. The IDNR found that water-level reductions in the Sumava Resorts community were likely due to combined irrigation pumping at Fair Oaks Farms and other local irrigators. The water-level drops south of Fair Oaks Farms were deemed influenced by Fair Oaks Farms irrigation pumping, but could have also been influenced by pumping in Illinois.

During the drought conditions of 1988, record low ground-water levels were recorded in 19 of the 23 bedrock and unconsolidated observation wells in the Kankakee River Basin. The greatest water-level declines were recorded in two bedrock wells in western Newton County, where maximum drawdowns were 88 and 71 feet. In the area monitored by these two wells, localized dewatering of the bedrock aquifer occurred during much of July and August, primarily as a result of hydrogeologic conditions, and heavy irrigation pumping on either side of the Indiana-Illinois state line.

IDNR Division of Water (1990) investigated all the complaints and found most problems reported for shallow water wells were the result of seasonal water-table fluctuations in the sand aquifer, and generally were corrected by deepening the wells or lowering the well pumps. Losses of water supply in wells completed in the carbonate aquifer, however, frequently resulted from water-level declines induced by high-capacity irrigation pumping from the bedrock. Many of the domestic and livestock wells in Jasper and Newton Counties that were shown to be adversely affected by irrigation pumping were voluntarily upgraded by area irrigators. In some cases, however, provisions of I. C. 13-2-2.59 were invoked to provide an immediate temporary supply of potable water to owners of affected small-capacity wells. Each matter was subsequently brought before the Natural Resources Commission to determine timely and reasonable compensation as specified in I. C. 13-2-2.5.

In response to recurring groundwater conflicts in Jasper and Newton Counties, the IDNR Division of Water (1990) suggested several water-management alternatives in an attempt to alleviate the potential for future conflicts, particularly during the irrigation season and during periods of drought. The suggested alternatives called for (1) the additional development of the surficial sand aquifer as an alternative or complementary groundwater source for irrigation; (2) an examination of the need for localized restrictions on the drilling of new high-capacity bedrock wells; (3) the implementation of water-conservation practices in some irrigation areas; (4) the proper installation of small-capacity wells; and (5) continued coordination with the State of Illinois to manage irrigation development in the bi-state area where the carbonate aquifer is heavily pumped.

Irrigation pumping in this area continues to affect the water table, but there have been fewer complaints regarding the effects of pumping since 1990. Pumping impacts are less noticeable now for several reasons. Some of the irrigation wells have been removed from service so there is less stress on the aquifer. Additionally, most of the residential and farm wells in this area have been deepened or had their pumps lowered.

A.4 References

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APPENDIX B

Data Collection, Pre-Processing, and Analysis for Water Budget Components: Availability and Supply

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Kankakee Basin Regional Water Study

Appendix B – Data Collection, Pre-Processing, and Analysis for Water Budget Components: Availability and Supply

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Abbreviations

CAFO	Concentrated Animal Feeding Operation, larger regulated livestock operation
CFO	Confined Feeding Operation, smaller regulated livestock operation
cfs	cubic feet per second
CSS	Combined Sewer System
DAR	drainage area ratio
DPR	drainage precipitation ratio
DSS	data storage system
ECHO	U.S. EPA Environmental Compliance History Online
EP	energy production (water-use sector)
EPA	U.S. Environmental Protection Agency

GIS	Geographic Information System
I&I	infiltration and inflow
ICIS-NPDES	Integrated Compliance Information System National Pollutant Discharge Elimination System
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IN	industrial (water-use sector)
IR	irrigation (water-use sector)
MG	million gallons
MGD	million gallons per day
MI	miscellaneous (water-use sector)
NID	National Inventory of Dams
NPDES	National Pollutant Discharge Elimination System
NWIS	National Water Information System
PS	public supply (water-use sector)
PWDAR	precipitation-weighted drainage area ratio
RU	rural use (water-use sector)
sq.mi.	square mile
SSS	sanitary sewer system
Study	Kankakee Basin Regional Water Study
Study Area	Kankakee Basin
SWWF	Significant Water Withdrawal Facility (high-capacity water pumping)
USGS	U.S. Geological Survey
WWTP	Wastewater Treatment Plant

Appendix B Historical Data Collection, Pre-Processing, and Analysis for Water Budget Components: Availability and Supply

This appendix describes the data sources and processes of data collection, screening, and pre-processing of all data specifically for water availability and supply components used in the modeling tools for Kankakee Basin Regional Water Study (Study).

B.1 Streamflow Data and Subbasin Delineation

B.1.1 DATA SOURCES

Streamflow data were obtained from publicly available websites for U.S. Geological Survey (USGS) gages within the Kankakee Basin (Study Area) (USGS 2025a). All USGS gage stations were identified in Indiana and Illinois and screened based on location (within the HUC08 boundaries of the Study Area), period of record (continuous measurements from at least 2007-2023), data availability (daily discharge), and drainage area (greater than 100 square miles). The period of record for streamflow (2007-2023) was selected based on data availability and public records required for our analysis (i.e., National Pollutant Discharge Elimination System (NPDES) return-flow data). Also, as noted in the main report (Section 2.2), annual flow volumes from this 17-year period were compared to the 100-year flow record (1925-2024) at USGS 05518000 (Kankakee River at Shelby, IN) and were found to represent the typical temporal streamflow patterns and flow magnitudes observed over the longer historical record.

B.1.2 PRE-PROCESSING

A total of 49 USGS stream gage candidates were identified across Indiana and Illinois. In Indiana, eight of the 40 gages met the screening criteria, and in Illinois, five of nine gages met the screening criteria. The Study Area was reviewed to assess the spatial distribution of the subset of 13 USGS gages with respect to dams, HUC08 boundaries, and significant surface and groundwater withdrawal facilities. When two gages met all criteria but were in close proximity to each other, the gage further downstream was selected for inclusion in the analysis. Additionally, the final subbasin delineations were bounded by the Indiana-Illinois state line, resulting in only two USGS gages located within Illinois. This resulted in the selection of six USGS gages to represent streamflow within the Study Area (Figure B-1 and Table B-1). For each USGS gage, daily streamflow data were accessed from the USGS National Water Information System (NWIS) using the data retrieval package in the R programming language (De Cicco et al. 2022) and assessed for completeness.

Key: N/A = not available NIDID = National Inventory of Dams ID sq. mi. = square mile

Figure B-1. Spatial Distribution of U.S. Geological Survey Gage Locations Utilized in the Study

Table B-1. Streamflow Gages Selected in Study Area

USGS Gage Number	USGS Station Name	State	Watershed Drainage Area (sq. mi.)
05517000	Yellow River at Knox, IN	Indiana	435
05515500	Kankakee River at Davis, IN	Indiana	405
05517530	Kankakee River near Kouts, IN	Indiana	1,376
05518000	Kankakee River at Shelby, IN	Indiana	1,779
05520500	Kankakee River at Momence, IL	Illinois	2,294
05525000	Iroquois River at Iroquois, IL	Illinois	686

Key:
IL = Illinois
IN = Indiana
sq. mi. = square mile
USGS = U.S. Geological Survey

To support subbasin delineation, drainage area boundary shapefiles for each selected USGS gage were obtained from USGS StreamStats (USGS 2025b). A geospatial analysis of drainage area, county boundaries, and significant water withdrawal facilities in Indiana was completed to finalize subbasin delineation for the Study Area. Subbasins were delineated around each USGS gage such that the subbasin drainage area included only the portions of the watershed that drained to that USGS gage, and not to any other gages.

A total of eight subbasins were delineated within the Study Area, one corresponding to each of the six USGS stream gages located in Indiana and Illinois, and two additional subbasins representing the downstream outlets of Beaver Creek and Sugar Creek at the Indiana–Illinois state boundary. The delineations were intentionally constrained to the Indiana boundary because withdrawal datasets from Illinois were not readily available for inclusion in the analysis. Although these two downstream locations did not have USGS gages with measured daily streamflow, they serve as appropriate hydrologic outlets for defining the downstream extent of the Study Area at the Indiana–Illinois state boundary.

To address the absence of measured streamflow at the Beaver Creek and Sugar Creek outlets, synthetic daily streamflow time series were developed using the precipitation-weighted drainage area ratio (PWDAR) method. This approach estimates streamflow at an ungaged location based on data from a hydrologically similar gaged (donor) watershed. For the Beaver Creek outlet, the Iroquois River near Chebanse, Illinois (USGS 05526000) gage was selected to represent the donor watershed, since Beaver Creek is a first-order tributary within this larger watershed (Figure B-1). The Sugar Creek at Milford, Illinois (USGS 05525500) gage provided the stream flow data to estimate a synthetic hydrograph for the ungaged Sugar Creek subbasin (Figure B-1).

The PWDAR method was applied as follows:

1. Drainage Area Ratio (DAR) was calculated as the ratio of the drainage area of the ungaged subbasin (A_u) to that of the donor watershed (A_d).

2. Monthly Drainage Precipitation Ratios (DPR) were computed as the ratio of mean monthly precipitation at the ungaged subbasin ($P_{u,m}$) to that at the donor watershed ($P_{d,m}$). Daily precipitation data were obtained from the DAYMET dataset (Thornton et al. 2022).

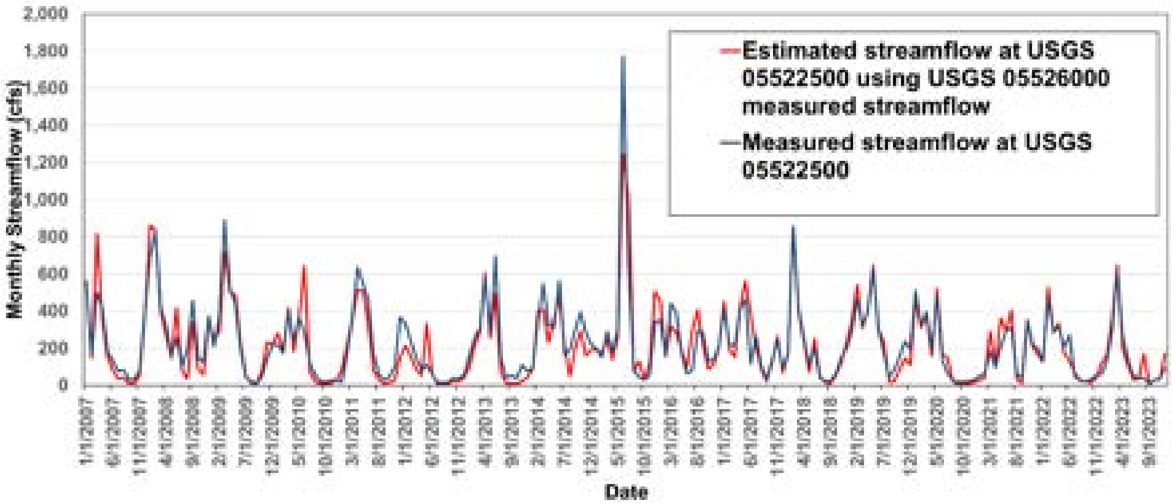
3. Synthetic monthly streamflow at the ungaged subbasin ($Q_{u,m}$) was calculated by scaling the donor watershed's monthly streamflow ($Q_{d,m}$) by both the DAR and DPR using the following relationship[1]:

$$Q_{u,m} = Q_{d,m} \times \left(\frac{A_u}{A_d}\right) \times \left(\frac{P_{u,m}}{P_{d,m}}\right)$$

4. This formulation means that if the ungaged subbasin receives proportionally more or less monthly precipitation than the donor subbasin, the resulting synthetic flow volume is adjusted accordingly. The resulting synthetic monthly streamflow series was then disaggregated to daily values using the daily flow pattern observed at the donor gage.

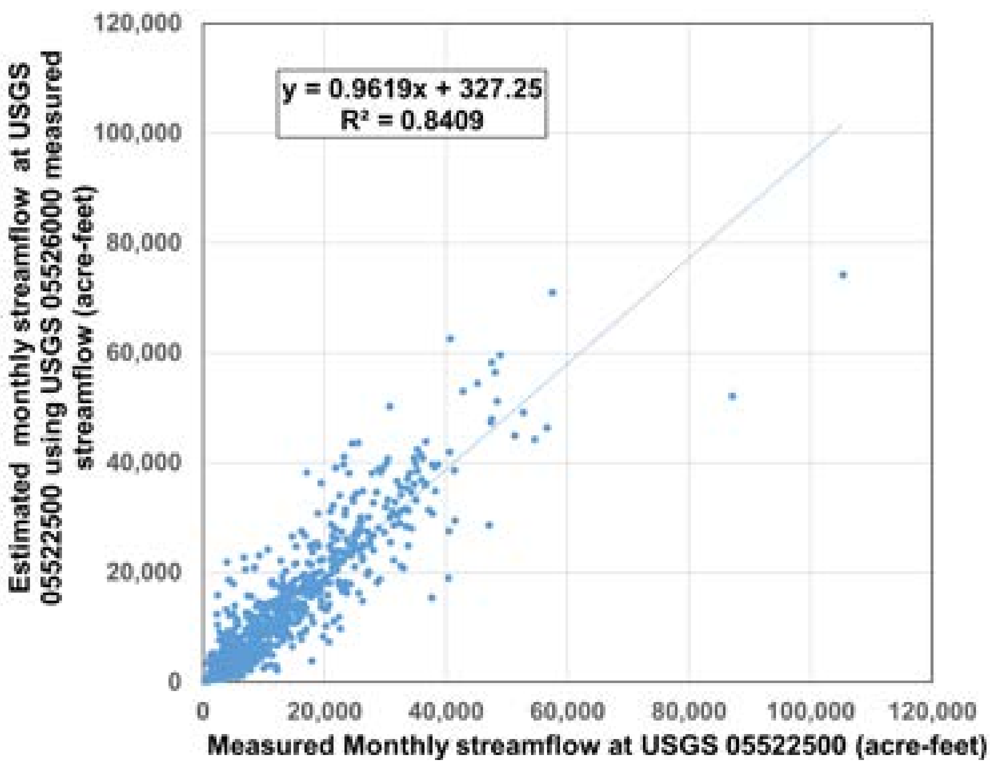
To evaluate the reliability of this method, a verification test was performed using the USGS 05522500 gage (Iroquois River at Rensselaer, IN) within the Study Area. This site is a first-order tributary of the Iroquois River (the donor watershed for Beaver Creek). Streamflow at USGS 05522500 was estimated using the PWDAR method with USGS 05526000 as the donor watershed and compared against observed values for 2007–2023. As shown in Figure B-2, the simulated monthly streamflow closely matched the observed hydrograph, capturing both peak and low-flow magnitudes and seasonal timing. The simulated and measured monthly flows also exhibited strong 1:1 correspondence (Figure B-3), indicating that the PWDAR method provides reasonable estimates of streamflow at ungaged locations within the Study Area.

[1] Note that this formulation assumes a 1:1 ratio of percent change in runoff to percent change in precipitation (a.k.a., runoff change elasticity to precipitation change); this is a source of uncertainty that varies by basin and can also vary based on hydrologic model selection.



Key:
cfs = cubic feet per second
USGS = U.S. Geological Survey

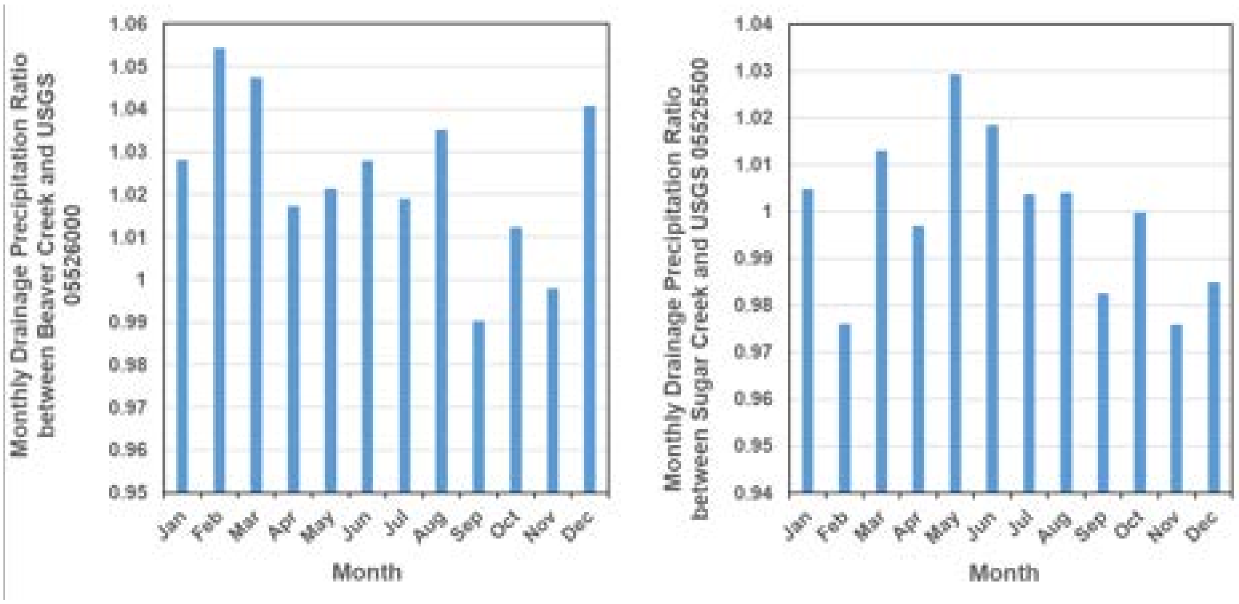
Figure B-2. Estimated and Measured Monthly Flow at USGS Gage 05522500 Iroquois River at Rensselaer, IN



Key:
USGS = United States Geological Survey

Figure B-3. Correlation of Mean Monthly Measured and Estimated Flow at USGS Gage 05522500 Iroquois River at Rensselaer, IN

The drainage area of Beaver Creek is approximately 60 square miles (sq.mi.), compared to 2,091 sq.mi. for the Iroquois River near Chebanse (USGS 05526000), resulting in a DAR of 0.03. The drainage area of Sugar Creek is 85 sq.mi., while that of Sugar Creek at Milford (USGS 05525500) is 446 sq.mi., giving a DAR of 0.19. The monthly DPRs (1980-2023) for Beaver Creek and Sugar Creek, relative to their respective donor watersheds, are presented in Figure B-4 (left and right panels, respectively).



Key:
USGS = United States Geological Survey

Figure B-4. Monthly Precipitation Factor (1980-2023) Between Beaver Creek and USGS 05526000 Iroquois River Near Chebanse, IL (Left), and Between Sugar Creek and USGS 05525500 Sugar Creek at Milford, IL (Right)

B.1.3 ANALYSIS

The final set of delineated subbasins is shown graphically (Figure B-5) and in tabular format with associated data characteristics (Table B-2).

Note: Subbasin names: 01 = Yellow Knox, 02 = Kankakee Davis, 03 = Kankakee Kouts, 04 = Kankakee Shelby, 05 = Kankakee Momence, 06 = Beaver, 07 = Iroquois, 08 = Sugar, 09.

Key:
FIPS = Federal Information Processing Standard
NAD = North American Datum
USGS = United States Geological Survey

Figure B-5. Map of Delineated Subbasins in Study Area

Table B-2. Characteristics of Subbasins in Study Area

Subbasin ID	Subbasin Name	Subbasin Area (sq. mi.)	Watershed Area (sq. mi.)	USGS Station at Outlet	Station Name
1	Yellow Knox	435	435	05517000	Yellow River at Knox, IN
2	Kankakee Davis	405	405	05515500	Kankakee River at Davis, IN
3	Kankakee Kouts	536	1,376	05517530	Kankakee River near Kouts, IN
4	Kankakee Shelby	403	1,779	05518000	Kankakee River at Shelby, IN
5	Kankakee Momence	515	2,294	05520500	Kankakee River at Momence, IL
6	Beaver	60	60	Synthetic[1]	-
7	Iroquois	686	686	05525000	Iroquois River at Iroquois, IL
8	Sugar	85	85	Synthetic[1]	-

Note:
[1] A synthetic hydrograph was developed for subbasins 6 and 8.
Key:
IL = Illinois
IN = Indiana
sq. mi. = square mile
USGS = United States Geological Survey

B.2 Significant Water Withdrawals

B.2.1 DATA SOURCES

Indiana water withdrawal data came from the Indiana Department of Natural Resources (IDNR) Indiana Significant Water Withdrawal Facility (SWWF) historical database from 1985-2023 and was provided to the consultant team at the beginning of the project (IDNR 2025). IDNR defines a “significant water withdrawal facility” as “the water withdrawal facilities of a person that, in the aggregate from all sources and by all methods, has the capability of withdrawing more than 100,000 gallons of ground water, surface water, or ground and surface water combined in one (1) day.”[2] The SWWF database includes two datasets: one contains facility and well data, and the other includes a time series of monthly water withdrawals by volume from each facility. Each withdrawal source for a facility (surface water intake or groundwater well) was included as a separate time series and assigned to one of six water use sectors:

- Energy production (EP): Production of electricity, power generation, and cooling water
- Industry (IN): Dedicated, industry-owned wells and surface water intakes, used for industrial production including process water, cooling water, mineral extraction (except coal), quarry dewatering, and waste assimilation. Note that this water demand does not account for industries historically served by public water suppliers
- Irrigation (IR): Agricultural irrigation, golf course irrigation

[2] Indiana's Water Resource Management Act (IC 14-25-7). https://www.in.gov/dnr/water/water-availability-use-rights/significant-water-withdrawal-facility-data/

- Miscellaneous (MI): Fire protection, construction dewatering, dust control, pollution abatement, hydrostatic testing, recreational field drainage, a correctional facility, waste management departments, and habitat management in natural areas
- Public supply (PS): Public water supply, drinking water/ sanitary facilities
- Rural use (RU): A variety of rural users, but not rural residential users. Examples include Livestock, aquaculture, and several agricultural limited liability corporations. Note it appears that some large CAFOs' water withdrawals may be reported in this category

Two known withdrawal sectors are not accounted for in the SWWF database due to pump capacities at individual facilities typically being less than the minimum required in the IC 14-25-7 statute; however, collectively they withdraw a notable annual volume of water. These sectors include withdrawals for self-supplied residential domestic uses and livestock operations of different sizes. Additional information on data collection and demand estimates for these categories is provided in Appendix C. In addition, Illinois withdrawal estimates were derived using data from the nearest Indiana county located within the same subbasin.

B.2.2 PRE-PROCESSING

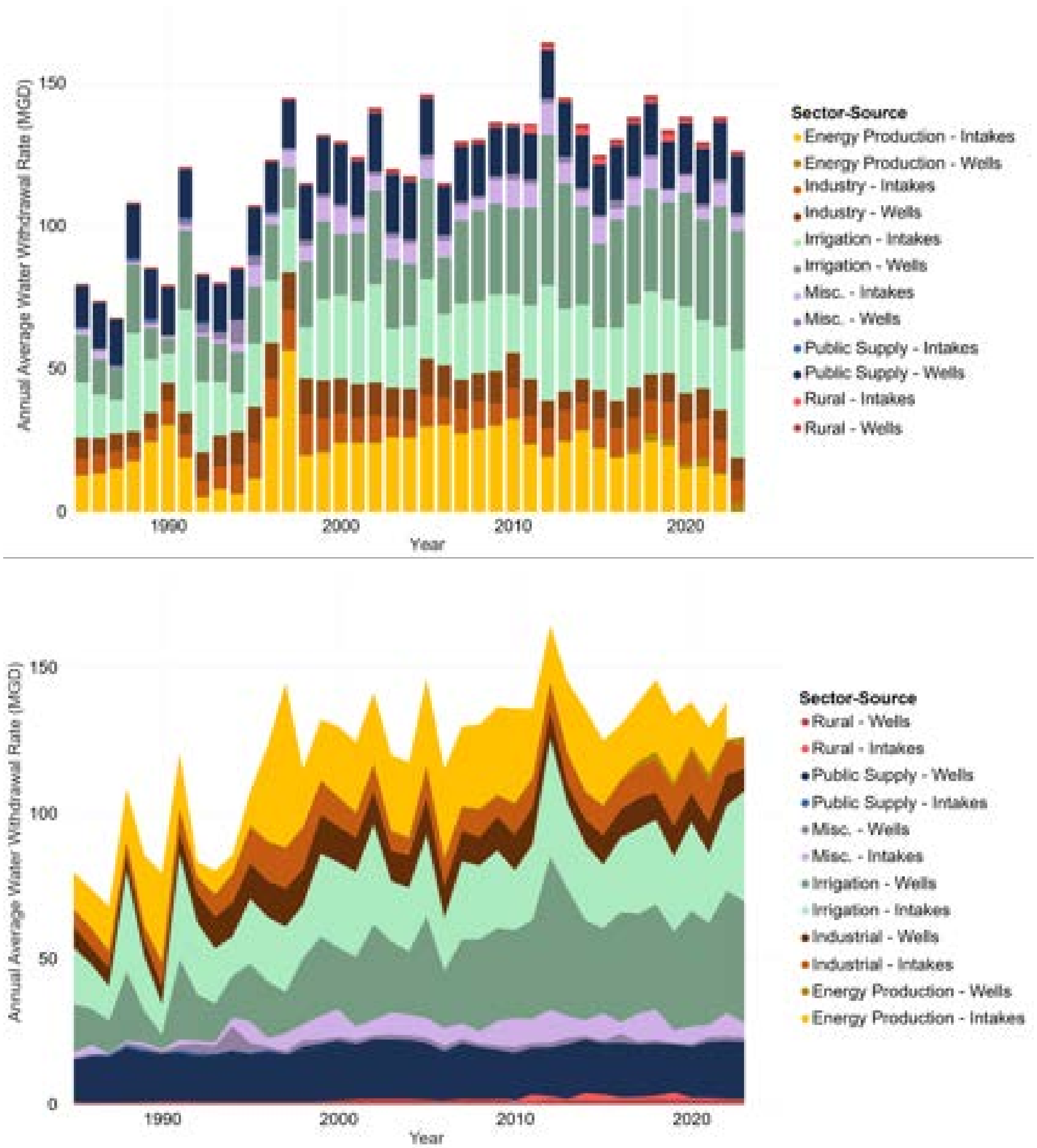
Raw data were initially reviewed for quality, facility locations, withdrawals, and pumping capacity. Spatial analysis of facility locations was employed using Geographic Information System (GIS) to review and validate the locations of large withdrawals and compare them with publicly available information to verify the accuracy of the dataset.

Additional attributes were added to each facility location to facilitate withdrawal analysis, including subbasin ID, an identifier to indicate if the withdrawal was inside or outside the Kankakee Basin Study Area, and an attribute indicating whether the withdrawal location overlaid an unconsolidated aquifer or a bedrock aquifer, based on the underlying IDNR, Division of Water aquifer units and the USGS aquifer type code.

Historical and future water withdrawals for Illinois were estimated from the nearest Indiana county within each subbasin. Details on sector-specific methodology for Illinois water withdrawal estimations are included in Appendix C.

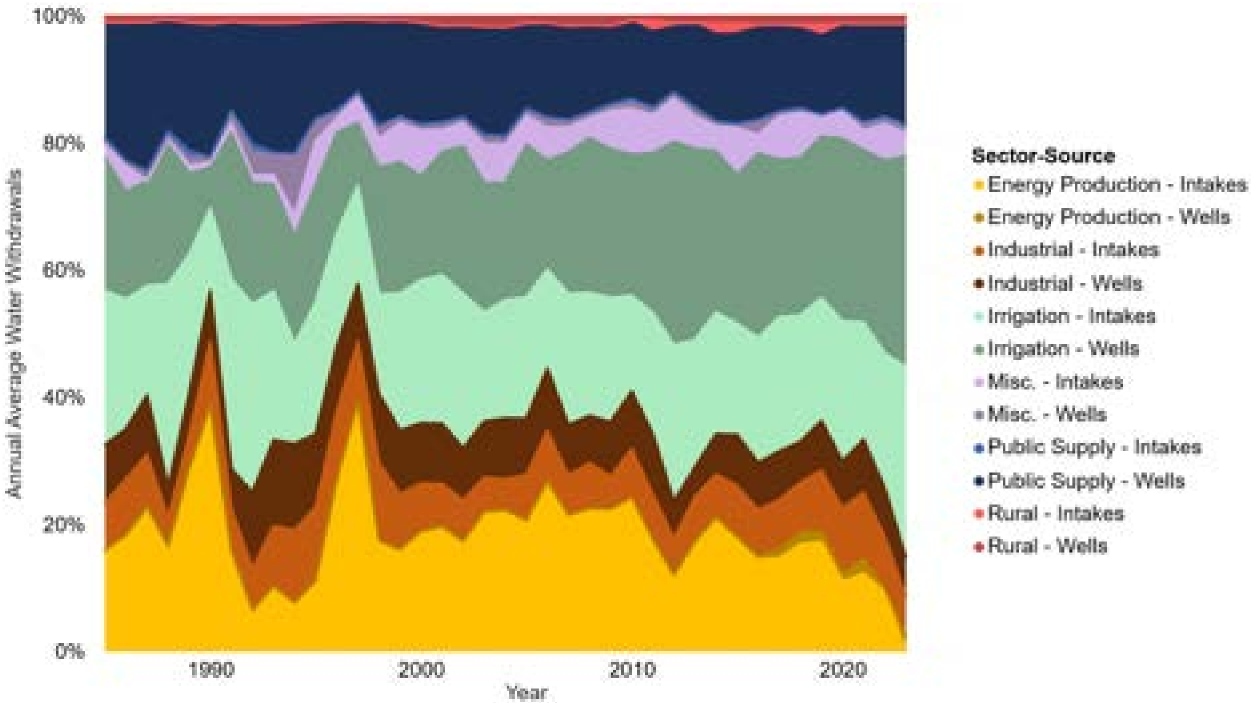
B.2.3 ANALYSIS

Utilizing geospatial data of facility and well location files provided to the consultant team (IDNR 2025), the two datasets were aggregated into one spatial file. This aggregation assigned well information to each withdrawal facility, creating a joint database. The geospatial locations for each facility were then re-evaluated, and the joint database was reviewed for accuracy relative to water use sector, associated aquifers, pump ID, and facility names. An analysis of the results aggregated across all Kankakee Basin Study Area counties (Benton, Jasper, Lake, La Porte, Marshall, Newton, Porter, St Joseph, Starke, Elkhart, Fulton, Kosciusko, Pulaski, and White) allowed for an initial investigation of sector usage trends, surface water usage, and groundwater usage. Annual water withdrawal magnitude and distribution in the Study Area for 1985 to 2023 are shown in Figures B-6 and B-7.



Key: well = groundwater well intake = surface water intake

Figure B-6. Stacked Bar (top) and Stacked Area (bottom) of Annual Water Withdrawal Magnitude by Sector and Source Type Within the Kankakee Basin Study Area from 1985–2023



Key:
well = groundwater well
intake = surface water intake

Figure B-7. Annual Water Withdrawal Distribution by Sector and Source Type Within the Kankakee Basin Study Area from 1985–2023

The database was checked to confirm that each facility and well was correctly assigned to the appropriate subbasin based on spatial location and boundary overlap.

B.3 NPDES Return Flows

B.3.1 DATA SOURCES

This study sourced timeseries data for historical wastewater return flows in each subbasin from the U.S. Environmental Protection Agency (EPA) Enforcement and Compliance History Online (ECHO) database (EPA 2025). The database contains discharge monitoring reports regulated by the NPDES program. In Indiana, the Indiana Department of Environmental Management (IDEM) administers the NPDES permit program on behalf of the EPA. All the timeseries data for return flows were downloaded from the EPA ECHO database[3] (EPA 2025). Major return flows in the Kankakee Basin include effluent from wastewater treatment plants, cooling water discharge from energy producers, industrial and commercial discharges, and dewatering discharge from mines. The data obtained from ECHO includes average discharges from regulated facilities on a monthly or quarterly basis from 2007-2023. There was no data reported prior to

[3] https://echo.epa.gov/trends/loading-tool/get-data/monitoring-data-download

2007. This important dataset was required to accurately estimate water returns within the hydrologically based water availability assessment for this Study. Therefore, the basis for limiting the historical period to 2007-2023 for water availability used in this study is the return-flow data availability from the NPDES database.

The location of discharging facilities and their corresponding NPDES Permit ID were obtained from the NPDES Discharge Points Feature Service (EPA ECHO Map Services[4]) and the IDEM List of NPDES Permits[5] (EPA 2025a, IDEM, 2025).

B.3.2 PRE-PROCESSING

A Python script that was developed for the prior regional water study (Stantec 2025) was utilized to download data from 2007 to 2023 for all NPDES IDs within the Study Area and aggregate them into a monthly time series. Data downloaded from EPA ECHO database incorporates information from Integrated Compliance Information System National Pollutant Discharge Elimination System (ICIS-NPDES) and contains standard attributes defined in the ICIS-NPDES Download Summary and Data Element Dictionary[6] (EPA, 2025b). Data was filtered using outfall number, monitoring location code, parameter description and statistical base. Key attribute values generally considered during data processing included: monitoring location code =”1,” parameter description = “Flow, in conduit or thru treatment plant,” and statistical base = “MO AVG.” An NPDES permit may include multiple outfalls; the data were analyzed, screened, and aggregated to only include outfalls discharging flow to an external waterbody. In some cases, the only value available was a quarterly discharge, which was converted to a monthly discharge as described below.

B.3.2.1 General

All returns were reviewed to identify facilities having Actual Average Flow Number or Total Design Flow Number (as defined in ICIS-NPDES Download Summary and Data Element Dictionary[6] (EPA, 2025b)) exceeding 1 million gallons per day (MGD) (a threshold used to filter out larger return flows that may influence the water budget calculation). Such facilities were thoroughly reviewed to understand the nature of the data and identify any anomalies. NPDES Permits, inspection reports, etc. obtained from IDEM’s Virtual File Cabinet (for facilities in Indiana), and Illinois Environmental Protection Agency’s (IEPA) document explorer (for facilities in Illinois) were used for review. This detailed review revealed some irregularities within the NPDES return flow data. When such anomalies were identified and considered clearly erroneous, adjustments were made to align the data with the values of adjacent months. Some of the anomalies found are explained in detail below:

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[4] https://services.arcgis.com/cJ9YHowT8TU7DUyn/arcgis/rest/services/oeca__echo__npdes_facilities_outfalls/FeatureServer
[5] https://www.in.gov/idem/cleanwater/files/permit_npdes_list.xlsx
[6] https://echo.epa.gov/tools/data-downloads/icis-npdes-download-summary

1. **Investigation of Monthly Flow Spikes:** Instances of abrupt monthly increases in discharge, inconsistent with the overall time series, were scrutinized. Discharge data were cross-referenced with the nearest downstream USGS gage streamflow data. If the USGS gage indicated an increase in streamflow, the discharge data was not modified. But if there was no discernible increase in USGS gage measured flow downstream, the monthly discharge value was assumed to be an average of the preceding and proceeding months.

2. **Units Consistency:** Some data entries were reported using one statistical base but contained values corresponding to another. For instance, Average Monthly Flow values were typically reported in MGD units but sometimes were reported in million-gallons-per-month units. To rectify this, necessary conversions were performed to ensure consistency and accuracy in the dataset.

3. **Statistical Consistency:** Certain mining facilities reported data as Quarterly Maximum rather than Quarterly Average. A relationship between Quarterly Average and Quarterly Maximum values was established, and Quarterly Average Values were computed and extended to develop a Monthly Average Flow time series.

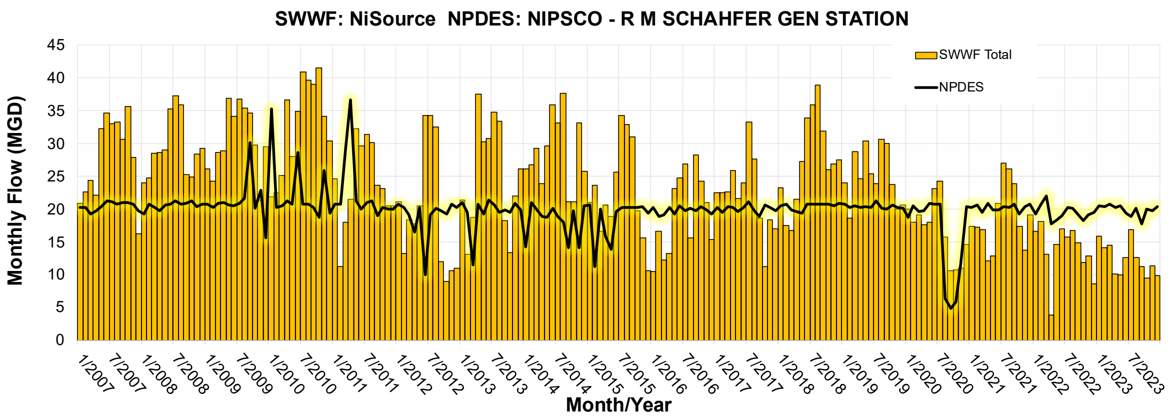
4. **Spatial Verification and Correction:** The spatial locations of some of the dischargers were incorrect in the GIS database. Such locations were investigated based on the physical address of the facility and corrected as necessary. For example, one facility (IN0063479) had discharge points in two entirely different geographical locations. Location was verified against the physical address of the facility and the appropriate subbasin ID was assigned. In addition, facility IN0021466 was excluded from the study as the spatial location of primary outfall was outside the study area even though other discharge points were within the subbasin boundary.

B.3.2.1.1 Energy Facilities

The major water discharge for the energy sector within the Study Area is the coal-fired R.M. Schahfer energy generating station in Jasper County, Indiana. Several outfalls are reported under the NPDES system for return flows, and one was identified that discharged to an external water body. Reported withdrawals for two SWWF facilities associated with this generating station were identified and matched with the reported NPDES return flows. In general, the withdrawals followed similar trends, but return flows were relatively stable at about 20 MGD monthly, indicating little to no variation even though there was presumably some level of consumptive use at the energy plants. Further review revealed facility inspection reports indicating that the final outfall discharge may have been pumped from the final settling basin, which could explain the relatively stable return flow observed throughout the period.

Because this analysis reflects historical operation of the coal-fired generating station (which is scheduled to be retired in 2025, with remaining gas-peaking units planned for retirement by 2028), the consumptive-use adjustment is applied only within the context of the historical framework evaluated in this study.

To more accurately reflect the consumptive use proportion, return flows from all coal-based generating facilities were adjusted to 44% of the monthly water withdrawal volumes, consistent with the 2010 consumptive-use coefficient for recirculating-tower cooling reported in Harris and Diehl (2019). Although a lower 2015 coefficient (40%) is also reported, the 44% value was selected to better represent the facility's historical cooling configuration during the analysis period and to maintain consistency with consumptive-use assumptions applied elsewhere in the Study. This adjustment results in an implied consumptive-use coefficient of 56%, which is within the range reported for historical coal-fired generation and consistent with published values for similar facilities. Figure B8 represents the comparison between NPDES return flow and SWWF withdrawal for the generating station.



Key:
MGD = million gallons per day
NPDES = National Pollutant Discharge Elimination System
SWWF = Significant Water Withdrawal Facility

Figure B-8. Monthly Water Withdrawals and Return Flows (left axis), for a Coal-Fired Energy Generating Station in Jasper County, Indiana

B.3.2.2 Wastewater Treatment Plants

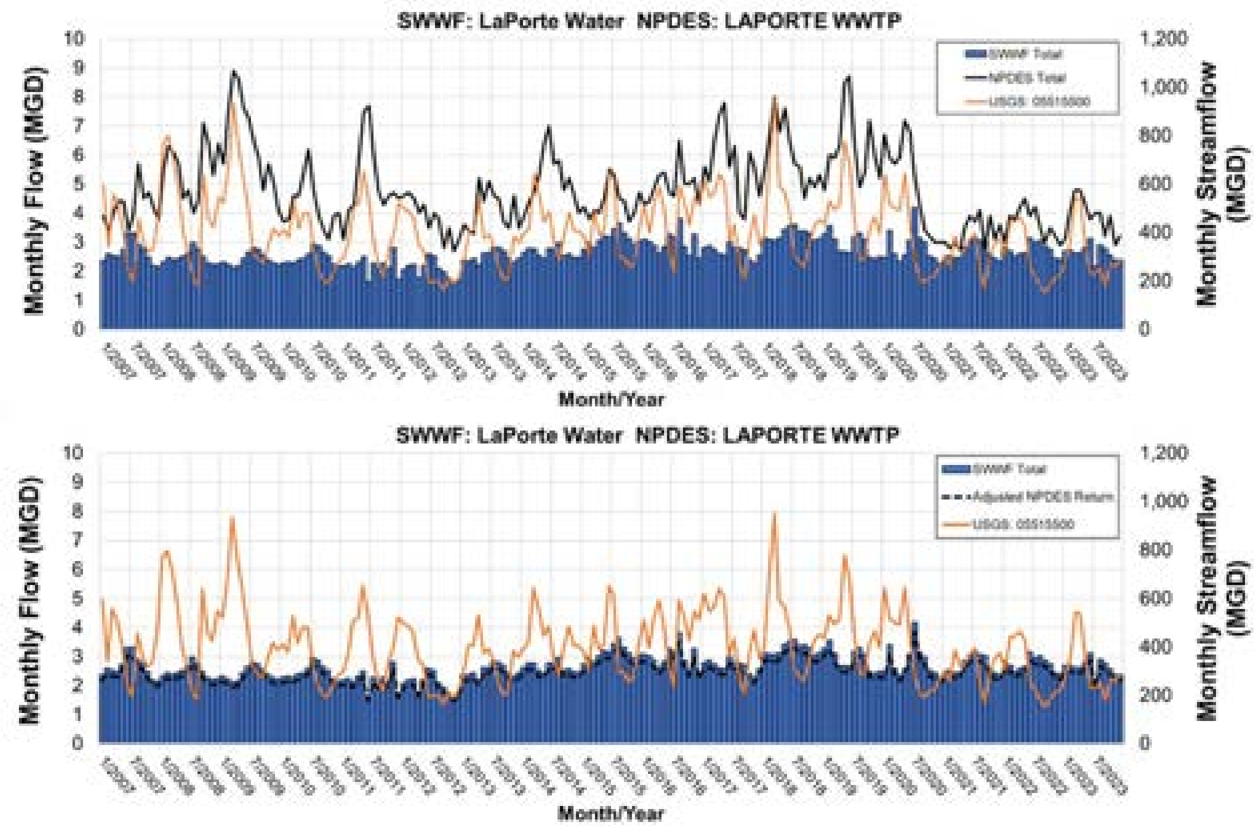
Establishing and evaluating the relationship between withdrawals and return flows based on water use type and identifying any major changes to the water system is vital for interpreting current water availability and projecting future conditions. To achieve this, significant water withdrawals were compared to corresponding return flows across major water use sectors defined by the IDNR. As part of the initial analysis and data modification, the Public Supply sector was examined in detail.

In Kankakee Basin Indiana, the primary dischargers in the Public Supply sector are Wastewater Treatment Plants (WWTP). Ten WWTPs with average return flows exceeding 1 MGD for the year 2023 were analyzed in detail and were compared to the associated SWWF facility or facilities that were presumed to be the primary source of treated water for that WWTP. In addition, facility permits, inspection reports etc. obtained from IDEM's Virtual Cabinet and IEPA's document explorer were reviewed. It was concluded that major Public Supply return flows within Kankakee Basin are from WWTPs serving Combined Sewer Service areas, where Public Supply withdrawals exceeded return flows during dry months (suggesting higher consumptive use during Summer) and return flows were significantly higher than withdrawals during wet months (indicating the presence of stormwater components, infiltration, and inflow in the reported return flows). For Combined Sewer System (CSS) WWTPs, the higher peaks in return flows can be attributed to stormwater, whereas for Sanitary Sewer System (SSS) WWTPs, they can be attributed to Infiltration and Inflow (I&I). For the purposes of this Study, return flows are assumed to be anthropogenic increases in measured streamflow that are accounted for in the estimation of natural streamflow. The inclusion of combined sewer overflow or sanitary sewer overflow events in return flows would artificially inflate return flows, which, when subtracted from measured streamflow, would artificially decrease the estimate of natural streamflow.

A method to modify reported WWTP return flows to remove stormwater and/or I&I contributions was developed and applied to reported data. This method was formulated based on the identified relationship between withdrawals and return flows and informed by measured streamflow at gages downstream of the withdrawal and return flow locations. For each of the major 10 WWTPs, a SWWF dataset was compiled that reflected the assumed water withdrawals associated with the WWTP. The monthly data for WWTPs and SWWFs were plotted from 2007-2023 and compared to measured streamflow downstream. Time periods were identified with minimum annual return flows, which generally correlated with periods of minimal streamflow. Return/SWWF ratios were calculated, and the ratios corresponding to lowest return flow each year were averaged to obtain a single average multiplier for each WWTP. This multiplier was applied to the timeseries of monthly withdrawals to generate a synthetic hydrograph for WWTP return flow. For facilities such as Lowell WWTP, where the return consistently exceeded withdrawals throughout the study period, the minimum annual return flow was applied across each month to develop monthly time series.

An example is provided for the LaPorte Water Utility, the LaPorte WWTP, and measured streamflow at USGS 05515500 Kankakee River at Davis, IN. The reported return flows exceed the reported withdrawals significantly in the Winter and Spring months, with peaks that correlate in time to peaks in measured streamflow and are inversely correlated to withdrawals (Figure B-9, top). The relationship between return flows and withdrawals during low streamflow and low return flow periods was identified and return flows as a percentage of withdrawals was calculated. This percentage was applied to the withdrawal timeseries to develop a synthetic return flow hydrograph for the study period (Figure B-9, bottom).

After finalizing the monthly time series data, it was converted into daily time series for integration into the Data Storage System (DSS) tool to streamline computational processes.



Note: Reported Return Flows (top) and Adjusted Return Flows to Remove Stormflow Component (bottom).
Key:
SWWF = Significant Water Withdrawal Facility
NPDES = National Pollutant Discharge Elimination System
MGD = Million gallons per day

Figure B-9. Monthly Water Withdrawals and Return Flows (left axis) and Measured Monthly Streamflow (right axis), for a Select Public Water Supply Withdrawal and Wastewater Treatment Plant

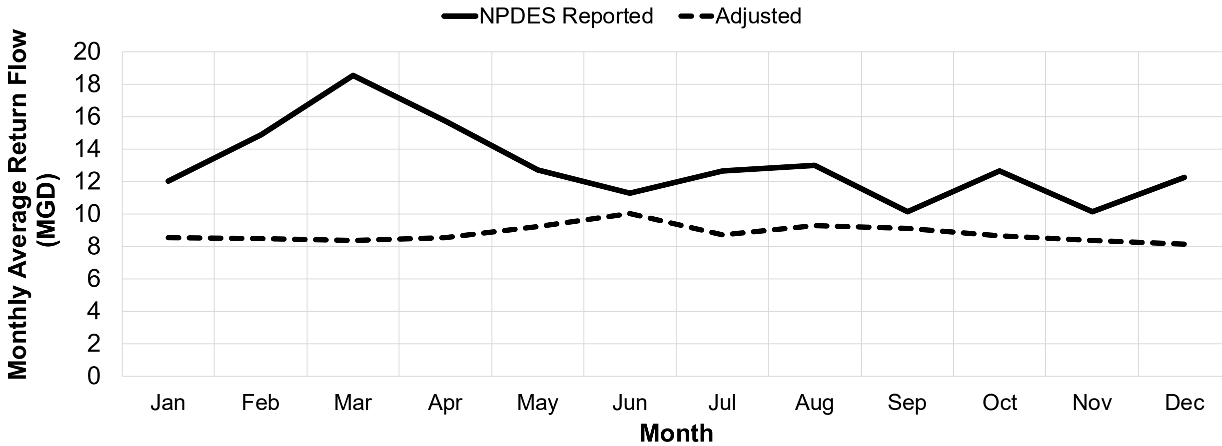
B.3.2.3 Analysis and Modification

Return flow adjustments to remove stormwater and/or I&I contributions for ten major WWTPs are summarized in Table B-3 including return flow before and after modification (in million gallons (MG)), the total volume removed (in MG), the percentage of return flow removed, and the average annual flow removed (in MGD). A total of 38,037 MG of return flow was estimated to be contributed by stormwater and/or I&I, or 41% of annual average reported return flow volume for these ten major WWTPs. These volumes were subtracted from return flow data for the water availability analysis. A summary of combined monthly average adjustments across all 10 major WWTPs in 2023 (Figure B-10) shows that reported return flows from January to May were relatively higher compared to the period of June to December. However, post-adjustment return flow shows less prominent variation between months.

Table B-3. 2007–2023 Estimated NPDES Return-Flow-Value Reduction for 10 Major WWTPs

NPDES ID	Facility Name	Reported Return Volume1 (MG)	Adjusted Return Volume1 (MG)	Volume Removed (MG)	Volume Removed (% of reported)	Average Annual Flow Removed (MGD)
IN0025577	LAPORTE WWTP	29,903	15,234	14,669	49%	40.1
IN0023621	LOWELL WASTEWATER TREATMENT PLANT	20,478	14,887	5,591	27%	15.3
IN0020991	PLYMOUTH WWTP	13,172	8,369	4,803	36%	13.2
IN0024414	RENSSELAER WWTP, CITY OF	8,291	3,338	4,952	60%	13.6
IN0037176	COMMUNITY UTILITIES OF INDIANA INC WWTP	5,742	3,232	2,510	44%	6.9
IN0020427	BREMEN WWTP	5,085	4,189	896	18%	2.5
IN0023329	KENTLAND WWTP, TOWN OF	3,188	1,298	1,890	59%	5.2
IN0020940	REMINGTON MUNICIPAL WWTP	2,571	1,433	1,138	44%	3.1
IN0020061	HEBRON WASTEWATER TREATMENT PLANT	2,267	1,216	1,051	46%	2.9
IN0021385	KNOX MUNICIPAL WWTP	2,450	1,912	538	22%	1.5
Total		**93,145**	**55,108**	**38,037**	**41%**	**6**

Notes:
[1] Based on monthly reported flow volumes from 1/1/2007-12/31/2023.
Key:
MG = million gallons
MGD = million gallons per day
NPDES = National Pollutant Discharge Elimination System
WWTP = wastewater treatment plant



Key:
NPDES = National Pollutant Discharge Elimination System
MGD = million gallons per day

Figure B-10. Comparison of Monthly Average Reported and Adjusted Combined Return Flow for Top 10 Wastewater Treatment Plants in the Study Area for 2023

B.4 Other Return Flows

B.4.1 CAFO RETURN FLOWS

For this analysis, it is assumed that self-supplied livestock operations (i.e., Confined Feeding Operations (CFO) and Concentrated Animal Feeding Operations (CAFO)) in the Study Area utilize approximately 80% of the water they extract, with the remaining 20% returning to the ground through infiltration. These estimates are supported by the findings from Shaffer (2009), which reported a median water consumption rate of 76% for livestock farms in Ohio, and are consistent with estimates from previous regional water studies (e.g., Letsinger and Gustin 2024). Given Indiana's slightly greater seasonal variability, particularly regarding increased water usage during the Summer, the consumption rate has been adjusted to 80%, with a corresponding return rate of 20% (Shaffer and Runkle 2007).

B.4.2 SELF-SUPPLIED RESIDENTIAL RETURN FLOWS

To estimate the consumptive water use by self-supplied residential users, the Southeast Central Indiana regional water study and 2009 USGS consumptive water use report (Shaffer 2009) were referenced. Specifically, Table 15 of the 2009 USGS report provides approximations of consumptive use in the Public Supply sector in Indiana. Although these values do not directly pertain to self-supplied residential users, the analysis assumes that usage patterns for both self-supplied and publicly supplied residential users are similar. According to the report, there is no consumptive use during the Winter, with all water being returned to the ground. The estimated consumptive use is 2% in the Spring, 19% in the Summer (primarily due to lawn watering and similar activities), and 7% in the Fall. This implies that 100% of the water pumped by self-supplied residential users is returned in the Winter, 98% is returned in the Spring, 81% is returned in the Summer, and 93% is returned in the autumn. These seasonal return rates were applied to the corresponding water seasons: Winter (December-February), Spring (March-May), Summer (June-August), and Fall (September-November).

B.4.3 IRRIGATION RETURN FLOWS

While irrigation is a highly consumptive water sector, a portion of the water applied to the land surface infiltrates into the soil and recharges the groundwater. For this analysis, it is assumed that 80% of the irrigation water is consumed by plants, with the remaining 20% returning to the ground. This assumption is supported by data from Table 24 of Shaffer (2009), which lists monthly average consumptive use coefficients for golf course and nursery and crop irrigation based on Ohio withdrawal and return flow data for 1999-2004, and is consistent with assumptions made in water availability studies for the Southeast-Central Indiana region (Letsinger and Gustin 2024). It is important to note that much of the cropland in the region is underlain by agricultural tile drainage, which artificially changes natural hydrological conditions. However, no modifications to the rates or timing of irrigation returns were incorporated into these analyses.

B.5 Dam Operations

Dam data were provided by the publicly available National Inventory of Dams (NID).[7] The dams selected for the Study were within the HUC8 boundaries and have a normal storage capacity of 1,000 acre-feet or greater.

B.5.1 DATA SOURCES

Data on dam location, size, and other key attributes were downloaded from the publicly available NID.

B.5.2 PRE-PROCESSING

Initially, attribute data from all dams within the Study Area were downloaded from the NID. These data were filtered to include only those dams with a normal storage capacity greater than or equal to 1,000 acre-feet, as these dams were considered to be capable of altering the monthly water balance in a manner that may influence water availability. The results initially included 16 dams of interest (Table B-4). Figure B-11 shows a map of the dam locations within the Study Area.

The screened dams were further analyzed based on storage capacity, the primary purpose of the dam, and data availability. Because no publicly available reservoir operations data were available for most dams, publicly available documents and descriptions were collected and analyzed. Eight reservoirs with less than 1,000 acre-feet of normal storage were excluded from further consideration, as their limited capacity is less likely to influence regional water availability. The remaining eight dams were determined to be recreational lakes, off-stream setting basins, or small impoundments with minimal drainage areas

[7] https://nid.sec.usace.army.mil/#/

relative to their corresponding subbasins. These facilities generally operate under conditions where inflow is approximately equal to outflow, lack publicly available operational data, and do not exert a measurable influence on downstream hydrologic conditions. Also, a historical imagery review of the impoundment showed relatively stable lake extent. Thus, dams and their operations were excluded from the development of water budget components for this Study. Table B-5 summarizes the identified dams and provides the rational for their exclusion.

Table B-4. Summary of Major Dams in the Study Area

Dam Name	NIDID	Maximum Storage Capacity (acre-feet)	Drainage Area (sq. mi.)	Surface Area (acres)	State	Primary Purpose	Primary Waterway	Included in Study ?
Potato Creek State Park Dam	IN00517	9000	11.8	345	Indiana	Recreation	Potato Creek	No
R.M. Schahfer Generating Station - Final Settling Basin	IN04075	3220	0.33	214	Indiana	Other	-	No
Koontz Lake Dam	IN00782	4820	6.25	324.43	Indiana	Recreation	Lawrence Pontius Ditch	No
R.M. Schahfer Generating Station - Waste & Recycle Basin	IN04076	2140	0.16	105.5	Indiana	Other	-	No
Lake Dalecarlia Dam (West)	IN00792	2331	20.1	162.16	Indiana	Recreation	Cedar Creek	No
Lake Dalecarlia Dam (East)	IN00791	2590	20.1	162.16	Indiana	Recreation	Cedar Creek	No
Lake of The Four Seasons (Lower) C	IN00139	0	3.6	180	Indiana	Recreation	Unnamed Tributary Stony Run	No
Zehner Mill Pond Dam	IN00783	2400	5.34	166.1	Indiana	Recreation	Eagle Creek	No
Lake Latonka Dam	IN00117	754	5	100	Indiana	Recreation	Henry Cool Ditch	No
Lake of The Four Seasons (Dam A)	IN00138	1375	2.22	56.84	Indiana	Recreation	Unnamed East Branch Stony Run Creek #1	No
Lake of The Four Seasons (Dam B)	IN00512	1375	2.22	14.53	Indiana	Recreation	-	No
R.M. Schahfer Generating Station - Intake Settling Basin	IN04074	330	0.05	29.4	Indiana	Other	-	No
Lakewood Estates Dam	IN03915	320	0.46	27.8	Indiana	Recreation	Unnamed Tributary Cedar Creek	No
Union Mills Dam	IN00352	83	19.2	18.64	Indiana	Recreation	Mill Creek	No
Schori Lake Dam	IN00784	95	0.73	10.61	Indiana	Recreation	-	No
Myers Lake Control Structure	IN03534	166	0	1245	Indiana	Recreation	-	No

Data source: USACE National Inventory of Dams (USACE 2025).
Key: N/A = Not available NIDID = National Inventory of Dams ID sq. mi. = square mile

Key: FIPS = Federal Information Processing Standard NAD = North American Datum
USGS = United States Geological Survey NID = National Inventory of Dams USACE = U.S. Army Corps of Engineers

Figure B-11. Locations of Major Dams Within the Study Area

Table B-5. Summary of Major Dams Identified in the Study Area and Rationale for Exclusion from Water Budget Analysis.

Dam	Waterway	Sub-basin	Primary Purpose	Normal Storage (ac-ft)	Drainage Area (sq mi)	Exclusion Reasoning
Potato Creek State Park Dam	Potato Creek	2	Recreation	3,220	11.8	Recreational purpose; General assumption is inflow=outflow; No publicly available operating rules/ data; Far from the mainstem and large rivers; Small drainage area relative to the subbasin (ratio=0.03); Lake extent relatively stable based on historical imagery.
R.M. Schahfer Generating Station - Final Settling Basin	-	3	Other	3,220	0.33	Settling basin for Generating Station; Off stream; Small drainage area relative to the subbasin (ratio=0.001).
Koontz Lake Dam	Lawrence Pontius Ditch	3	Recreation	2,980	6.25	Recreational purpose; General assumption is inflow=outflow; No publicly available operating rules data; Far from the mainstem and large rivers; Small drainage area relative to the subbasin (ratio=0.01); Lake extent relatively stable based on historical imagery.
R.M. Schahfer Generating Station - Waste & Recycle Basin	-	3	Other	2,140	0.16	Settling basin for Generating Station; Off stream; Small drainage area relative to the subbasin (ratio=0.0003).
Lake Dalecarlia Dam (West)	Cedar Creek	3	Recreation	2,109	20.1	Recreational purpose; General assumption is inflow=outflow; No publicly available operating rules/ data; Small drainage area relative to the subbasin (ratio=0.04); Lake extent relatively stable based on historical imagery.
Lake Dalecarlia Dam (East)	Cedar Creek	3	Recreation	2,072	20.1	Recreational purpose; General assumption is inflow=outflow; Lake extent relatively stable based on historical imagery; Small drainage area relative to the subbasin (ratio=0.04); No publicly available operating rules/data.
Lake of The Four Seasons (Lower)	Unnamed Tributary Stony Run	5	Recreation	1,700	3.6	Recreational purpose; General assumption is inflow=outflow; Far from the mainstem and large rivers; Small drainage area relative to the subbasin (ratio=0.007); No publicly available operating rules/data.
Zehner Mill Pond Dam	Eagle Creek	1	Recreation	1,520	5.34	Recreational purpose; General assumption is inflow=outflow; Small drainage area relative to the subbasin (ratio=0.01); No publicly available operating rules/data.

B.5.3 ANALYSIS

Dams were not thought to have a significant impact on the water availability assessment and were not further analyzed in this Study.

B.6 Instream Flow

B.6.1 DATA SOURCES

Daily measured flow data from 1990 to 2020 from USGS gages identified in Section B.1 were used to calculate minimum instream flow metrics for each subbasin (Blum et al. 2019). This timeframe was chosen to reflect recent climatic and hydrologic trends and to ensure alignment with other regional water studies.

B.6.2 PRE-PROCESSING

To define minimum instream flow requirements, two key metrics were calculated from the daily measured flow data:

- 7Q10 metric: Represents the lowest seven-day average flow with a ten-year recurrence interval. This metric was applied during the drier months (June through November) to address low-flow conditions critical for water management, consistent with Indiana's Water Shortage Plan (IDNR 2015).
- Q90 metric: Represents the daily average flow exceeded 90% of the time. This metric was applied during the wetter months (December through May) to capture high-flow periods and support ecosystem health.

The daily measured flow data were then processed to compute 7Q10 and Q90 values for each subbasin.

B.6.3 ANALYSIS

The calculated 7Q10 and Q90 values for each subbasin are presented in Table B-5. The analysis highlights variability in instream flow values across the Study Area, with subbasins 06 and 08 exhibiting the lowest values and subbasin 05 the highest.

Results show that 7Q10 values ranged from 1 MGD (2 cubic feet per second (cfs)) in Subbasins 06 and 08 to 318 MGD (492 cfs) in Subbasin 05 whereas Q90 values ranged from 2 MGD (3 cfs) in Subbasins 06 and 08 to 541 MGD (837 cfs) in Subbasin 05.

Table B-6. Instream Flow Values by Subbasin

Subbasin	USGS gage[1]	7Q10 (cfs)	7Q10 (MGD)	Q90 (cfs)	Q90 (MGD)
01	05517000 Yellow River at Knox, IN	71	46	130	84
02	05515500 Kankakee River at Davis, IN	204	132	300	194
03	05517530 Kankakee River near Kouts, IN	354	229	586	379
04	055180000 Kankakee River at Shelby, IN	418	270	723	467
05	05520500 Kankakee River at Momence, IL	492	318	837	541
06	Synthetic[2] (Beaver, IN)	2	1	3	2
07	05525000 Iroquois River at Iroquois, IL	23	15	51	33
08	Synthetic[2] (Sugar, IN)	2	1	3	2

Note:
[1] The assessment period for calculating the instream flow was from 1990 to 2020.
[2] A synthetic hydrograph was developed for subbasins 06 and 08. Additional details are provided in Section B.1.
Key:
cfs = cubic feet per second
IL = Illinois
IN = Indiana
MGD = million gallons per day
sq. mi. = square mile
USGS = United States Geological Survey

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APPENDIX C

Historical and Future Water Demand Methodology and Future Water Demand by Sector

Stantec

Kankakee Basin Regional Water Study

Appendix C –Historical and Future Water Demand Methodology by Sector

December 2025

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ABBREVIATIONS

°C	degrees Celsius
ACS	American Community Survey
ARS	U.S. Agricultural Research Service
CAFO	concentrated animal feeding operation
CC	combined cycle
CFO	confined feeding operation
EGR	economic growth region
EIA	U.S. Department of Energy, Energy Information Administration
EP	energy production (water-use sector)

EPA	U.S. Environmental Protection Agency
ET	evapotranspiration
gal/kWh	gallons per kilowatt-hour
GPCD	gallons per day per capita
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IEC	Indiana Enterprise Center
IN	industrial (water-use sector)
INCCIA	Indiana Climate Change Impacts Assessment
IR	irrigation (water-use sector)
MGD	million gallons per day
MI	miscellaneous (water-use sector)
MWh	megawatt hour
NAD	National Address Database
NASA	National Aeronautics and Space Administration
NPDES	National Pollutant Discharge Elimination System
OLQ	Office of Land Quality
PC1	principal component 1
PCA	principal component analysis
PET	potential evapotranspiration
Primary Study Area Counties	counties located nearly fully within the Kankakee Basin
PS	public supply (water-use sector)
PSR/day	public supply ratio per day
PWS	public water supplier
RMSE	root mean squared error
RU	rural use (water-use sector)
SIS	STATS Indiana – Stantec
SJEC	St. Joseph Energy Center

SS	self-supplied residential
SSP	Shared Socioeconomic Pathway
Study	Kankakee Basin Regional Water Study
Study Area	Kankakee Basin
SWWF	significant water withdrawal facility (high-capacity water pumping)
US DOT	U.S. Department of Transportation
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

Appendix C Historical and Future Water Demand Methodology by Sector

C.1 Development of Future Baseline Water Demand Methodology

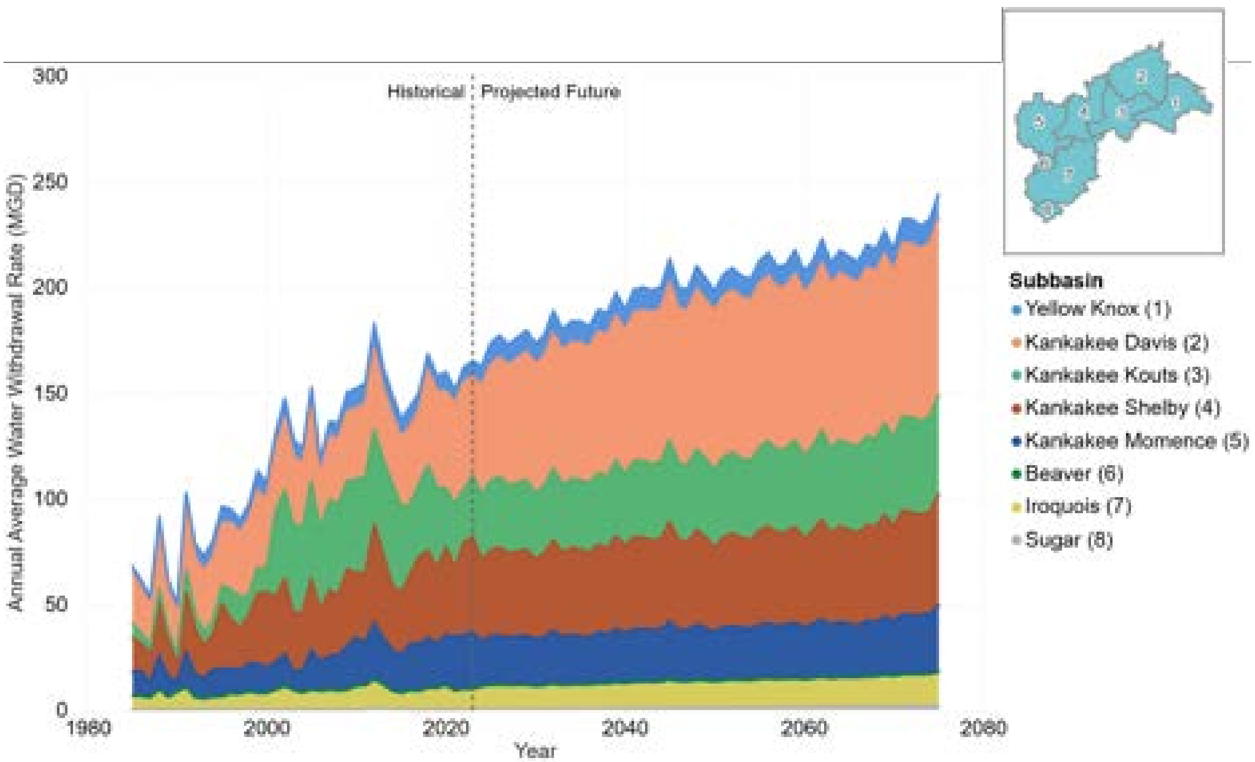
The Kankakee Basin Regional Water Study (Study) presents the future baseline water demand analysis projecting the next 50 years of water use for each sector at a subbasin and county level (Figure C-1). The modeling methods for each water use sector, the geographic modeling units, and data sources used to estimate the future water demand projections for each water use sector are described below.

Historical and Future Water Demand Methodology by Sector
December 2025

Figure C-1. Study Area, Counties, Subbasins, and Cities

The modeling method estimates water availability at a subbasin level; therefore, all future water demand projections must ultimately be reported at a subbasin level. Figure C-2 summarizes the historical and projected water demand for the Kankakee Basin at the subbasin level. Historically, Kankakee Davis (Subbasin 2) and Kankakee Kouts (Subbasin 3) had the highest water demand. This Study projects that Kankakee Davis (Subbasin 2) will have the greatest growth in the basin, while all other subbasins forecast modest growth. See Appendix D for details on subbasin specific trends.

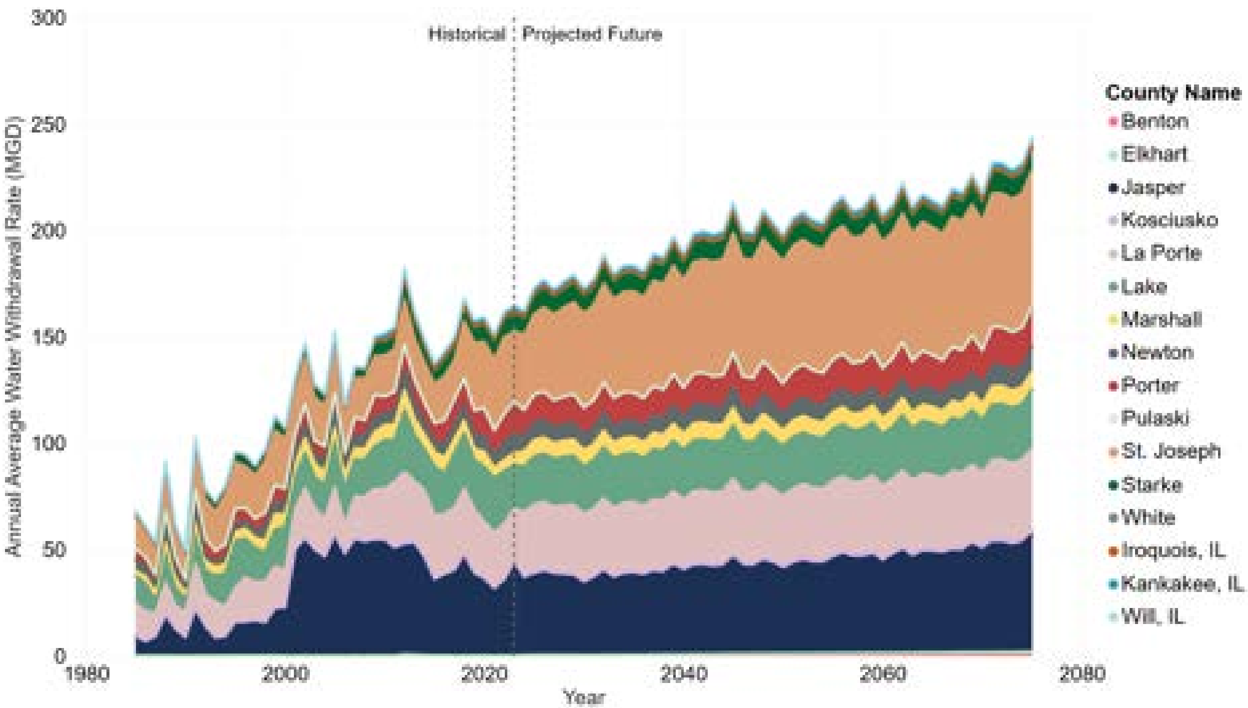
The steep increases in total water use around the year 2001 are due to **increased data availability** for specific types of water use. As detailed in this appendix, some of the explanatory data also became available in 2001, limiting the scope to include only historical estimates between 2001-2023 and projections relied on this shorter dataset. **Water demand in 2023 is estimated at 165 million gallons per day (MGD), and demand is projected to increase to 244 MGD by 2075.**



Key:
MGD = million gallons per day

Figure C-2. Historical (1985-2023) and Projected Future (2024-2075) Annual Water Demand in Kankakee Basin, by Subbasin (MGD)

Many of the predictive variables used to estimate future water demand are reported at the county level. For example, future population and irrigated crop acreage are publicly available at the county level. The future demand for some water use sectors was estimated at a county level and then aggregated or disaggregated into a subbasin, while for others the predictive variables were disaggregated first then used in subbasin-county level estimates. Figure C-3 shows the same stacked plot of historical and projected water demand broken out by county instead of subbasin. Jasper had the highest demand between 2000-2023 with 31% of total basin withdrawals. La Porte, St, Joseph, and Lake Counties were similar with 17%, 16%, and 15% of total withdrawals during that period. St. Joseph leads demand in the future between 2024-2050 with 26% of total basin withdrawals and Jasper at 21% of total withdrawals. La Porte and Lake Counties follow with 18% and 13% of projected total basin withdrawals in the same period, respectively.



Key:
MGD = million gallons per day

Figure C-3. Historical (1985-2023) and Projected Future (2024-2075) Annual Water Demand in Kankakee Basin, by County (MGD)

The counties that are included in the analysis have been categorized as either Primary Study Area Counties or Supplemental counties. As the boundaries between counties and subbasins do not coincide, the Primary Study Area Counties were defined as those counties located nearly fully within the basin. Supplemental Counties are defined as Indiana counties that are partially located within the basin, along with all of the Illinois counties (Table C-1). In order to fully understand basin-wide water availability, the future projection of water withdrawals was estimated for those portions of both the Primary Study Area Counties and Supplement Counties in a given subbasin.

Table C-1. County Designations for Counties Included in the Water Demand Analysis

Primary Study Area Counties	Supplemental Counties	Illinois Counties
Benton	Elkhart	Iroquois
Jasper	Fulton	Kankakee
Lake	Kosciusko	Will
La Porte	Pulaski	
Marshall	White	
Newton		
Porter		
St. Joseph		
Starke		

C.1.1 PRIMARY WATER WITHDRAWALS DATA

Water withdrawals within the Kankakee Basin are primarily characterized using data from the significant water withdrawal facility (SWWF) database (IDNR 2025), where a facility is defined as “the water withdrawal facilities of an entity, in the aggregate from all sources and by all methods, [that] has the capacity of withdrawing more than 100,000 gallons of groundwater, surface water, or ground and surface water combined in one (1) day” (IC 14-25-4). Data obtained for this study included a monthly withdrawal time series for all SWWF facilities in the Study Area from 1985 to 2023, with each withdrawal characterized by source (surface water intake or groundwater well) and one of six water use sectors.

Two withdrawal sectors are not accounted for in the SWWF database due to the rate of their individual withdrawals not meeting the minimum criteria for registration, even though collectively they withdraw a notable annual volume of water. These sectors include withdrawals for self-supplied residential domestic uses and livestock (Concentrated Animal Feeding Operations (CAFO)) operations. Additional information on data collection and demand estimates for these categories is provided later in this section and is discussed in other sections of this Appendix.

The water use sectors included in this analysis are (in order of the magnitude of the future projection of water demand):

- Irrigation (IR), representing water used in the production of crops
- Energy production (EP), representing water used in the production of energy
- Public supply (PS), representing water served to cities and towns from a public or private water utility and schools, or other public entities, that have their own water wells to meet their individual institutional demand
- Industrial (IN), representing dedicated, industry-owned wells and surface water intakes, used for industrial production. Note that this water demand does not account for industries historically served by public water suppliers
- Self-supplied (SS) residential, representing individual residential well owners supplied by on-site wells for domestic use

- Miscellaneous (MI), representing a variety of uses including fire departments, country clubs, and a correctional facility
- Confined feeding operations (CFO) and CAFO, CAFOs representing larger scale livestock facilities than CFOs (IDEM OQL 2024b)
- Rural (RU), representing a variety of rural users, but not rural residential users. Examples include Purdue University Physical Facilities, and several agricultural limited liability corporations. Note it appears that some very large CAFOs' water withdrawals may be reported in this category in the SWWF database

The SWWF historical database is the primary resource in this study for analyzing historical demand and for building forecasts of future demand (IDNR 2025). However, possible limitations of the data require acknowledgment here. As the data are self-reported, it can be difficult to confirm the accuracy of the information. The discussions for each sector describe the specific methods and data sources used to address data gaps and develop a more complete historical record of withdrawals.

This Appendix describes the sector-specific future projection method, the geographic basis for the modeling unit, the data used, and the assumptions underlying the future projections by county and subbasin. Note that not all areas of a county located within a subbasin have reported historical withdrawals for all water use sectors. For sectors reported through SWWF, if there was no historical water withdrawal for a specific water use sector within a specific county or subbasin, there was no future projection estimated for that specific water use type in that location. One exception is the EP forecast, which uses additional data sources to identify water withdrawals and provide insights about expected new power plant development. For sectors that do not report to SWWF, the location of withdrawals was based on the historical location of CAFO facilities and self-supplied residential addresses, as reported to state and national agencies.

C.2 Common Predictive Variables

Prior to the description of the water use sector-specific demand projection methods is a review of common data-predictive variables used for multiple water use sectors.

For a presentation of subbasin-only future water demand see Appendix D and for county-specific future water demand see Appendix I.

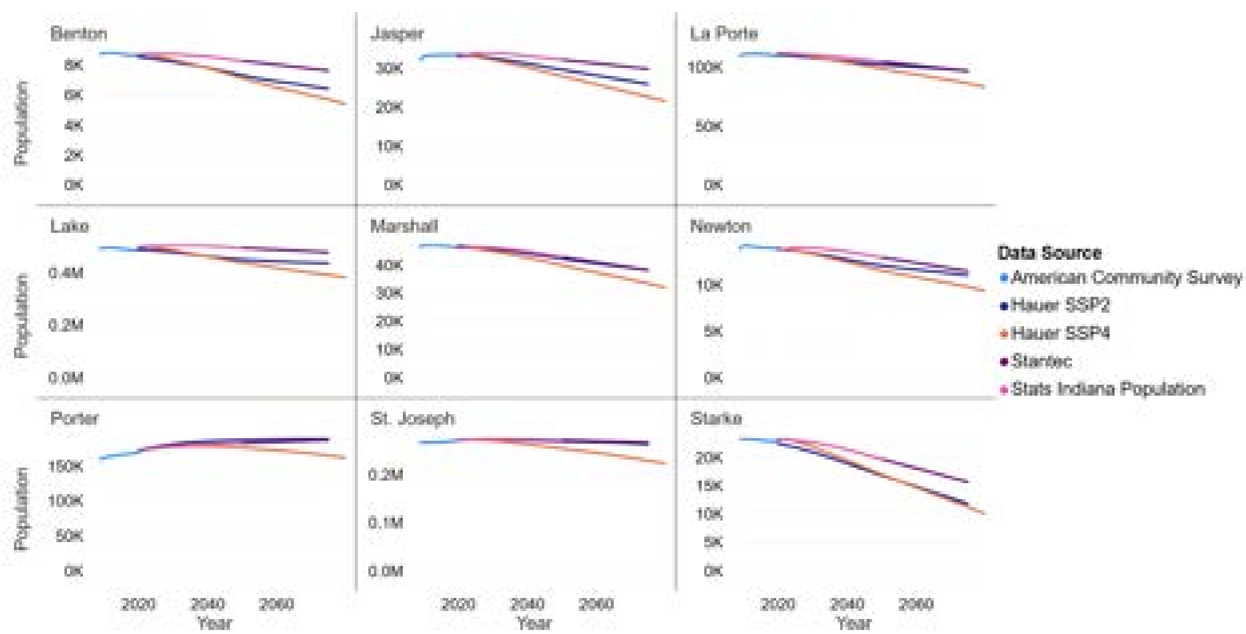
C.2.1 POPULATION

Population is a critical variable in this study due to its significant influence on residential water demand. Both the PS and SS sector models control for population, although distinct analytical approaches are used. The PS model includes population data in the regression analysis, while the SS model calculates SS water as a function of the population.

This study differed in its approach to estimating the population forecast compared to the North Central Indiana Regional Water Study (Stantec 2025) for two important reasons. First, evidence obtained from regional expertise through interviews and state-specific publications indicated that national sources of population projections may not be representative of Indiana, and of the Kankakee Basin in particular. Second, in-county differences in population growth and water use characteristics required development of a Kankakee Basin-specific forecast at the sub-county level.

C.2.1.1 County Level Population Projection

Previous watershed studies used the Shared Socioeconomic Pathways (SSP) population projections (Calvin et al. 2017, Hauer 2018). A review of multiple published population projections identified a wide range of estimates. The SSP scenarios and STATS Indiana projections differed (Figure C-4). This population forecasting approach utilized local knowledge of the region selected STATS Indiana data (2024). STATS Indiana used 2020 population estimates from the U.S. Census Bureau, American Community Survey (ACS), by county, as the base population and projected this out to 2050 using Indiana specific data to develop fertility, mortality, and migration rates for each county.



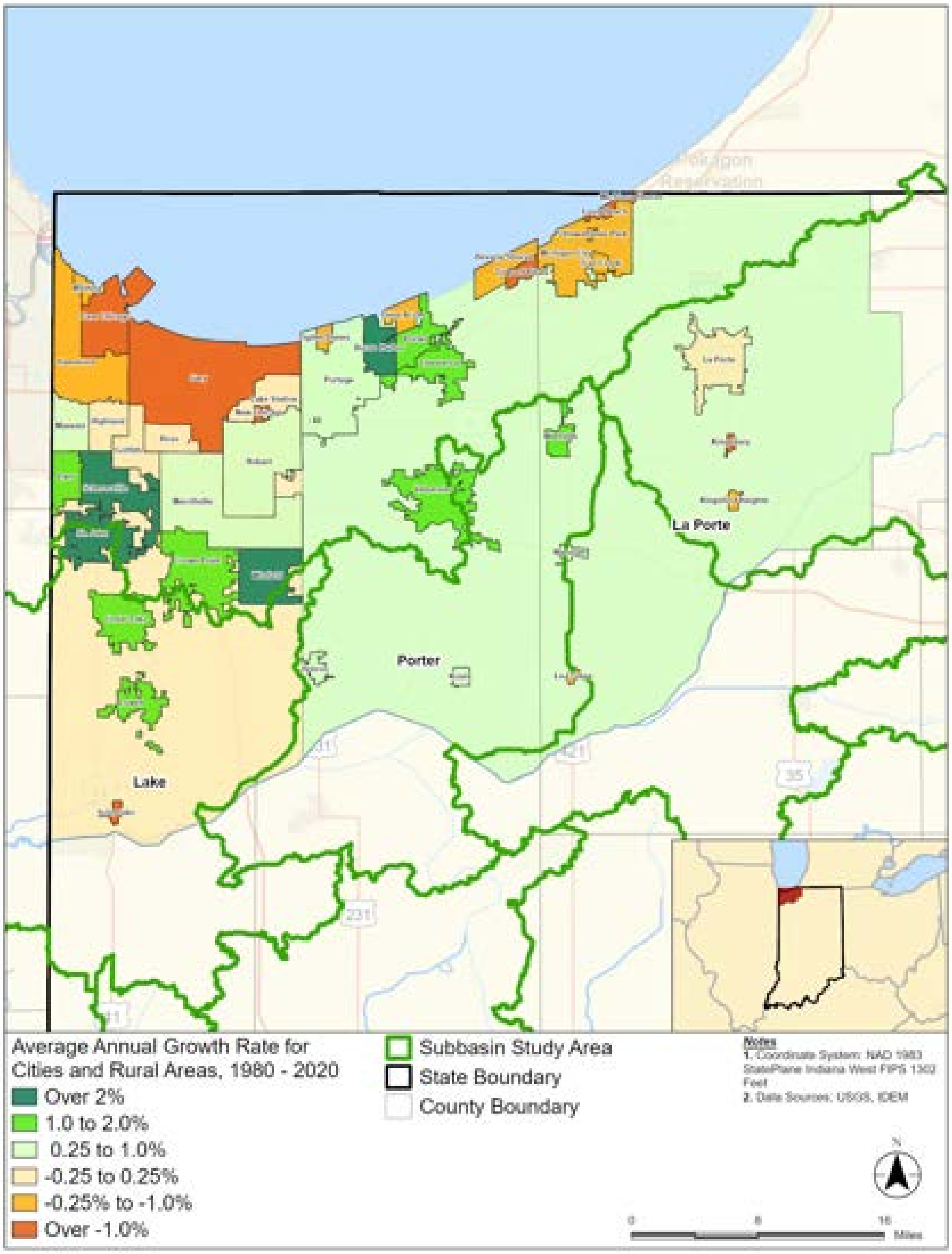
Key:
SSP = Shared Socioeconomic Pathway

Figure C-4. Comparison of Published Population Projections for Primary Study Area Counties

Historical population by county is from the ACS DP03 Table (U.S. Census Bureau DP03, 2023). STATS Indiana provided the anticipated future county-level population estimates through 2050 and Stantec extrapolated the additional forecast through 2075 for the full period of this study (STATS Indiana 2024). The Stantec forecast was an extrapolation of the observed trends between 2035-2050 for each county projection from STATS Indiana. This Study refers to the subregion level population projection as the STATS Indiana – Stantec (SIS) forecasts.

C.2.1.2 Subregion Level Population Projections

The second limitation of published population projections was due to the scale of the forecast. Published population projections, including STATS Indiana, are estimated at the county level. The recent historical trends in population growth for several of the cities and towns within Kankakee Basin display different characteristics than the full county. County level projections underestimated the population growth expected by local experts within the region. The Northwestern Indiana Regional Planning Commission (2023) identified a southward migration since 1980 that is expected to continue into the future (Figure C-5). Additionally, there are large industrial water users in the northern part of Lake County which are embedded within the public water supply withdrawal data creating a distinct water use signature of that region which does not match water use characteristics of public water supply withdrawals in the Kankakee Basin portions of Lake County.



Source: Northwestern Indiana Regional Planning Commission (2023)

Figure C-5 Average Annual Growth Rate for Cities and Rural Areas, 1980-2020

To address the within-county differences in population growth and water use, a subregion population forecast for each county and subbasin combination was developed. Historical baseline populations were drawn from the ACS DP03 tables at census tract levels to ensure consistent basis for allocating county totals to subregions.

The allocation procedure occurred in three major steps. First, historical subregion population data were expressed as proportional shares of each county's total population. These subregion proportional population shares established recent distribution trends that would otherwise be masked in county-level projections.

Second, the relationship between the subregion proportional population shares to the total county population was estimated using beta regression with time-based predictors. Annual subregion shares were calculated as the ratio of subregion to county population and constrained to the open interval (0,1) for estimation. The beta regression captured the bounded nature of share values, and the time predictors represented long-run intraregional population dynamics. Modeling was done only when at least two distinct historical share values were available. Forecasts for 2023 through 2075 were produced from the fitted beta models and then normalized within each county and year so that the predicted shares summed to one. For counties containing a single subregion, shares were fixed at 1.

Finally, projected subregion proportional shares were multiplied by the county-level population SIS forecasts, producing subregion-level population estimates that preserved observed intraregional differences in population growth. A county-specific scaling factor was applied to align 2023 forecast totals with historical values, ensuring consistency between observed and projected data.

Since well-studied population forecasts already exist at the county level from STATS Indiana, the objective of this study's population methodology was to build on those forecasts by extending them to 2075 and disaggregating the county-level projections into subregion-level forecasts. Stantec extended the STATS Indiana forecasts beyond 2050 by extrapolating observed growth trends, providing consistent long-term control totals at the county level. From there, beta regression was applied to disaggregate the county forecasts into subregion-level population estimates. This method was selected because beta regression is specifically designed for data that take values between 0 and 1, in this case the percentage of a county's population located in a particular subregion. By using beta regression, the study was able to allocate population based on historical proportional shares without developing a new population forecasting model. This approach effectively extended observed historical distribution trends into the future while ensuring that the forecasts remained both realistic and bounded.

A key challenge, however, was that the historical data showed sharp "bumps" in some counties where population growth shifted quickly between subregions. For example, during the 2020 COVID pandemic, rapid population movement in La Porte, Lake, and Porter Counties produced abrupt increases in the population share of certain subregions trending southward. Meanwhile northern subregions in the same counties experienced steep population declines. These sudden swings created irregular patterns that could not be captured by simple time-based projections. To address this, the beta regression was refined with flexible step parameters, which is similar to a piece-wise function, enabling the model to represent abrupt shifts in population shares without distorting long-term trends. These parameters allowed the model to incorporate sudden changes in population while adjusting to the long-term trend that followed. In practice, this meant the model could account for a one-time shift, without letting that short-term disruption influence the entire projection. When no such shifts were present, the step parameters were statistically insignificant and did not alter the long-term trend. This ensured that forecasts did not overreact to temporary spikes but still reflected the broader direction of demographic change. In this way, the subregion forecasts maintain both sensitivity to real population shifts, and the stability needed for long-term water-demand planning.

A brief discussion of the regression specification selected for the population share regression is included below. Although this approach is referred to as a beta regression, the actual regression estimation is of the beta link function, which is a logistic regression. Let $y_{it} \in (0,1)$ be the annual share of a county's population that resides in a given subregion i during year t. Then y_{it} has a beta distribution, $y_{it} \sim Beta(\mu_{it}, \phi)$ with mean μ_{it} and precision ϕ. The mean of the distribution, μ_{it}, is modeled by a logistic link function as follows:

Equation 1. Beta Regression for Subregion Population Shares

$$logit(\mu_{it}) = \alpha_0 + \alpha_1 \cdot log(Year) + \alpha_2 \cdot 1[Year \geq 2020] + \alpha_3 \cdot log\big(max(1, Year - 2019)\big)$$

Where:

> y_{it} = the normalized population share of a subregion within its county for that year.
>
> μ_{it} = the conditional mean of y_{it}, representing the expected population share given the model predictors after applying the inverse logit transformation. It reflects the long-term proportion of county population residing in that subregion.
>
> ϕ = the precision parameter of the beta distribution, which controls the dispersion of y_i around its mean. Larger values of ϕ indicate that the observed shares are tightly clustered near μ_i (less variability across years), while smaller values imply more year-to-year fluctuation around the mean share.
>
> Year = the calendar year used as a continuous numeric variable in the model, where the year corresponds to t.
>
> 1[Year≥2020] = an indicator variable that captures post-2020 structural changes, including the migration effects.
>
> Log(max(1,Year – 2019)) = a flexible post-2019 slope adjustment similar to a piece-wise trend, primarily included to capture post-pandemic redistribution effects in population shares.

Figure C-6 below shows the distribution of population shares across subregions within Kankakee Basin for La Porte, Lake, and Porter Counties. Each of the three counties shows a steep shift in population shares around 2020, with sudden increases in certain subregions and corresponding decreases in others. The remaining population shares for these counties fall outside the subbasin delineation and are classified as "None." This figure highlights the importance of incorporating a step function in the model to capture abrupt population changes, while also preserving the ability to represent gradual long-term growth trajectories within the study area.

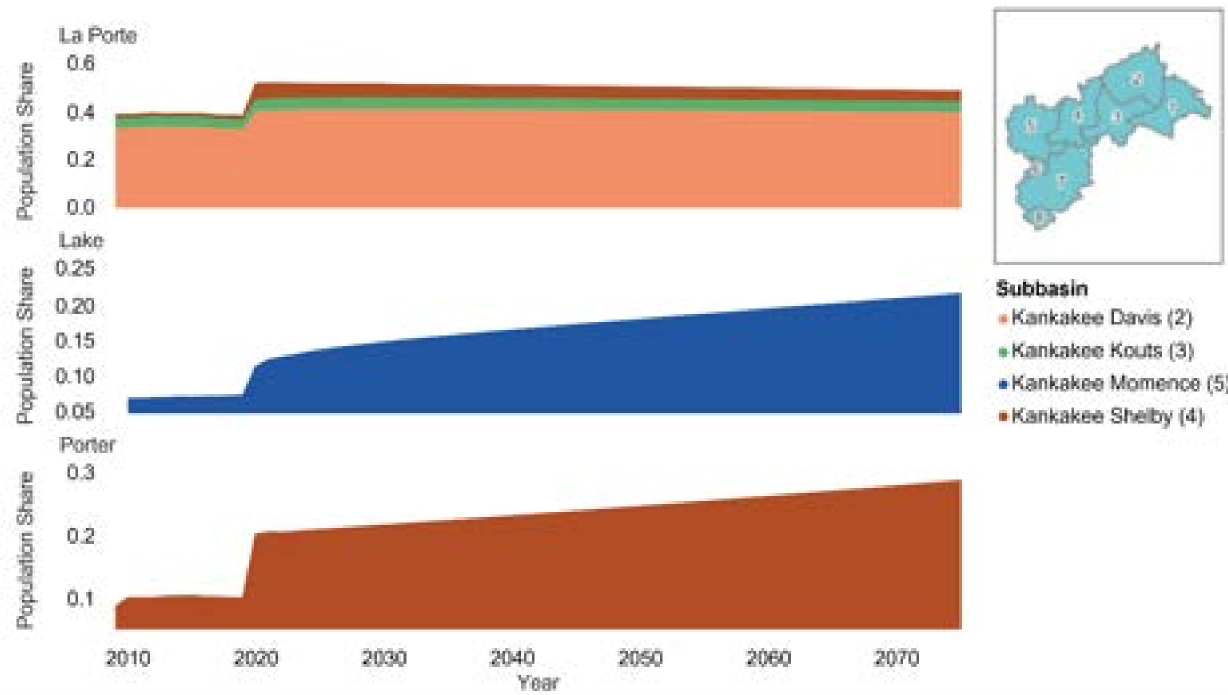


Figure C-6. Historical and Future Projected Shares of Population, Northern Counties, 2010 to 2075

The population of the entire Kankakee Basin is shown in Figure C-7 with the eight subbasin populations stacked. Overall, the population is projected to remain relatively stable with modest growth through 2075, but individual subbasins follow different trends. Kankakee Momence (Subbasin 5) shows the strongest and most sustained increase, reflecting continued growth in Lake County. Kankakee Shelby (Subbasin 4) also demonstrates steady long-term growth following a sharp increase around 2020. In contrast, the rest of the subbasins (Subbasins 1, 2, 3, 6, 7, and 8) generally show declining populations over the forecast horizon, with some experiencing short-term gains around 2020 before trending downward. These patterns show how growth in a limited number of subbasins offsets decline across much of the watershed.

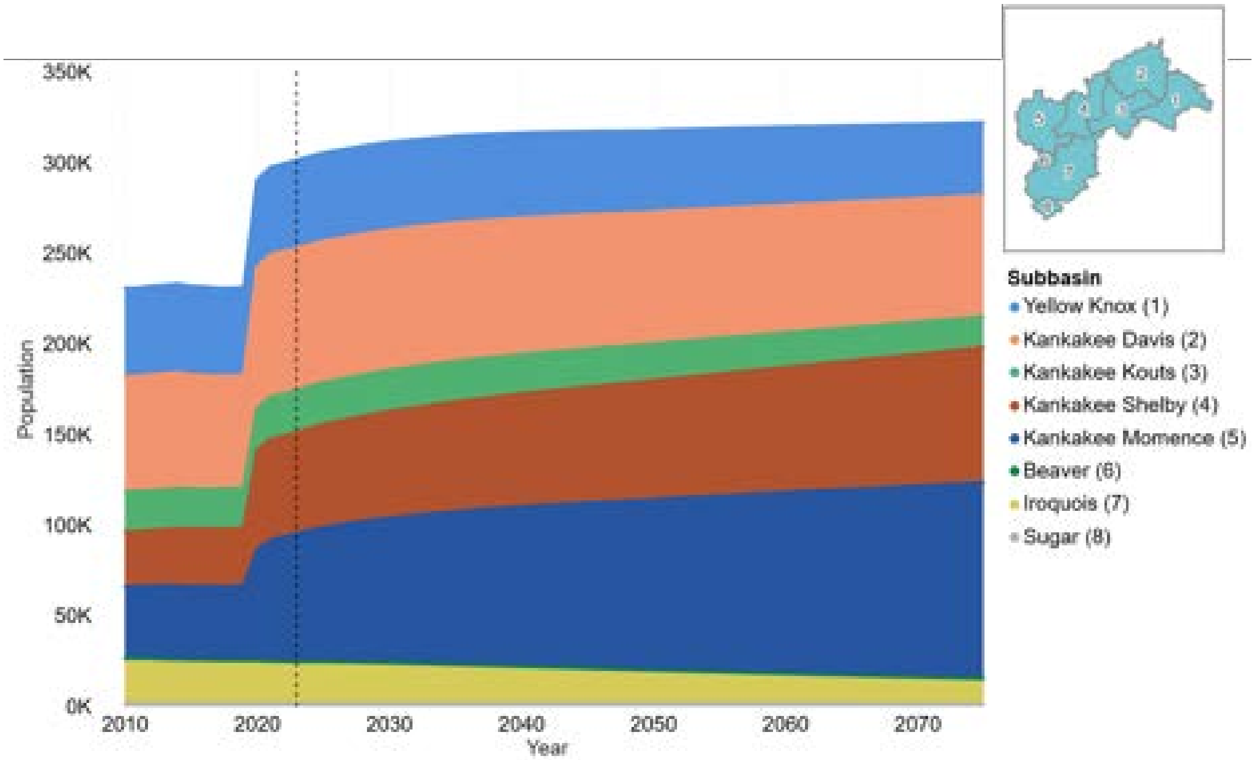
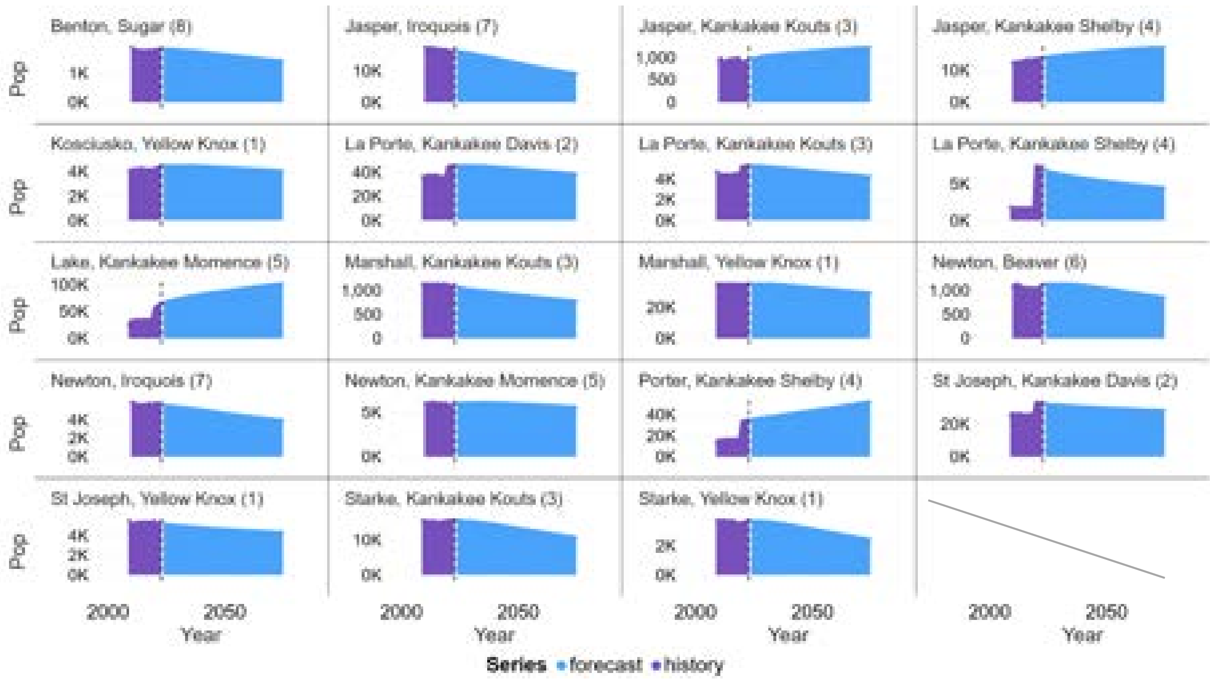


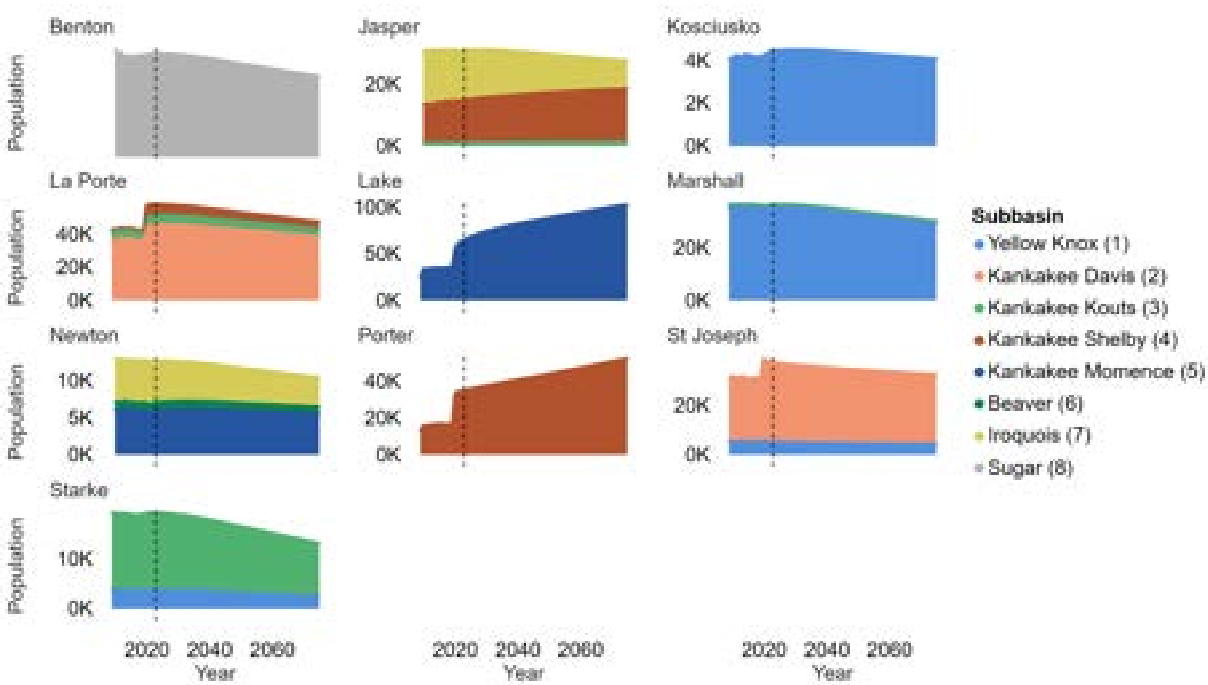
Figure C-7. Historical and Future Projected Rate of Change of Population, Study Area Subbasins, 2010 to 2075

Figure C-8 presents historical and projected population by subregion (county–subbasin overlays) from 2010 through 2075. Several subregions within Lake (Kankakee Momence, Subbasin 5), Porter (Kankakee Shelby, Subbasin 4), and La Porte (Kankakee Davis, Subbasin 2 and Kankakee Shelby, Subbasin 4) Counties are projected to show modest long-term growth. In contrast, most other subbasins, including those in Benton, Jasper, Marshall, Newton, Starke, and the Illinois portions of Iroquois and Kankakee, are expected to steadily decline over the forecasted horizon. Figure C-9 illustrates the aggregated county-level rate of population change. Growth in Lake County offsets projected declines in much of the study area, resulting in a pattern of modest regional growth concentrated within a limited number of subbasins.



Note: the vertical axis scale is different for each region

Figure C-8. Historical and Future Projected Population, Study Area Subregions, 2010 to 2075



Note: the vertical axis scale is different for each region

Figure C-9. Historical and Future Projected Rate of Change of Population, Primary Study Area Counties, 2010 to 2075

C.2.1.2.1 Illinois Population Estimates

The volume of water use in the Kankakee Basin within Illinois is relatively small. It was determined that a simple population estimation method was appropriate. A simplified time-trend method was applied to estimate subregion populations for the Illinois portion of the study. Consistent with the approach for the Indiana portion of the basin, the analysis relied on ACS population data at the census tract level to construct a historical population series for the Illinois subregions. These historical series were extended through 2075 using simple linear regression with year as the explanatory variable to capture long-term trends.

The resulting projections indicate an overall population decline across the Illinois subregions. The population is estimated to decrease by 0.51% per year in the Iroquois County subregion, 0.66% in the Kankakee County subregion, and 0.26% in the Will County subregion. The regression models estimated for these subregions are summarized below in Table C-2.

Table C-2. Illinois Subregion Population Projection Models

Subregion	Model
Iroquois County and Subbasin 7	Log(subregion_pop) = 17.0901 - .0051 * year
Kankakee County and Subbasin 5	Log(subregion_pop) = 22.0100 - .0066 * year
Will County and Subbasin 5	Log(subregion_pop) = 3.3841 - .0026 * year

C.2.2 CLIMATE AND WEATHER VARIABLES

Climate variables project the future precipitation and temperature of the Study Area. Climate variables were included in the projection for PS and IR water withdrawals. These variables help predict not only future trends in demand but also seasonal variation of future water demand.

The historical regression analysis for both PS and IR included precipitation, temperature, and potential evapotranspiration (PET). Historical precipitation was based on monthly total precipitation for the historical period included in the analysis. Precipitation data were collected from the National Aeronautics and Space Administration (NASA) Daymet dataset (Thornton, et al. 2022). PET was calculated using the Hargreaves Method (Hargreaves and Allen 2003). PET is a measure of atmospheric thirst that varies seasonally, reflecting the capacity of warm air to hold moisture from soil and transpiring plants during the growing season. Previous regional water studies related a portion of increases in seasonal water demand in the PS and IR sectors to increases in PET.

The Hargreaves Method is a widely used empirical approach for estimating PET, particularly in situations where climate data is limited. The method is based on temperature data and simplifies the calculation of PET by requiring only daily maximum and minimum temperatures and extraterrestrial radiation, which is estimated based on latitude and day of the year. The formula for the Hargreaves Method is defined below:

Equation 2. Hargreaves Method

$$PET = 0.0023 \times (T_{mean} + 17.8) \times (T_{max} - T_{\min})^{0.5} \times R_a$$

where:

PET = potential evapotranspiration (mm/day),

T_{Mean} = average temperature (degrees Celsius (°C))

T_{Max} = daily maximum temperature (°C),

T_{Min} = daily minimum temperature (°C),

R_a = extraterrestrial radiation (mm/day), based on latitude and the Julian day.

The components of the calculation are described below:

Temperature difference (T_{max}−T_{min}): This difference represents the diurnal temperature range, which is used as an indicator of the energy available for evaporation and transpiration.

Extraterrestrial radiation (R_a): This component accounts for the solar energy reaching the Earth's atmosphere on a given day and latitude. In addition to the day of the year and latitude, it can be calculated using a formula that considers solar declination and other astronomical parameters.

Empirical constant (0.0023): This constant was calibrated by Hargreaves and Samani (1985) to adjust the units and scale the equation appropriately for estimating PET under standard atmospheric conditions.

Future projections of precipitation, temperature, and PET were simulated for each county intersecting Kankakee Basin by scaling historical trends in daily precipitation and air temperature by the effects of future climate change centered around three periods: 2011-2040 (Period 1), 2041-2070 (Period 2), and 2071-2100 (Period 3). The methods reflect the assumptions used in the water supply analysis, based on the INCCIA study (Cherkauer et al. 2021). Future regional climate trends were applied from downscaled GCM output from the CESM1-CAM5 model (See Chapter 3 of the main report for details on the climate forecast models used).

For both historical weather and projected climate variables, this study retrieved county-specific precipitation and temperature data from the 5 x 7-kilometer spatial grid for the cell located at the centroid of each county for area within the Kankakee Basin. To validate the representativeness of this approach, the study compared trends in historical daily weather data against county-wide averages derived from all grid cells within Jasper County. Daily values for all weather variables showed no statistically significant deviation from county-wide averages, suggesting that the selected method represented county-level climate trends, as shown in Table C-3.

Table C-3. Correlation Between Mean Daily Weather Data Across Methods for Jasper County

Climate Variable	Statistical Correlation in Daily Weather Data between County Center Grid Cell vs. County Average Estimates
Daily Minimum Temperature	99.998%
Daily Maximum Temperature	99.998%
Daily Potential	99.998%
Daily Total Precipitation	99.118%

Notes: NASA Daymet data (Thornton, et al., 2022) is a gridded, continuous dataset of daily weather data (including precipitation and temperature) spanning the United States. County center grid cell data refers to data collected from the grid cell intersecting the center point of the area in Jasper County intersecting Kankakee Basin (Selected by GIS analysis). County average estimate refers to the daily average values of variables across all grid cells intersecting Jasper County.

C.3 Water-Use Specific Projections

What follows are the water use sector specific projections listed by order of the magnitude of the withdrawals:

- Irrigation
- Energy
- Public Supply
- Industrial
- Self-Supplied Residential
- Miscellaneous
- CFO and CAFO
- Rural

The main report of the Kankakee Regional Water Study provides results in context of the water regional supply with implications to water availability. This appendix provides supplemental information with additional results and methods. For each sector, information is presented in a similar format. First, an overview presents the main results to highlight the geographical distribution of historical and projected water withdrawals for each sector. Then each section dives into the sector-specific methodology used including details on data sources, data processing, and analysis.

C.3.1 IRRIGATION WITHDRAWALS

IR withdrawals refer to all water used to support agricultural irrigation and turf irrigation. Historical irrigation (IR) water withdrawals from the Indiana Department of Natural Resources (IDNR) SWWF database were modeled for the Study Area subbasins and counties based on economic and agronomic factors and weather conditions. While a broad range of factors may influence irrigation rates, including crop type, irrigation technology, market conditions, and farm-level decision-making, this study was limited to those factors for which consistent historical records and forecasted data were available. As a result, the modeling focused on variables such as weather and climate trends, which could be projected into the future and time trends to capture the influence of unaccounted for economic factors. The sections that follow describe the context of agricultural irrigation in the region and the forecasting methodology in detail, including the data sources, climate and seasonal variables, regression model structure, and the approach used to disaggregate county-level projections into subbasin estimates.

C.3.1.1 Context

Both historical and future irrigation withdrawals are concentrated in the central portion of the Study Area in Jasper and La Porte Counties (Figure C-10).

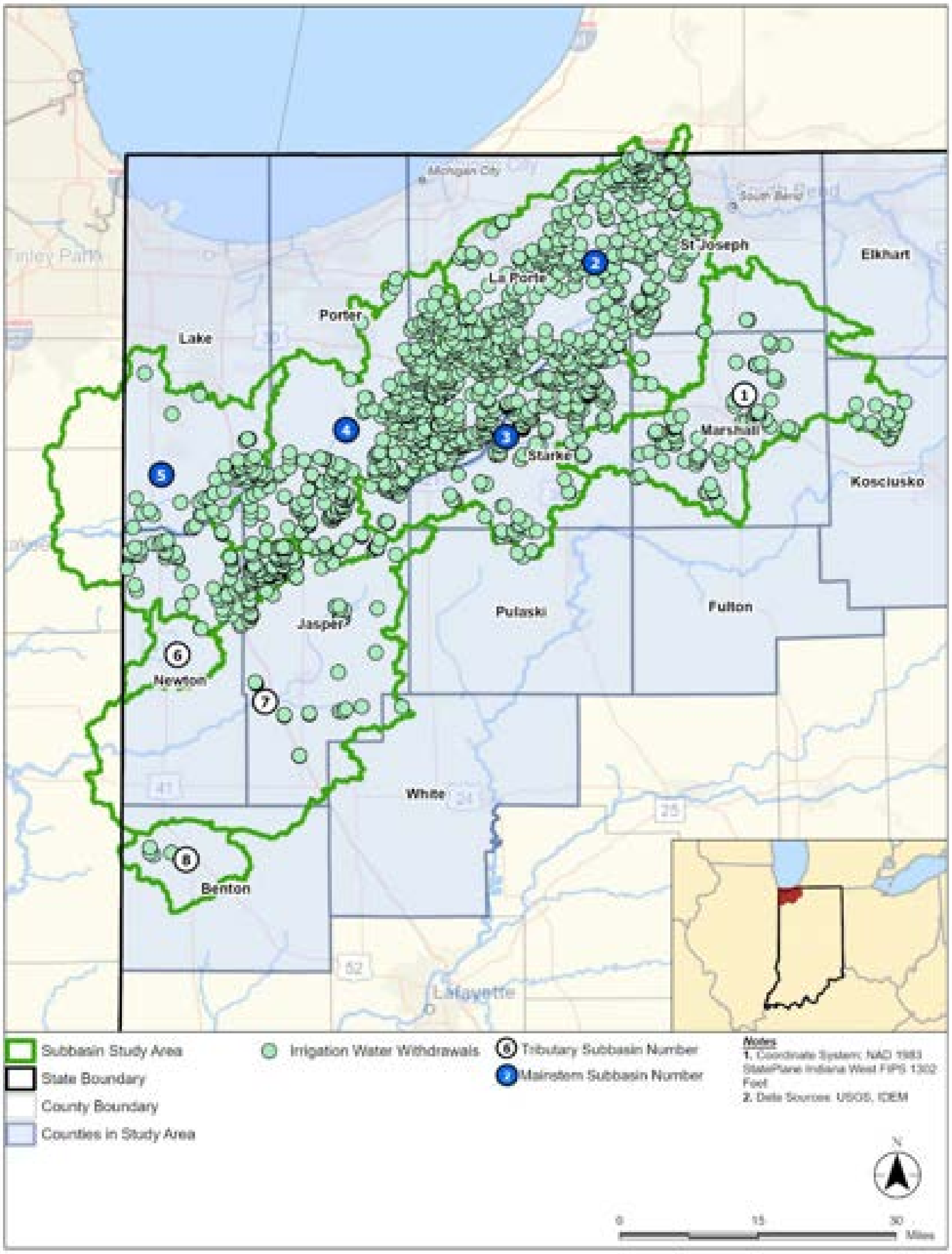
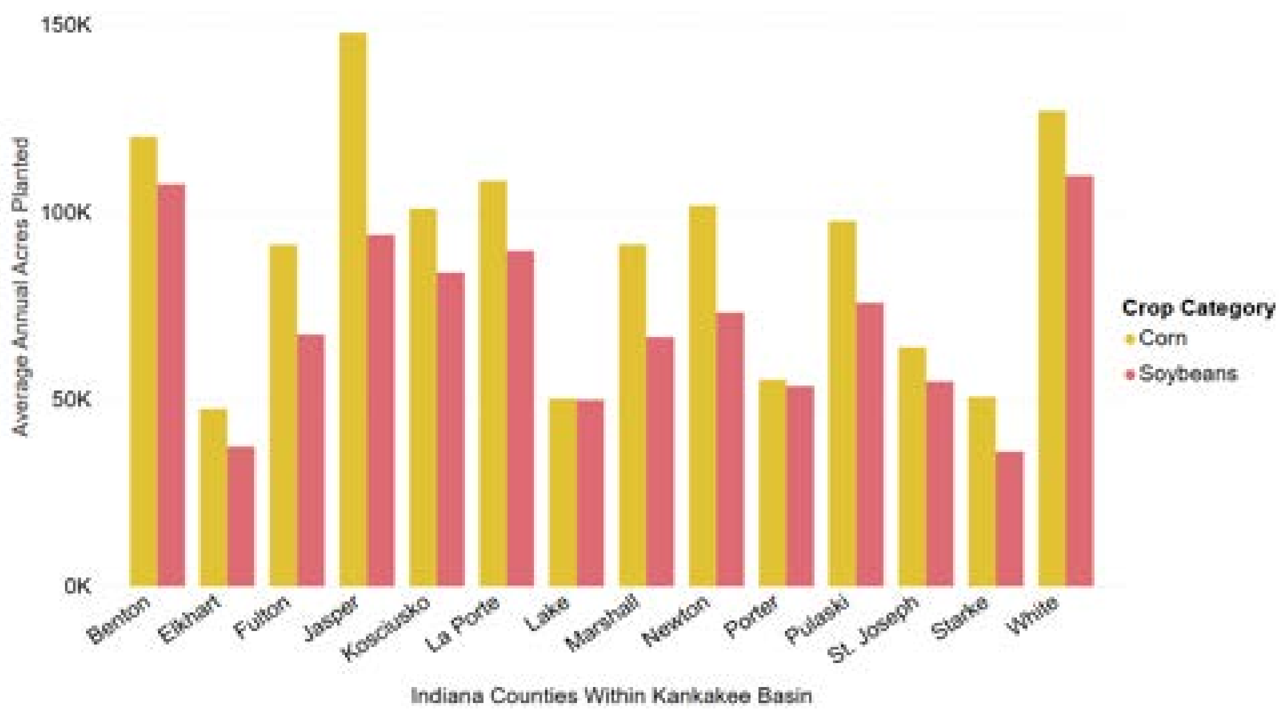


Figure C-10. Irrigation Water Withdrawal Locations Within the Study Area

The Study Area supports a significant agricultural industry. Indiana is the seventh largest agricultural exporter in the U.S. The value of unprocessed agricultural commodities sold in 2022 was $18 billion. The two primary crops are corn and soybeans. Agricultural production for corn and soybeans makes up approximately 46% and 38% of total Indiana production, respectively (USDA NASS Indiana State Overview Quick Stats database 2022). For these crops, Indiana counties intersecting the Kankakee Basin contribute approximately 21% and 15% of total statewide corn and soybean production as of 2022 (USDA 2023a, USDA 2023b). From 2019 to 2024, data on land use by crop type showed that Jasper, White, Benton, La Porte, and Kosciusko Counties contained the greatest average annual acreage of land planted for corn and soybeans in the basin (Figure C-11). These counties also lead in total corn and soybean production when compared to other counties intersecting Kankakee Basin (USDA 2023a, USDA 2023b).



Source: USDA NASS Quick Stats database 2022.

Figure C-11. Acres of Planted Corn and Soybeans for Indiana Counties All or Partially Located in the Kankakee Basin (Annual Average, 2019-2024)

The forecast assumes corn and soy will continue as the primary crops in the Basin. Corn and soybeans consistently account for the predominant share of agricultural land, while other crops, such as hay and oats, remain consistently planted but represent a minor proportion of total acreage (USDA NASS Quick Stats database 2022). Much like the commercial development of biofuel from corn in the mid- to late-1980s, the industry seeks new and diversified revenue streams for both corn and soybeans (USDA 2021). For example, the U.S. Agricultural Research Service (ARS) has developed a way to make jet biofuel from soybean oil (USDA 2021). There are two ethanol processing plants in the basin. One of those, South Bend Ethanol is currently investing $230 million in plant expansion, signaling the industry's commitment to corn production (WSBT 2024).

The acres of cropland within the Study Area has remained relatively stable for the last 25 years. In 2022, the U.S. Department of Agriculture (USDA) (NASS Quick Stats database) reported 3.8 million acres of cropland for counties partially or fully within the Study Area, relatively unchanged from the 3.9 million acres reported in 1997 (Table C-4). While the number of acres of harvested cropland has been relatively constant, irrigated acres have been increasing. In 2022 the USDA reported 354,000 irrigated acres (9.3% of total cropland) in the Study Area (Table C-4). This represents an increase from 344,000 irrigated acres (9.1% of total cropland) in 2017, 275,000 irrigated acres (7.4% of total cropland) in 2012, and 177,000 irrigated acres (4.5% of total cropland) in 1997 USDA (NASS Quick Stats database). Several counties show a significant increase in irrigated cropland over time. The percentage of irrigated cropland in La Porte County, for example, increased from 12% in 1997 to 31% in 2022. Similarly, irrigated cropland in Starke County increased from 8.9% in 1997 to 25% in 2022. During that time, the cropping patterns remained relatively unchanged, with corn and soy being the dominant crops (USDA NASS Indiana State Overview Quick Stats database). Despite research investments being made to develop crops with higher yields and lower water demand, as well as crops that are more resistant to severe weather events (e.g., shorter corn varieties that can withstand extreme wind events), the expectation is that farms will continue to irrigate crops in order to increase yields (Stantec 2025).

Table C-4. Total Cropland, Irrigated Cropland, Kankakee Basin Counties 1997-2007

Year	1997			2002			2007			2012			2017			2022		
County	Cropland (1,000 acres)		% of Total	Cropland (1,000 acres)		% of Tota l	Cropland (1,000 acres)		% of Total	Cropland (1,000 acres)		% of Total	Cropland (1,000 acres)		% of Total	Cropland (1,000 acres)		% of Total
	Irrig.	Total		Irrig.	Total		Irrig.	Total		Irrig.	Total		Irrig.	Total		Irrig.	Total	
Benton	NA	250	NA	NA	237	NA	4	263	2%	NA	247	NA	7	246	3%	4	210	2%
Elkhart	24	167	14%	23	176	13%	22	142	16%	26	140	18%	25	146	17%	32	166	19%
Fulton	10	154	6%	16	174	9%	20	166	12%	23	169	14%	25	197	13%	27	159	17%
Iroquois	4	632	1%	3	648	0%	4	647	1%	3	638	0%	6	656	1%	5	637	1%
Jasper	17	258	6%	21	260	8%	23	316	7%	21	257	8%	26	252	10%	14	286	5%
Kankakee	14	341	4%	14	334	4%	16	376	4%	15	328	4%	18	300	6%	11	309	4%
Kosciusko	13	216	6%	19	225	8%	28	219	13%	18	220	8%	30	230	13%	43	262	16%
La Porte	28	230	12%	32	222	15%	48	232	21%	54	209	26%	68	230	30%	81	261	31%
Lake	6	142	4%	7	117	6%	10	121	8%	8	124	7%	5	106	4%	4	112	4%
Marshall	5	180	3%	9	179	5%	9	156	6%	13	182	7%	17	177	9%	22	182	12%
Newton	7	194	4%	4	169	2%	6	176	3%	6	174	4%	5	161	3%	3	164	2%
Porter	7	126	6%	8	133	6%	9	106	8%	10	109	9%	10	115	9%	14	106	13%
Pulaski	12	217	5%	19	206	9%	20	213	9%	18	197	9%	30	218	14%	40	231	17%
St. Joseph	13	143	9%	20	149	13%	25	164	15%	28	136	20%	28	134	21%	24	142	17%
Starke	10	118	9%	11	116	10%	17	133	13%	26	115	22%	39	131	30%	21	84	25%
White	2	257	1%	3	260	1%	3	301	1%	4	268	2%	5	266	2%	9	282	3%
Will	4	281	1%	2	253	1%	2	209	1%	1	221	1%	0	208	0%	1	228	0%
Total	177	3,906	5%	210	3,858	5%	265	3,939	7%	275	3,736	7%	344	3,774	9%	354	3,821	9%
Avg Annual Growth Rate of Irrig. Land Per Period (%)	**NA**			**4%**			**5%**			**1%**			**5%**			**1%**		

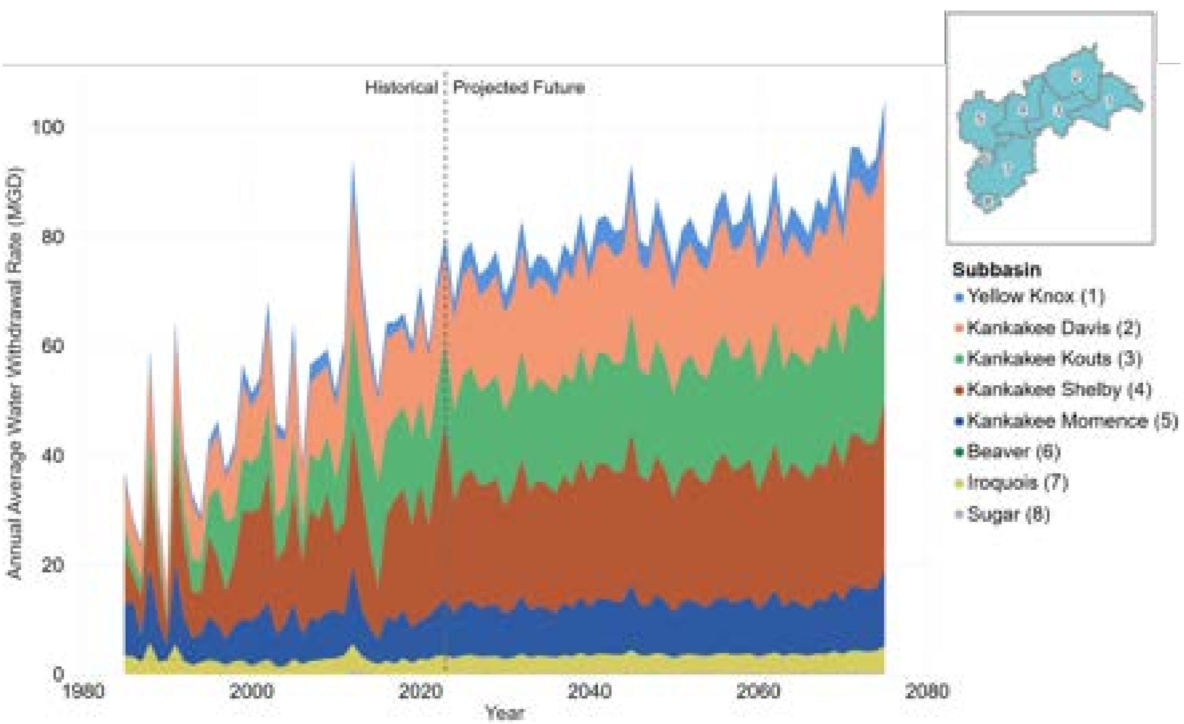
Source: USDA NASS Quick Stats database.
Note: irrig. = irrigated

C.3.1.2 Overview

County level regression modeling was used to model IR water demand. Explanatory variables include county-level historical data for precipitation, temperature, evapotranspiration (ET), a time trend, and monthly seasonality variables. This combination of dependent and explanatory variables was chosen based on what could be reasonably projected into the future. Predicted agriculture-related economic variables such as corn or soybean production rates and prices were not available at the timescale of the forecast for this study.

County-level projections were produced and aggregated or disaggregated by subbasin according to the spatial distribution of demand sources. This approach was adopted, rather than estimating a subbasin level IR demand, in order to provide visibility to the county-level resource managers about estimates relative to their area of management. In addition, these county level estimates could be compared to county-level estimates of irrigation and irrigated acres published by the USDA.

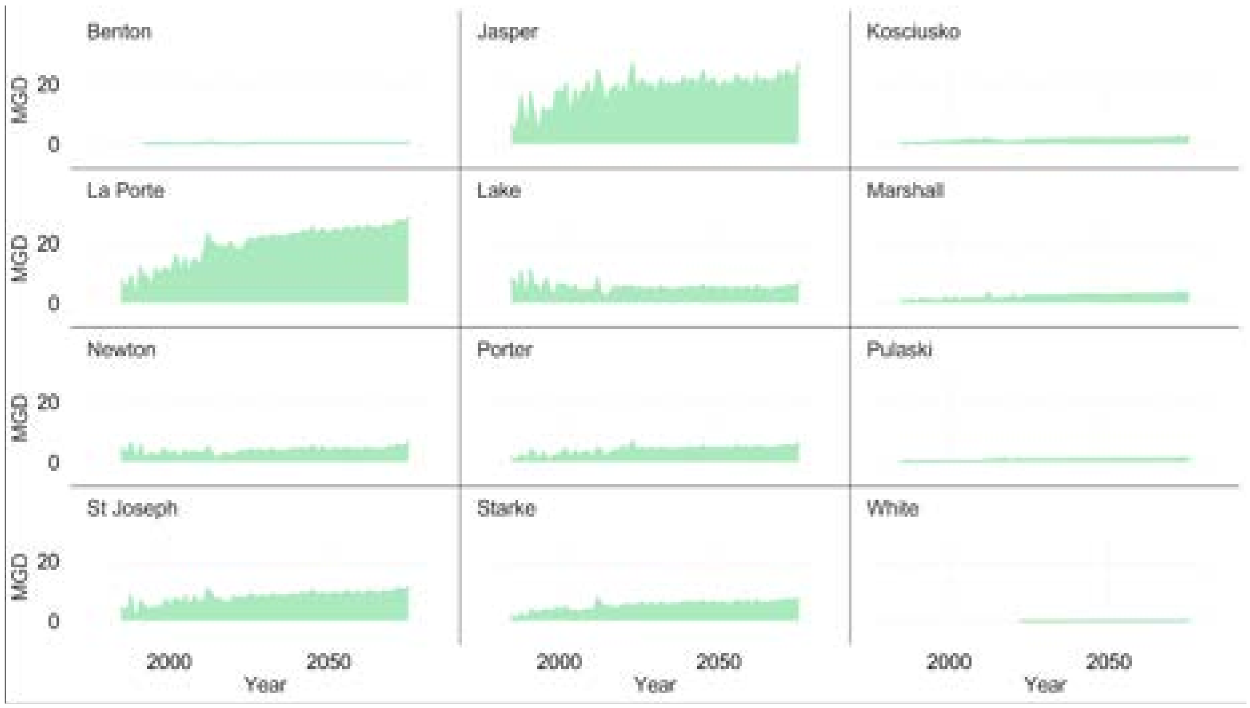
Figure C-12 shows the total IR demand for the entire Kankakee Basin by subbasin for the historical and projected period. These are the final results after disaggregation into the subbasin level. Annual average water withdrawals for agricultural irrigation are expected to be 105.2 MGD in 2075 across Kankakee Basin. Withdrawals are expected to be greatest in Kankakee Shelby (Subbasin 4), Kankakee Kouts (Subbasin 3), and Kankakee Davis (Subbasin 2), which also have the greatest volume of historical water demand (Figure C-12).



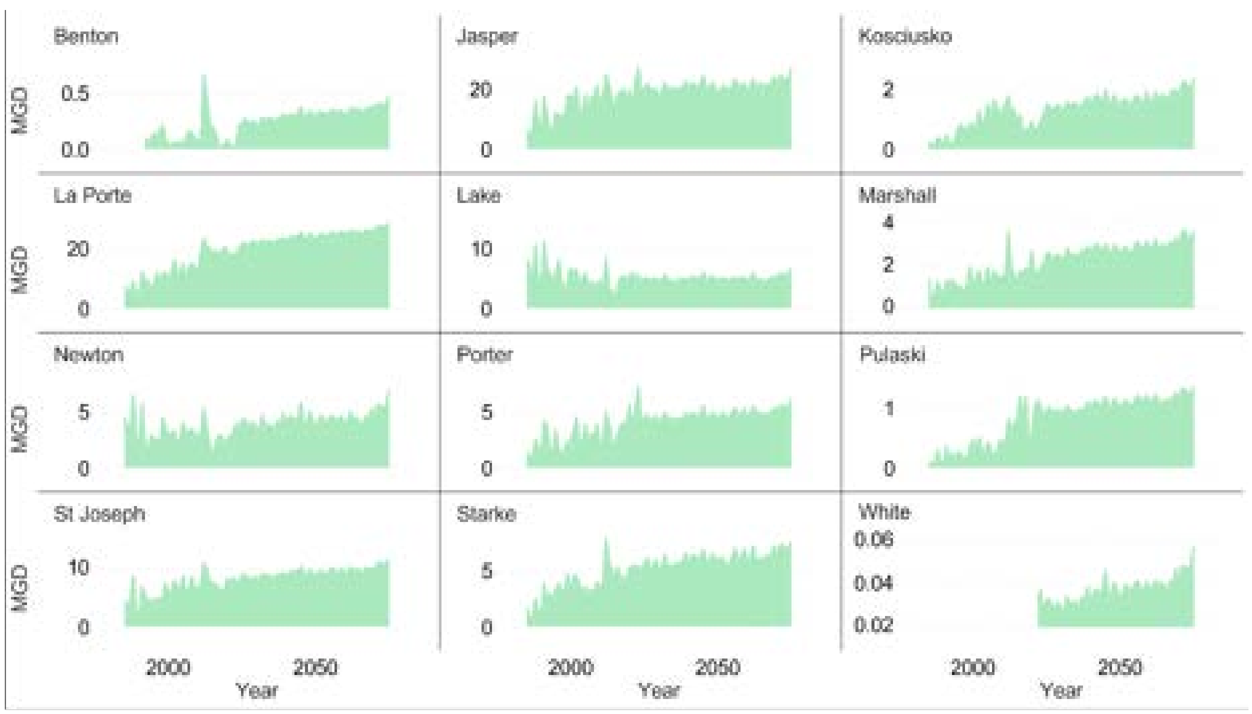
Key: MGD = million gallons per day

Figure C-12. Historical and Future Projected Annual Irrigation Water Demand for Kankakee Basin, 1985-2075 (MGD)

The analysis suggests that county irrigation withdrawals exhibit a constant or increasing trend. The study predicts that seasonal trends in agricultural irrigation water use will continue into the forecast period. Withdrawals increase during summer months relative to winter months. These trends remain consistent across counties varying based on county-specific climate and historical water use. Counties with relatively high historical irrigation withdrawals, such as La Porte, Jasper, and St. Joseph, are forecasted to experience proportionally greater future irrigation demand. Counties with lower historical withdrawals, including Pulaski, Marshall, and Kosciusko, are projected to have comparatively lower future irrigation withdrawals (Figure C-13).



Note: the vertical axis scale is fixed for each region.



Note: the vertical axis scale is different for each region.
Key: MGD = million gallons per day

Figure C-13. Historical and Future Projected Annual Irrigation Water Demand by County, Fixed (top) and Variable Scale (bottom), 1985-2075 (MGD)

C.3.1.3 Data Sources

Estimates of historical water demand gathered from Indiana's SWWF water-use database were used to develop a dataset of historical demand records for Indiana counties in Kankakee Basin. This data set served as the dependent variable in all county-level regression analyses.

The data sources used for the modeling are:

C.3.1.3.1 Dependent Variable

- **Water Use Data**
  - Historical public supply withdrawals were obtained from the Indiana SWWF database (IDNR 2025).
    - The SWWF provides monthly withdrawal totals reported by facility.
    - Records span from 1985 through 2023.

C.3.1.3.2 Explanatory Variables

- **Weather and Climate Data**
  - Precipitation and temperature
    - Historical (1985-2023)
      - NASA Daymet V4 (Thornton et al. 2022)
        - Daily gridded precipitation and temperature data
    - Future (2023-2075)
      - Indiana Climate Change Impacts Assessment (INCCIA) (Cherkauer et al. 2021).
        - Historical daily precipitation and temperature data scaled to future periods based on downscaled climate projections from the CESM1-CAM5 GCM under RCP8.5
  - Evapotranspiration (PET)
    - Derived from historical and future climate projections (Hargreaves method) (See Section C.2.2 for a detailed summary).
- **Time trend**
- **Seasonality**

- Monthly indicator variables
- Growing season indicator variable (May through September)

C.3.1.4 Pre-Processing

The study collected and processed data on historical water withdrawals and weather and climate data to produce monthly, county-level datasets for regression modeling.

C.3.1.4.1 SWWF Water Withdrawal Data

The first step in data processing was to identify and remove water usage records corresponding to field dewatering or drainage. Field dewatering is any process that is used to remove existing water from an inundated agricultural field to protect their fields from stubble accumulation and prepare the field ahead of the growing season. Water use entries in which the purpose field is labeled “drainage” that occur during the off-season from November to April were identified and removed from the dataset. All other entries during the off-season were included in the dataset.

Processed water withdrawal records were then aggregated by year, month, and county. The regression models used the full set of withdrawal data for each county and later disaggregated county total forecasts by subbasin. The regressions were run at a county-level in order to compare model results against county-wide historical data on cropland use.

C.3.1.4.2 Weather and Climate Data

The regressions incorporated daily observations and climate model predictions of precipitation, minimum temperature, and maximum temperature for each county in the Study Area from 1985 through 2075. Daily PET was calculated using the Hargreaves Method (see Section C.2.2 for methodology). Daily climate data were aggregated by year, month, and county, and monthly summary statistics were calculated for use in regression modeling. Table C-5 summarizes the monthly climate variables used in the analysis.

Table C-5. Monthly Weather and Climate Summary Variables.

Climate Variable	Monthly Summary Statistic
Precipitation	Monthly sum precipitation
Precipitation	Monthly mean precipitation
Precipitation	Monthly maximum precipitation
Precipitation	Monthly frequency – precipitation days
PET	Monthly mean PET
PET	Monthly maximum PET
PET	Monthly minimum PET
Temperature	Monthly maximum, daily maximum temperature
Temperature	Monthly mean, daily mean temperature
Temperature	Monthly minimum, daily minimum temperature

Key: PET= potential evapotranspiration

C.3.1.4.2.1 Principal Component Approach

Each monthly summary statistic provides a distinct representation of intra-month climate variation, contributing unique explanatory power to the regression models. While including all weather variables—precipitation, PET, and temperature—in the regression analysis improved the accuracy of water withdrawal predictions, temperature and PET exhibit a high degree of multicollinearity, as temperature is a key input in the Hargreaves Method used to estimate daily PET (see Section C.2.2 for details).

Multicollinearity makes it difficult to isolate the individual effect of weather variables on water demand and increases the uncertainty of coefficient estimates. To address multicollinearity between temperature and PET variables, the study employed a principal component analysis (PCA). This technique captures the underlying variation across all monthly temperature and PET variables while controlling for redundancy and is commonly employed to extract trends in large scale climate data for statistical and econometric analyses (Serrano-Candela F. et al. 2024, Alsumaiei 2025, Gonzalez-Jardines et al. 2024). Precipitation variables were excluded from PCA because exploratory modeling showed that monthly sum precipitation consistently served as the most reliable predictor of water withdrawal variation and exhibited lower correlation with temperature and PET, reducing concern for multicollinearity.

Table C-6 summarizes the total variability of explanatory variables captured by each principal component, while Table C-7 presents the loadings of each individual variable. Larger absolute values for loadings indicate a greater contribution to each component. The principal component 1 (PC1) captured 92% of the variation across all monthly temperature and PET using a single variable. This result indicates that temperature and PET variables exhibit relatively uniform variation across the Study Area. Additional principal components were tested in regression modeling; however, they did not improve explanatory power and were excluded from the final regression models.

Table C-6. Principal Component Variables, Proportion of Temperature and PET Variation

Variance Measures	Principal Component Variables					
	PC1	PC2	PC3	PC4	PC5	PC6
Standard Deviation	2.35	0.48	0.43	0.21	0.13	0.07
Proportion of Variance	92	4	3	1	0	0
Cumulative Proportion	92	96	99	100	100	100

Key:
PET = potential evapotranspiration

Table C-7. Loadings of Weather Variables on Principal Components

Variable	Principal Component Variables					
	PC1	PC2	PC3	PC4	PC5	PC6
PET (Average)	0.417	0.307	0.254	-0.226	0.437	0.653
PET (Max)	0.408	0.062	0.637	-0.352	-0.299	-0.459
PET (Min)	0.399	0.657	-0.228	0.535	-0.232	-0.134
Temperature (Max Daily Max)	0.401	-0.626	0.223	0.562	-0.147	0.245
Temperature (Average Daily Average)	0.418	-0.211	-0.307	-0.021	0.662	-0.498
Temperature (Min Daily Min)	0.408	-0.186	-0.578	-0.471	-0.454	0.192

Key:
PET = potential evapotranspiration

C.3.1.4.2.2 Weather Variables Seasonal Sensitivity

Water withdrawals exhibit significant seasonal variation for irrigation use, which aligns closely with growing season and climate patterns across the Study Area. Growing season months (May through September) consistently show elevated withdrawal volumes compared to off-season winter months, when water withdrawals remain low.

The study hypothesized that weather variables have a significant influence on water withdrawals and tested multiple combinations of weather variables to evaluate the relationship between weather and water withdrawal patterns. Exploratory data analysis revealed that the relationship between temperature and PET varies by month. Data analysis found that temperature and PET changes during non-growing season months do not significantly influence irrigation demand; however, increases in temperature or PET during peak summer months drive higher irrigation water demand.

To model seasonal sensitivity, the study developed an adjusted principal component variable for temperature and PET. This variable applied a cut-off threshold: values below zero were reset to zero, while values above zero remained unchanged. PC1 values below zero generally corresponded to non-growing-season months and showed no significant correlation with water withdrawals, whereas values above zero aligned with growing-season months and showed strong correlation. This transformation ensured that the regression models captured only the significant growing-season temperature and PET effects.

Monthly total precipitation exhibited a more uniform average trend across the year; with less inter-month variability compared to temperature and evapotranspiration (PET). Although precipitation showed seasonal swings, its relative consistency supported its inclusion in the regression models without seasonal adjustment.

C.3.1.4.3 Time Trends and Seasonality

Irrigation models incorporated three types of variables to capture effects of time and season. A time trend variable was included in the regression models to account for long-term changes in irrigation withdrawals and act as a proxy for unobservable factors such as crop prices and demands. Seasonally dependent time trend effects were further captured by creating an indicator variable that is equal to one only during the growing season (May through September) months and interacting this variable with the time trend. Month fixed effects were included to control for seasonal patterns of water consumption.

C.3.1.4.3.1 Time Trend Assumptions and Agricultural Capital Investment

Exploratory data analysis showed that, for each county, time series data of water withdrawals showed significant year-over-year trends that were not explained by seasonal or weather variables. Including a time trend variable enables the models to capture underlying structural, economic, and technological influences on agriculture, which directly impact production rates and water withdrawals.

Existing data on land use, along with qualitative reports from stakeholder interviews (described in Chapter 3), indicate that historical investment in irrigation equipment contributed to increases in irrigation water withdrawals between 1985 and 2000 (Table C-8). Data from the USDA shows that from 1997 to 2022 irrigated cropland has increased in Kankakee basin counties from 4.5% of total cropland to 9.5% of total cropland. The rate of growth in irrigated cropland also has decreased over time. From 1997 to 2002 the annual average growth in irrigated cropland was 4%. That rate of growth fell to 1% for the period 2017 to 2022, indicating that capital investment in irrigation equipment has potentially slowed over time (USDA NASS Quick Stats database). This trend was confirmed by interviews with individuals in the industry.

Furthermore, tests of time series stationarity, which evaluate whether time series data exhibit consistent trends, suggest that water withdrawals across all counties included in the analysis exhibit year-over-year differences in withdrawals that are not explained by seasonal trends. The results of this analysis, conducted using an Augmented Dickey-Fuller test, are summarized in Table 3-6 below.

Table C-8. Augmented Dickey Fuller Test Results

County	Hypothesis Tested	P- value (Stationary)	ADF Test Statistic	Conclusion
Benton	stationary	0.5	-2.3	Time trends present in county data
Elkhart	stationary	0.5	-2.3	
Fulton	stationary	0.4	-2.3	
Jasper	stationary	0.3	-2.6	
Kosciusko	stationary	0.8	-1.5	
La Porte	stationary	0.3	-2.8	
Lake	stationary	0.5	-2.2	
Marshall	stationary	0.5	-2.3	
Newton	stationary	0.1	-3.3	
Porter	stationary	0.6	-2.1	
Pulaski	stationary	1.0	-0.7	
St. Joseph	stationary	0.6	-1.9	
Starke	stationary	0.3	-2.7	
White	stationary	0.5	-2.1	

Note: ADF Test evaluates hypothesis that time series is stationary, or trends stay constant over time. P-value greater than 0 indicates that the county dataset is non-stationary, meaning the trends vary over time. This finding suggests that year-over-year changes, likely due to economic or agronomic factors, are present in the data.

The presence of a significant a year-over-year time trend suggests that additional economic and agronomic factors, such as crop prices, capital investment, market demand, cultivar efficiency, technology, incentives, and supply chain dynamics, are influencing water withdrawal patterns. These factors are difficult to forecast and introduce uncertainty into long-term water demand projections and were not investigated. Instead, a time trend variable, year, was included in the model to capture broad year-over-year changes.

Statistical tests and model comparisons confirm that the inclusion of the log-transformed year variable improves model performance and stability. The study applied a logarithmic transformation under the assumption that agricultural capital investment reached saturation prior to the study period. A log-transformed time trend that flattens over time aligns with this assumption more effectively than a linear specification, reflecting diminishing marginal changes in irrigation demand as capital infrastructure stabilizes. A stable time trend provides a better match for input assumptions in terms of expected water withdrawals, with changes being driven by seasonal and climate trends.

After reviewing the effects of the time trend variable, the regression models were run on a truncated SWWF dataset. Instead of including all SWWF data, from 1985-2023, the models were estimated using data from 2000-2023, to exclude the period with the relatively more rapid increase in irrigated acres from 1997-2000.

C.3.1.4.3.2 Seasonal Differences in Time Trends

As expected, historical withdrawals primarily occur during the growing season (May through September) and future withdrawals are expected to exhibit similar seasonal trends. The study created a binary growing-season indicator variable, equal to 1 for withdrawal records in months May through September and interacted this term with the log transformed time trend variable. This method ensured that the regression models capture time-dependent effects only during the growing season, as cold-season withdrawals have remained relatively constant over the historical data.

C.3.1.4.3.3 Monthly Seasonality of Irrigation Demand

Agricultural irrigation exhibits highly seasonal demand patterns. Monthly indicator variables controlled for base seasonal effects independent of climate variation. By including both weather variables and monthly indicators, the models distinguish between fixed seasonal withdrawal patterns that do not vary over time and climate-driven deviations within those seasons. Incorporating both components stabilized long-term, off-season predictions and preserved significant seasonal trends in irrigation water withdrawals, which are influenced by climate conditions as well as growing season dynamics and economic factors.

C.3.1.5 Analysis Methods

Multivariate regression analysis was applied to a preprocessed dataset to quantify the relationship between monthly water withdrawals and weather variables, seasonal trends, and time trends. For each county, historical data from 2000-2023, including water withdrawals, weather variables, monthly indicator variables, and a time trend, were divided into training and testing datasets. Numerous combinations of explanatory variables were tested to determine optimal model fit.

Model validity was assessed using the root mean squared error (RMSE) of predictions against actual withdrawals in the testing dataset. Additional model diagnostics included review of Adjusted R^2 values, variable coefficients, and associated p-values.

Following review of model performance across counties, the following functional form was selected for all Indiana counties in the study (Equation 3).

Equation 3. Regression Model for Agricultural Irrigation Water Withdrawals

$$\begin{aligned} Monthly\ Withdrawals_i &= \beta_0 + \beta_1 \cdot Adjusted\ PC1_i + \beta_2 \cdot Monthly\ Precipitation_i\ + \beta_3\ \cdot Feb_i\ + \beta_4\ \cdot Mar_i + \beta_5 \\ &\cdot Apr_i + \beta_6 \cdot May_i + \beta_7 \cdot Jun_i + \beta_8 \cdot Jul_i + \beta_9 \cdot Aug_i + \beta_{10} \cdot Sep_i + \beta_{11} \cdot Oct_i + \beta_{12} \cdot Nov_i \\ &+ \beta_{13} \cdot Dec_i + \beta_{14} \cdot [log(Indexed\ Year_i) \times Growing\ Season\ Indicator_i] + \varepsilon_i \end{aligned}$$

Where:

Monthly Withdrawals = monthly total agricultural irrigation water withdrawals in millions of gallons.

Adjusted $PC1_i$ = the monthly adjusted principal component 1 variable. Values below 0 adjusted to 0 for PC1 on withdrawals during growing season months only.

Monthly Precipitation = the total monthly precipitation (mm/month).

Feb-Dec = monthly indicator variables. First month (Jan) is used as a reference variable for other months and is dropped from regression to prevent multi-collinearity.

[log(Indexed Year) x Growing Season Indicator] = numeric, log transformed year variable indexed to 2000 (e.g., year 2000 =1, 2001=2) interacted with an indicator variable for months May-September.

ε_i = random error term representing unexplained variation in the model.

Table C-9 and D-10 provide the results of the regression analysis. Most county regressions have an R^2 above 0.788, indicating a good fit with the data, except Benton County, which has a lower R^2 of 0.554. Weather variables (PC1 and monthly precipitation) generally exhibit statistically significant effects on water withdrawals. In Benton and Fulton Counties, adjusted PC1 is not significant and monthly total precipitation is not significant in La Porte County. Despite these exceptions, all weather variables are retained in county-level models to account for future climate-related variation across temperature, PET, and precipitation.

Monthly indicator variables are significant in some counties but not all. Coefficient values on the growing-season month indicators are higher than non-growing-season months, as to be expected. The interaction term *log(Indexed Year) × Growing Season* is not statistically significant in all counties. However, the study includes this term to support out-of-sample prediction validity and to capture economic and agronomic factors influencing water withdrawal trends during the historical period (2000-2023).

Table C-9. Agricultural Irrigation Water Withdrawal Regression Model Results by County. Jasper – Lake

Variables	Jasper	Benton	Elkhart	Fulton	Kosciusko	La Porte	Lake
(Intercept)	190.705**	7.237	54.871	149.226	52.919	34.832	33.451
P-Value	*0.009***	*0.618*	*0.217*	*0.347*	*0.3*	*0.606*	*0.472*
Adjusted PC1	193.976*	9.386	288.899***	90.829	388.693***	182.908**	99.404*
P-Value	*0.022**	*0.294*	*<0.001****	*0.154*	*<0.001****	*0.002***	*0.018**
Monthly Sum Precipitation	−2.772***	−0.140*	−0.908***	−2.057***	−0.843*	−0.402	−0.507*
P-Value	*<0.001****	*0.016**	*<0.001****	*<0.001****	*0.011**	*0.193*	*0.031**
Feb Month Variable	−18.818	−0.693	−0.459	−77.154	11.187	−5.707	2.005
P-Value	*0.842*	*0.968*	*0.994*	*0.727*	*0.865*	*0.951*	*0.974*
Mar Month Variable	11.558	1.599	8.607	17.898	3.068	0.776	4.891
P-Value	*0.902*	*0.927*	*0.881*	*0.929*	*0.964*	*0.993*	*0.941*
Apr Month Variable	96.415	5.914	19.143	25.362	18.991	3.044	52.715
P-Value	*0.314*	*0.73*	*0.738*	*0.879*	*0.778*	*0.97*	*0.333*
May Month Variable	−185.119	−62.743+	−437.826***	−340.063+	−501.890***	−311.275*	134.057
P-Value	*0.271*	*0.057+*	*<0.001****	*0.074+*	*<0.001****	*0.012**	*0.108*
Jun Month Variable	430.893+	−42.876	−262.691*	−35.275	−377.065*	105.311	274.554*
P-Value	*0.076+*	*0.26*	*0.040**	*0.876*	*0.014**	*0.542*	*0.027**
Jul Month Variable	2046.589***	−21.692	435.913**	555.558*	250.932	911.973***	475.568***
P-Value	*<0.001****	*0.561*	*0.002***	*0.022**	*0.14*	*<0.001****	*<0.001****
Aug Month Variable	1896.572***	−8.284	629.612***	538.417*	357.327*	844.554***	595.415***
P-Value	*<0.001****	*0.808*	*<0.001****	*0.015**	*0.013**	*<0.001****	*<0.001****
Sep Month Variable	64.284	−62.512*	91.785	−247.892	−117.769	−129.678	143.193+
P-Value	*0.66*	*0.044**	*0.271*	*0.172*	*0.213*	*0.264*	*0.067+*
Oct Month Variable	158.219	6.534	62.965	60.739	29.21	168.925*	41.864
P-Value	*0.106*	*0.694*	*0.272*	*0.71*	*0.665*	*0.035**	*0.45*
Nov Month Variable	30.611	0.863	9.78	−1.564	9.233	−1.035	1.186
P-Value	*0.746*	*0.959*	*0.861*	*0.993*	*0.887*	*0.99*	*0.984*
Dec Month Variable	21.183	0.425	8.898		0.934	−6.205	−5.937
P-Value	*0.823*	*0.98*	*0.875*		*0.989*	*0.946*	*0.926*
log(Indexed Year) × Growing Season	46.982	19.510*	77.490***	177.804***	33.786	239.008***	−52.814**
P-Value	*0.191*	*0.011**	*<0.001****	*<0.001****	*0.186*	*<0.001****	*0.002***
Num.Obs.	231	100	224	146	232	200	185
R2	0.917	0.554	0.917	0.839	0.874	0.923	0.779
R2 Adj.	0.912	0.481	0.911	0.824	0.866	0.917	0.761
AIC	3287.3	939.2	2943.7	2003.9	3142.7	2736.6	2366.9
BIC	3342.4	980.9	2998.3	2048.7	3197.8	2789.4	2418.4
Log.Lik.	−1627.670	−453.614	−1455.860	−986.973	−1555.339	−1352.302	−1167.437
RMSE	277.9	22.58	160.84	208.75	197.38	209.05	133.16

Notes: + indicates significance at the 0.1 level, * indicates significance at the 0.5 level, ** indicates significance at the 0.01 level and *** indicated significance at the 0.001 level

Table C-10. Agricultural Irrigation Water Withdrawal Regression Model Results by County. Marshall - White

Variables	Marshall	Newton	Porter	Pulaski	St. Joseph	Starke	White
(Intercept)	43.909*	70.9	44.311*	83.216	57.783*	72.246	12.952
P-Value	*0.042**	*0.267*	*0.049**	*0.599*	*0.019**	*0.173*	*0.288*
Adjusted PC1	73.549***	107.346***	52.919*	99.417*	147.388***	72.275*	75.381***
P-Value	*<0.001****	*<0.001****	*0.041**	*0.038**	*<0.001****	*0.015**	*<0.001****
Monthly Sum Precipitation	−0.541***	−0.816***	−0.780***	−1.469***	−0.645***	−1.024***	−0.174*
P-Value	*<0.001****	*<0.001****	*<0.001****	*<0.001****	*<0.001****	*<0.001****	*0.014**
Feb Month Variable	−19.079	23.136	−1.120	21.189	−2.107	−8.169	1.13
P-Value	*0.495*	*0.83*	*0.97*	*0.908*	*0.946*	*0.917*	*0.947*
Mar Month Variable	−2.902	−5.799	7.87	15.274	2.172	−15.003	4.024
P-Value	*0.914*	*0.936*	*0.789*	*0.933*	*0.945*	*0.816*	*0.813*
Apr Month Variable	4.751	−6.491	25.118	15.075	27.012	9.695	−0.902
P-Value	*0.843*	*0.922*	*0.378*	*0.928*	*0.395*	*0.867*	*0.957*
May Month Variable	−135.679***	−69.079	−69.155	−406.229*	−146.160**	−97.692	−169.954***
P-Value	*<0.001****	*0.377*	*0.164*	*0.024**	*0.008***	*0.188*	*<0.001****
Jun Month Variable	−89.444+	−17.356	81.682	−180.158	71.464	77.846	−158.338***
P-Value	*0.064+*	*0.856*	*0.282*	*0.377*	*0.365*	*0.425*	*<0.001****
Jul Month Variable	92.186+	193.573+	263.886***	334.46	606.835***	412.225***	−75.928+
P-Value	*0.076+*	*0.051+*	*<0.001****	*0.117*	*<0.001****	*<0.001****	*0.080+*
Aug Month Variable	90.843*	156.117+	323.929***	396.814*	641.721***	425.530***	−57.676
P-Value	*0.044**	*0.085+*	*<0.001****	*0.047**	*<0.001****	*<0.001****	*0.124*
Sep Month Variable	−68.656*	−33.781	34.63	−262.037	104.574*	10.09	−129.790***
P-Value	*0.031**	*0.647*	*0.454*	*0.132*	*0.038**	*0.885*	*<0.001****
Oct Month Variable	16.283	9.212	54.025+	60.076	43.193	42.891	7.823
P-Value	*0.507*	*0.888*	*0.064+*	*0.713*	*0.178*	*0.449*	*0.621*
Nov Month Variable	−2.596	−11.580	2.521	−6.595	5.064	13.288	0.153
P-Value	*0.918*	*0.872*	*0.93*	*0.971*	*0.871*	*0.833*	*0.992*
Dec Month Variable	−7.567	16.634	1.457	14.52	−2.124	−12.674	−0.723
P-Value	*0.78*	*0.877*	*0.962*	*0.948*	*0.946*	*0.862*	*0.965*
log(Indexed Year) × Growing Season	40.631***	−16.998	30.423**	179.000***	32.721*	44.843***	36.502***
P-Value	*<0.001****	*0.14*	*0.008***	*<0.001****	*0.012**	*<0.001****	*<0.001****
Num.Obs.	187	142	224	137	232	157	208
R2	0.864	0.812	0.818	0.875	0.947	0.883	0.788
R2 Adj.	0.853	0.792	0.806	0.86	0.944	0.871	0.773
AIC	2070.2	1689.6	2645.1	1791.6	2798.9	1915.5	2198.6
BIC	2121.9	1736.9	2699.7	1838.4	2854	1964.4	2252
Log.Lik.	−1019.079	−828.782	−1306.538	−879.817	−1383.441	−941.763	−1083.306
RMSE	56.3	82.89	82.58	148.87	94.08	97.47	44.22

Notes: + indicates significance at the 0.1 level, * indicates significance at the 0.5 level, ** indicates significance at the 0.01 level and *** indicated significance at the 0.001 level

C.3.1.6 Forecast Methods for Illinois Counties

The Kankakee Basin partially overlaps three Illinois counties: Kankakee County, Will County, and Iroquois County. Although Illinois has a database of water withdrawals, previous experience with the database revealed that this data has some irregularities. Due to the absence of reliable historical water withdrawal data for Kankakee, Will, and Iroquois Counties, this study applied the predicted values from the regression models from adjacent Indiana counties to estimate both historical (1985-2023) and projected future (2024-2075) withdrawals, adjusting the results by the proportion of irrigated acres. This approach ensured methodological consistency and leveraged available data from regions with comparable hydroclimatic and land use characteristics (Table C-11). The results are supported by a previous water supply report conducted by the State of Illinois (Kelly et al. 2019). The report found that agriculture was the largest water use sector in the region. The water use for irrigation in Indiana is expected to be representative of the neighboring region in Illinois.

Table C-11. Regression Model Transfer for Illinois Counties.

Illinois County	Nearest Indiana County Used for Model Transfer
Iroquois County	Newton County, Indiana
Kankakee County	Newton County, Indiana
Will County	Lake County, Indiana

To improve predictive accuracy for historical withdrawals, the transferred models excluded the log-transformed, indexed year time trend and its interaction with the growing-season indicator variable which produced results more within an expected range than a non-log-transformed, indexed year. All other variables were used in the regressions.

C.3.1.7 Scaling County-Level Forecasts to Subbasin Estimates

Because the water availability portion of the study required demand estimates at the subbasin level, the IR county-level water withdrawal forecasts were disaggregated to subbasin-level forecasts using average proportions of historical water withdrawals within each county. Proportions were derived from the withdrawal data subset used in the regression analysis (2000-2023) with the exception of White County, where withdrawals only occurred in 2022 and 2023.

For example, in Jasper County, approximately 77% of withdrawals from 2000- 2023 were located within Kankakee Shelby (Subbasin 4), while an additional 4%, 8%, and 9% were located in Kankakee Kouts (Subbasin 3), Kankakee Momence (Subbasin 5), and Iroquois (Subbasin 7), respectively (Table C-12).

For Illinois counties within the Study Area (Will, Iroquois, and Kankakee Counties) where historical water withdrawal data were not available, the study estimated the spatial overlap between each county and its intersecting subbasins. The proportional area of each subbasin relative to the total county area was calculated and applied to county-wide withdrawal estimates.

Table C-12. Subbasin Withdrawals as Proportion of County Total Estimated Withdrawals

County Name	Percent of County Within Each Subbasin[a]								Percent of County Within Kankakee Basin[b]
	Yellow Knox (1)	Kankakee Davis (2)	Kankakee Kouts (3)	Kankakee Shelby (4)	Kankakee Momence (5)	Beaver (6)	Iroquois (7)	Sugar (8)	
Benton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.6	38.6
Elkhart	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fulton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jasper	0.0	0.0	4.2	77.3	8.4	0.0	9.3	0.0	99.3

County Name	Percent of County Within Each Subbasin[a]								Percent of County Within Kankakee Basin[b]
	Yellow Knox (1)	Kankakee Davis (2)	Kankakee Kouts (3)	Kankakee Shelby (4)	Kankakee Momence (5)	Beaver (6)	Iroquois (7)	Sugar (8)	
Kosciusko	10.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3
La Porte	0.0	43.8	45.2	10.1	0.0	0.0	0.0	0.0	99.1
Lake	0.0	0.0	0.0	13.0	75.0	0.0	0.0	0.0	88.0
Marshall	45.9	1.6	10.4	0.0	0.0	0.0	0.0	0.0	57.9
Newton	0.0	0.0	0.0	10.6	61.2	1.6	25.3	0.0	98.7
Porter	0.0	0.0	19.4	74.1	0.0	0.0	0.0	0.0	93.4
Pulaski	0.0	0.0	8.7	0.0	0.0	0.0	0.1	0.0	8.7
St. Joseph	0.3	80.0	1.0	0.0	0.0	0.0	0.0	0.0	81.4
Starke	8.2	1.9	75.3	0.0	0.0	0.0	0.0	0.0	85.3
White	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
Iroquois	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	2.7
Kankakee	0.0	0.0	0.0	0.0	15.1	0.0	0.0	0.0	15.1
Will	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	4.0

Notes:
[a] Subbasin area in county / county total land area.
[b] Kankakee Basin area in county / county total land area. Note: Subbasin proportions were estimated using data on agricultural irrigation withdrawals from the SWWF database from 2000-2023 for Indiana counties. Illinois county proportions were estimated using percent overlap by land area due to a lack of available spatially-specific and appropriate temporal historical withdrawal data.

These proportions were applied to the county-level forecasts to estimate subbasin-specific monthly and annual water withdrawals throughout the forecast period.

C.3.2 ENERGY PRODUCTION WITHDRAWALS

EP withdrawals refer to all water used to support generation of electricity. Water withdrawal data reported through SWWF for this sector did not comprehensively represent the withdrawals for the EP sector. Instead the SWWF data were used as a comparison tool, but alternative data sources and supplemental information were developed to estimate historical and projected EP water demand. Historical EP withdrawals were modeled for the Study Area subbasins and counties based on historical power plant data, published forecasts of electricity generation trends, and estimated water use rates by generation technology. The sections that follow describe the context of energy production in the region, an overview of results at the subbasin and county levels, and the data developed for this analysis including historical facility-level data, regional energy generation trends, and technology-specific water use factors.

C.3.2.1 Context

Indiana's energy production industry has historically relied on nonrenewable generation technologies to meet the state's energy demands. Nonrenewable technologies, such as coal and natural gas generation, have a heavy reliance on water (Global Energy Monitor 2021). In 2024, Indiana was the seventh largest coal producer in the nation, with 80% of that coal used in-state (EIA 2023a). In the Kankakee Basin, the energy production industry consists mainly of small-scale operations. Like the rest of the state, historically, energy production operations in the Study Area have been built with coal- or natural-gas- fired technology. In recent decades, coal facilities are being replaced/repurposed to utilize natural gas. In the Study Area, renewable energy consists of 12 solar facilities and three wind facilities. There are two active natural gas plants, a third that retired in 2020, and one active coal power plant that is set to be closed in 2028.

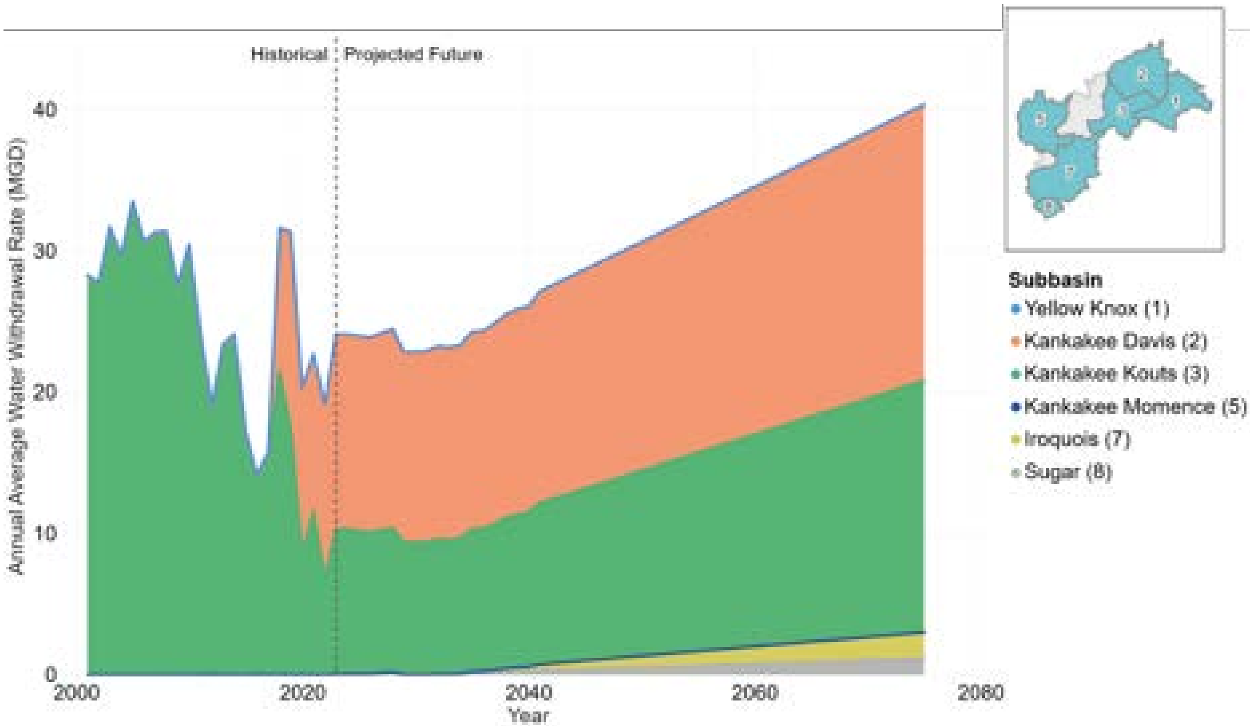
Additionally, Indiana is home to some of the largest wind farms in the country, falling in the top 15 states for installed wind energy generation capacity (American Clean Power Association 2022). Energy production companies like NIPSCO have publicly committed to and have begun replacing aging coal facilities with expanded renewable energy production technology. It is anticipated that the Kankakee Basin will continue to depend on natural gas energy production in the coming decades as the region's dominant water use sectors (such as Public Supply and Industrial) grow substantially. However, the Study Area should also expect to see expansion in wind and solar projects, mirroring what recent regional and statewide trends have suggested.

C.3.2.2 Overview

Figure C-14 below illustrates historical and forecasted total annual water demand by subbasin in the Study Area. The future projected annual EP water demand increases over the period of study, following the expected trend for increased electricity demands that will be partially met by increased natural gas generation. The spike in the historical data in 2018 corresponds to the opening of a new natural-gas-fired power plant. In 2023, total annual water demand from EP was 24.1 MGD. By 2075, the annual water demand from EP is projected to have increased by an annual average of 1.3% to 40.3 MGD.

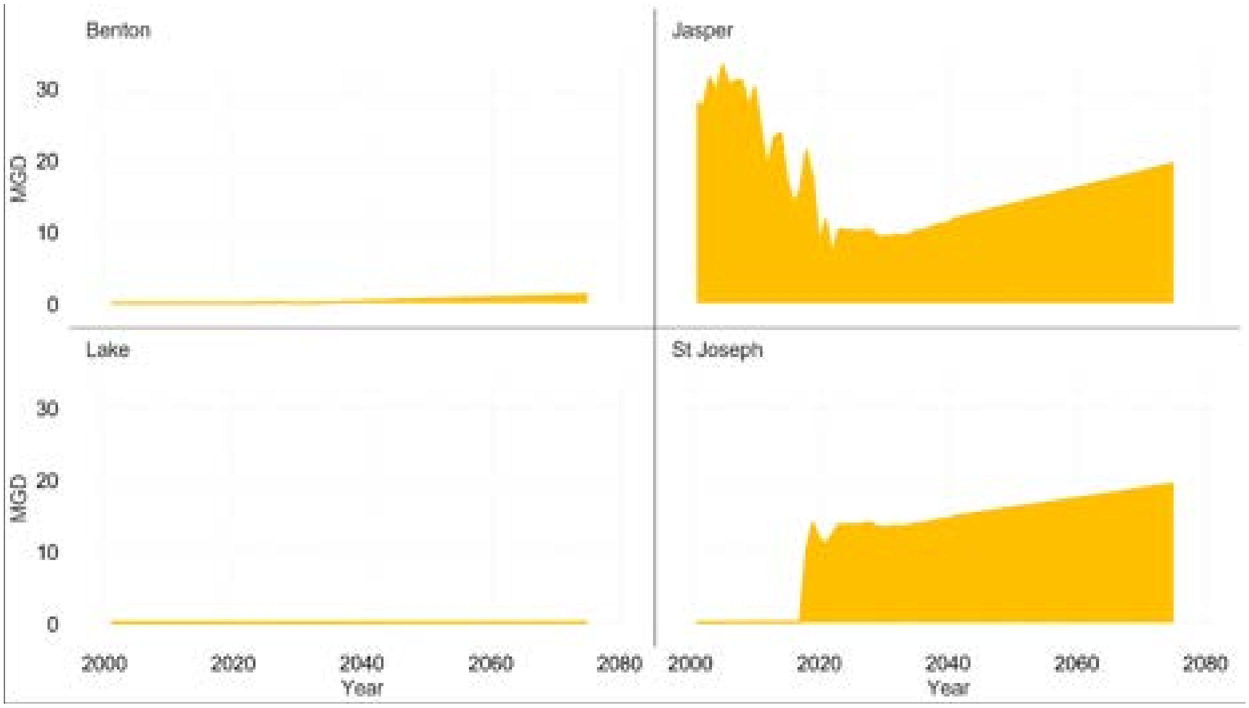
Historical EP water use and the future projected demand by county is shown in Figure C-15. All the future projected demand in the basin comes from Benton, Lake, Jasper, and St. Joseph Counties. The study area's only coal facility, located in Jasper County, is scheduled to retire by 2028, with water demand projected to decrease in phases until then (NIPSCO 2024). The facility's capacity will be replaced by a combination of natural gas and renewable generation technologies, aligning with the broader statewide trend of natural gas facilities replacing coal generation units. While natural gas generation technology still requires substantial water resources, the demand is significantly less than that of traditional coal plants.

What follows in this section is a detailed description of how the future projection was estimated on a subbasin level to align with the water availability analyses in this Study.

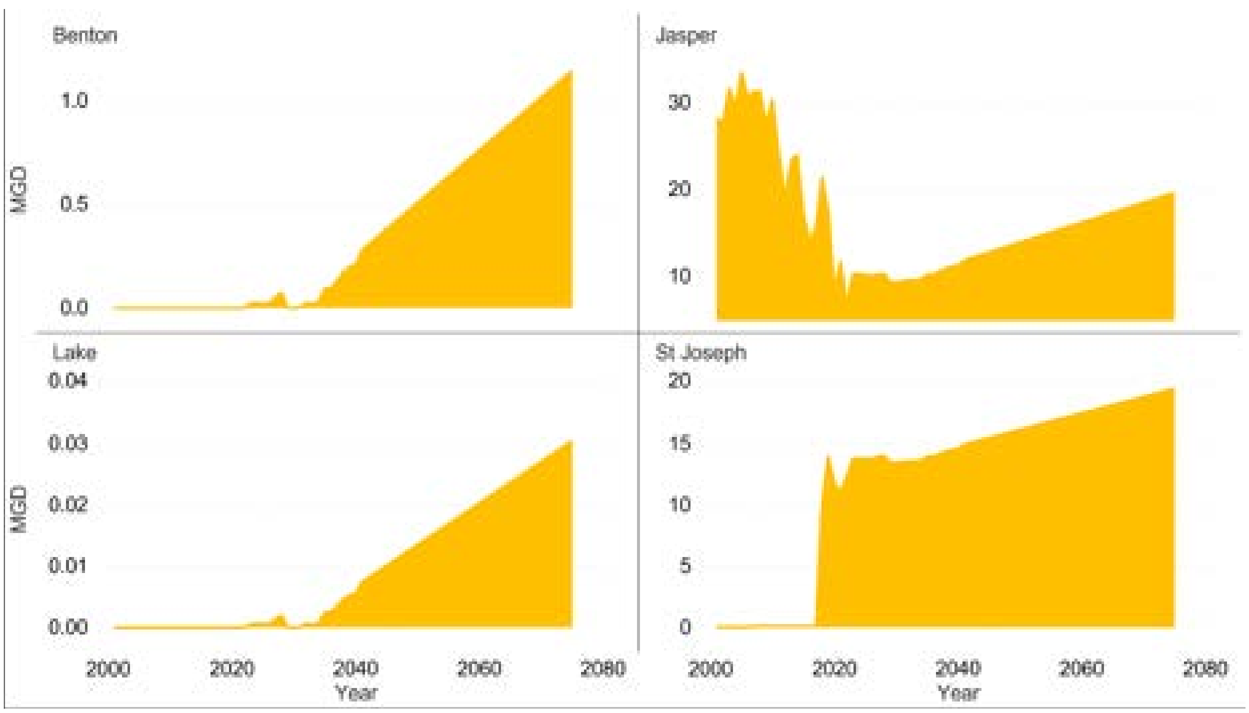


Key:
MGD = million gallons per day

Figure C-14. Historical and Future Projected Annual Water Demand by Subbasin, 2001-2075, MGD



Note: the vertical axis scale is fixed for each region



Note: the vertical axis scale is different for each region
Key: MGD = million gallons per day

Figure C-15. Historical and Future Projected Annual Water Demand of Energy Production by County, Fixed (top) and Variable (bottom) Scale, 2001-2075, MGD

C.3.2.3 Data Sources

Data used for estimating water demand for energy production was primarily (but not exclusively) sourced from the U.S. Department of Energy, Energy Information Administration (EIA). Estimates of water use are based on the available data, projections, and assumptions made during the research process. The actual water demand may vary due to factors such as technological advancements, changes in energy policies, and unforeseen events. Therefore, regular updates and revisions to the methodology and data sources are necessary to refine and improve the accuracy of future water demand estimates.

The data sources used for the modeling are:

- Historical water use
  - Historical facility level water withdrawals, EIA (EIA 2023b).
    - Calculated technology-specific water withdrawal factors, see Table C-13.
  - Facility level capacity levels, EIA (EIA 2023c)
    - Calculated technology-specific capacity factors in conjunction with facility level energy generation, see Table C-15.
  - Historical facility level energy generation, EIA (EIA 2023c)
    - Calculated technology-specific capacity factors in conjunction with facility level capacity levels, see Table C-15.
- Future water use
  - Indiana Electricity Demand, Energy Efficiency, and Demand Response Forecast, Purdue University's State Utility Forecasting Group (SUFG 2023).

C.3.2.4 Pre-Processing

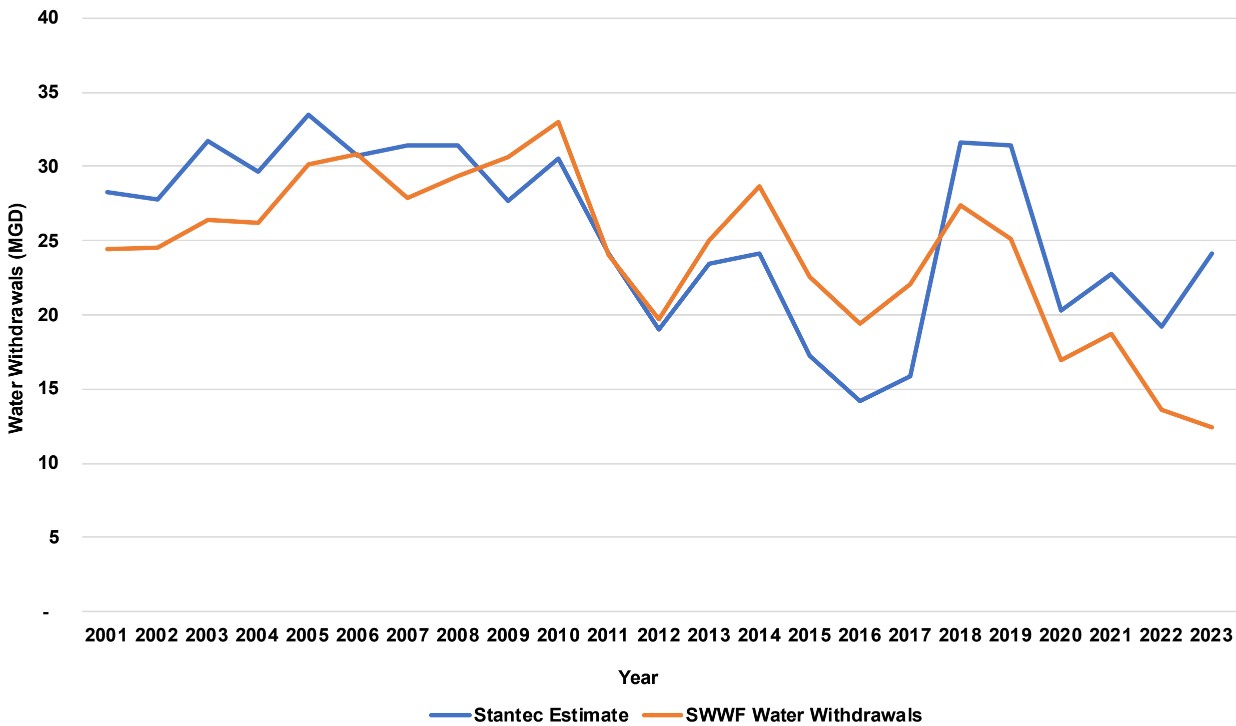
Energy generation data was used to estimate historical water demand and forecast future water demand. The estimated water demand using energy demand data was compared to the SWWF withdrawal data to validate the accuracy of the forecast (Figure C-16). In general, the estimated demand follows the trends of SWWF data in some instance higher and in some lower. The amount of energy being produced, by generation source, is the main driver in estimating how much water the energy production sector uses annually. The generation technologies identified in the study region and forecasted in future estimates are coal, combined cycle (CC), wind, and solar. Utilizing historical facility-level energy generation information, obtained from the EIA, power generation by subbasin was estimated for all regional facilities dating back to 2001.

To estimate the water withdrawal factor for each specific generation technology, the analysis relied on the EIA's generation cooling water withdrawal data (EIA 2023b). This dataset provided valuable information to calculate the withdrawal factors associated with each generation technology. These withdrawal factors represent the amount of water withdrawn, measured in gallons per kilowatt-hour (gal/kWh), for electricity generated. Energy production from renewable technologies like solar and wind do require small amounts of water for operations, however, the water withdrawal factors for these technology types were assumed to be zero for this analysis. Because there are no recorded water withdrawals from existing solar and wind facilities in the Study Area in the SWWF database, it was assumed that all water demand associated with renewable energy production was supplied by public water suppliers (PWS) or that their pump capacities did not meet the statutory reporting requirement threshold of 100,000 gallons per day. This analysis therefore assumes that the growth in PWS demand captures any growth in water demand from solar and wind facilities (see Appendix C, Section 3.3). Table C-13 contains the water withdrawal factors by generation technology used throughout this analysis. For example, the withdrawal factor for coal generation technology is 1.15 gal/kWh, while natural gas technology has a withdrawal factor of 0.90 gal/kWh. Figure C-16 illustrates the estimated historical withdrawal patterns in this study in comparison to SWWF withdrawal data from 2001-2023.

Table C-13. Water Withdrawal Factors by Generation Technology

Generation Technology	Water Withdrawal Factor (gal/kWh)
Coal	1.15
Natural Gas	0.90
Solar	0.00
Wind	0.00

Source: EIA 2023b
Key:
gal/kWh = gallons per kilowatt-hour



Key:
MGD = million gallons per day

Figure C-16. Energy Production Water Withdrawals, SWWF Data & Stantec Estimates, 2001-2023, Millions of Gallons per Day (MGD)

When analyzed alongside historical energy generation patterns, a clear relationship emerges between water withdrawal rates and shifts in energy generation sources. Figure C-17 illustrates that daily water use (in MGD) declines in parallel with nonrenewable generation's decreasing share of total generation. Total generation is provided in megawatt hours (MWh) in accordance with the large scale of regional energy production. This trend is further evidenced by a steeper reduction in water withdrawals as wind generation expands. Although natural gas generation is less water-intensive than coal, it remains more water-intensive than renewable energy sources.

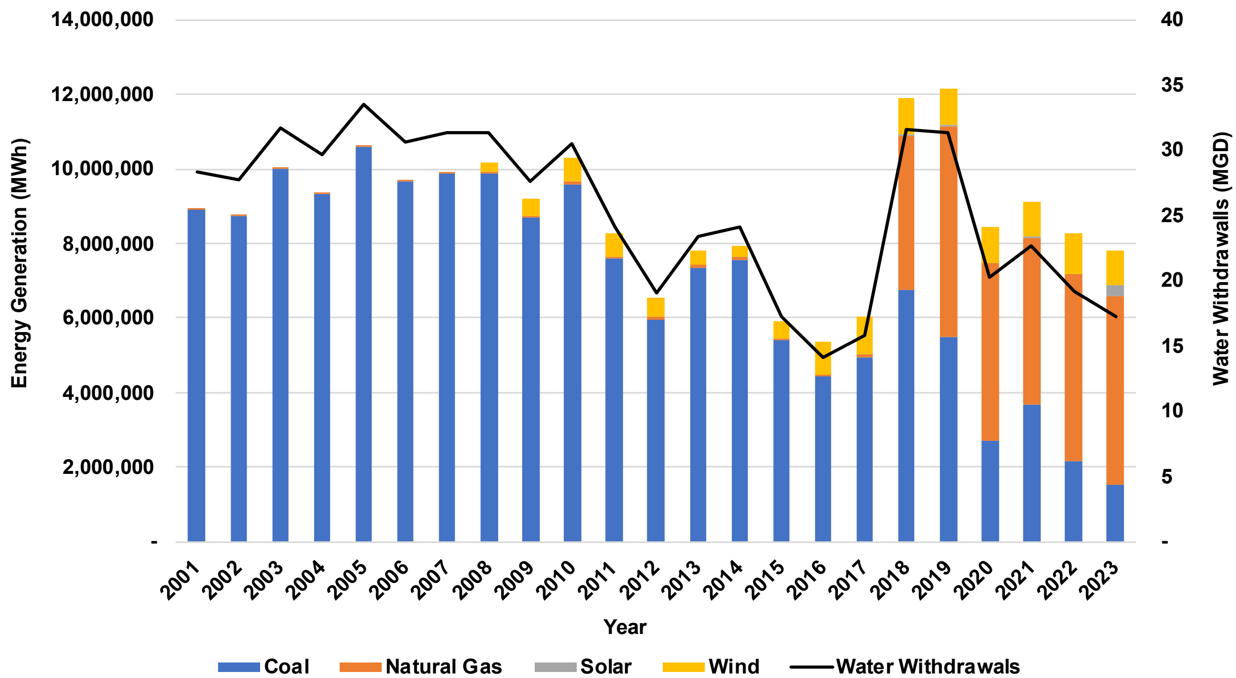


Figure C-17. Estimated Energy Generation vs. Water Withdrawals, by Technology, 2001-2023

Once historical generation and withdrawal patterns were established, the next step in setting up the basis for projecting future water demand from energy production was establishing the energy production capacity in the study region. To assess the regional capacity for each generation technology, the study utilized facility nameplate capacity (also known as the rated capacity or gross capacity) intended levels (EIA 2023b). Facilities were identified by the category of energy generation technology and organized by subbasin based on facility location. Table C-14 shows 2023 generation capacity by technology and subbasin based on facility level data.

Table C-14. Expected Total Annual Energy Production by Technology by Subbasin, 2023 (MWh)

Subbasin Name	Generation Method			
	Coal	Natural Gas: CC	Solar	Wind
Subbasin 1, Yellow Knox	-	72,702	12,413	-
Subbasin 2, Kankakee Davis	-	9,438,180	106,845	-
Subbasin 3, Kankakee Kouts	13,254,557	115,510	72,003	-
Subbasin 4, Kankakee Shelby	-	-	-	-
Subbasin 5, Kankakee Momence	-	-	48,219	-
Subbasin 6, Beaver	-	-	-	-
Subbasin 7, Iroquois	-	25,077	62,310	2,830,837
Subbasin 8, Sugar	-	15,673	8,956	1,799,261

Key:
CC = combined cycle
MWh = megawatt hour

The generation capacity in Table C-14 provides a baseline for projecting future water demand from energy production. The baseline provides a current estimate for the generation capacity within the study region. With a baseline capacity established, the analysis projected capacity growth by energy generation technology was combined with the established generation and withdrawal patterns to ultimately estimate future water demand from energy generation.

Additionally, this study calculated region-specific capacity factors using facility level generation data (2001-2023) and facility nameplate capacity obtained through EIA. Capacity factors are a measure of the amount of energy generated from a facility as a proportion of the facility's generation capacity. These factors, listed in Table C-15, provided the study with a baseline estimate of the capacity for each energy producing technology in the region. The use of these factors will be explained later in the analysis.

Table C-15. Estimated Capacity Factors by Energy Producing Technology

Generation Technology	Capacity Factor
Coal	24.02
Natural Gas	58.80
Solar	18.79
Wind	27.22

Source: EIA 2023b

C.3.2.5 Analysis

The 2023 Forecast of Purdue's statewide report, "Indiana Electricity Projections" (SUFG 2023), provided the forecasted energy generation growth by each generation technology (e.g., natural gas combined cycle, solar, wind, etc.) from 2023-2041. These growth trends are assumed to be proportional to the capacity growth by technology in the entire study region. By applying these growth trends starting from the actual capacity in each of the eight subbasins in 2024 (Table C-14), this study estimated capacity growth for each technology in the subbasin study region.

The average overall capacity growth rate from 2023-2041 was used to forecast capacity growth into 2075. This growth rate was allocated across the four generative technologies according to the proportion of growth observed for each technology from 2023-2041. This approach extended growth trends through 2075, providing estimates of future energy capacity for each technology. Table C-16 includes the annual percentage growth by technology for the study region from 2024-2075. While there is an expected transition to renewable energy in the future, there are periods of natural gas growth which overall lead to an increase in EP water demand. Between 2027-2029 and 2033-2039 the majority of growth in electric generation will come from natural gas. The longer-term growth between 2043-2075 assumes linear growth over the period of 53% for natural gas, which is based on the average growth rate during 2034-2043. Future growth of electric generation capacity will primarily come from relatively water intensive natural gas power.

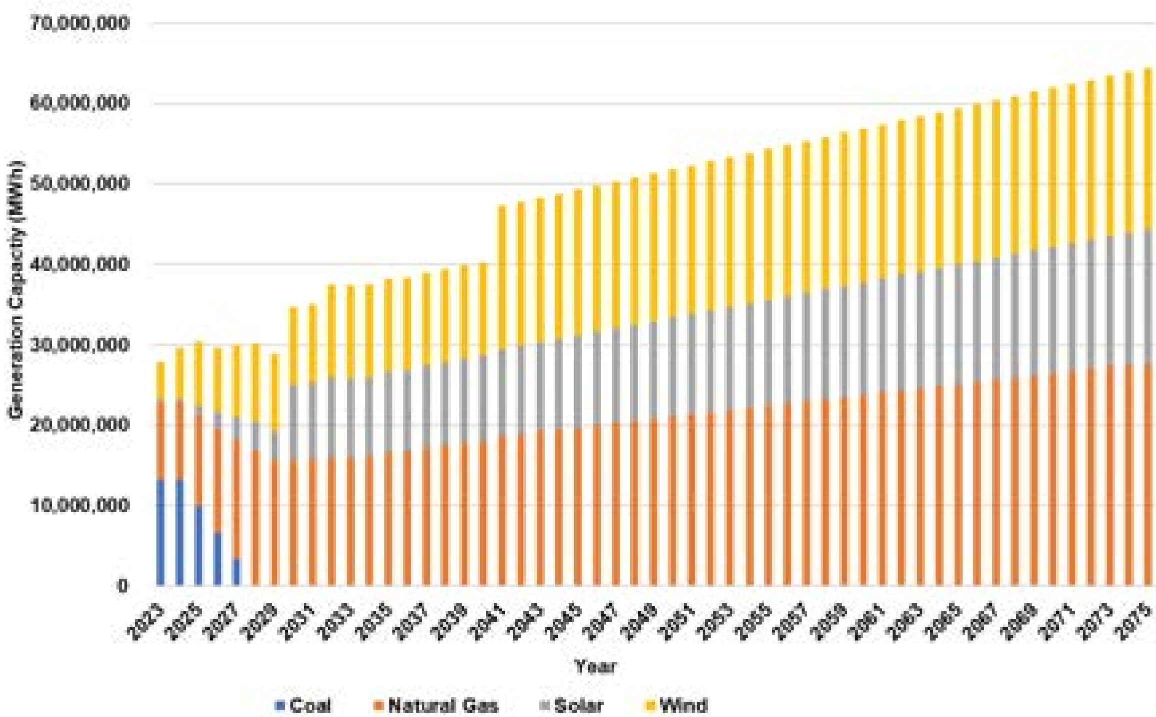
The Purdue report did not include capacity growth projections for coal, as it is being phased out statewide. However, there is one remaining coal facility, the R.M. Schahfer Plant operated by NIPSCO, in the region located in Jasper County. Based on industry reports, the coal units at the facility were originally scheduled to retire in 2023, but the date shifted to 2025 following delays in opening a planned solar facility (NiSource 2022). Considering the uncertainty around replacement timelines and market conditions for renewable technologies, this study assumed that the R.M. Schahfer Plant would be retired by 2028 at the latest, as NIPSCO's Integrated Resource Plan states that the company plans to retire 100% of its coal-fired generation by 2028 (NIPSCO 2024). It is expected that this coal facility will be replaced with a combination of renewable technologies and natural gas units (Ober 2025). This study accounted for this transition in the projections, as described below.

Table C-16. Regional Capacity Annual Percentage Growth by Technology, 2023-2075

Year	Natural Gas: Combined Cycle	Solar	Wind
2024	0	0	96
2025	0	0	32
2026	0	0	100
2027	85	0	15
2028	95	5	0
2029	75	8	0
2030	0	100	0
2031	14	60	26
2032	9	19	72
2033	100	0	0
2034	100	0	0
2035	91	9	0
2036	71	29	0
2037	60	40	0
2038	91	9	0
2039	61	39	0
2040	30	70	0
2041	10	0	86
2042-2075	53	34	13

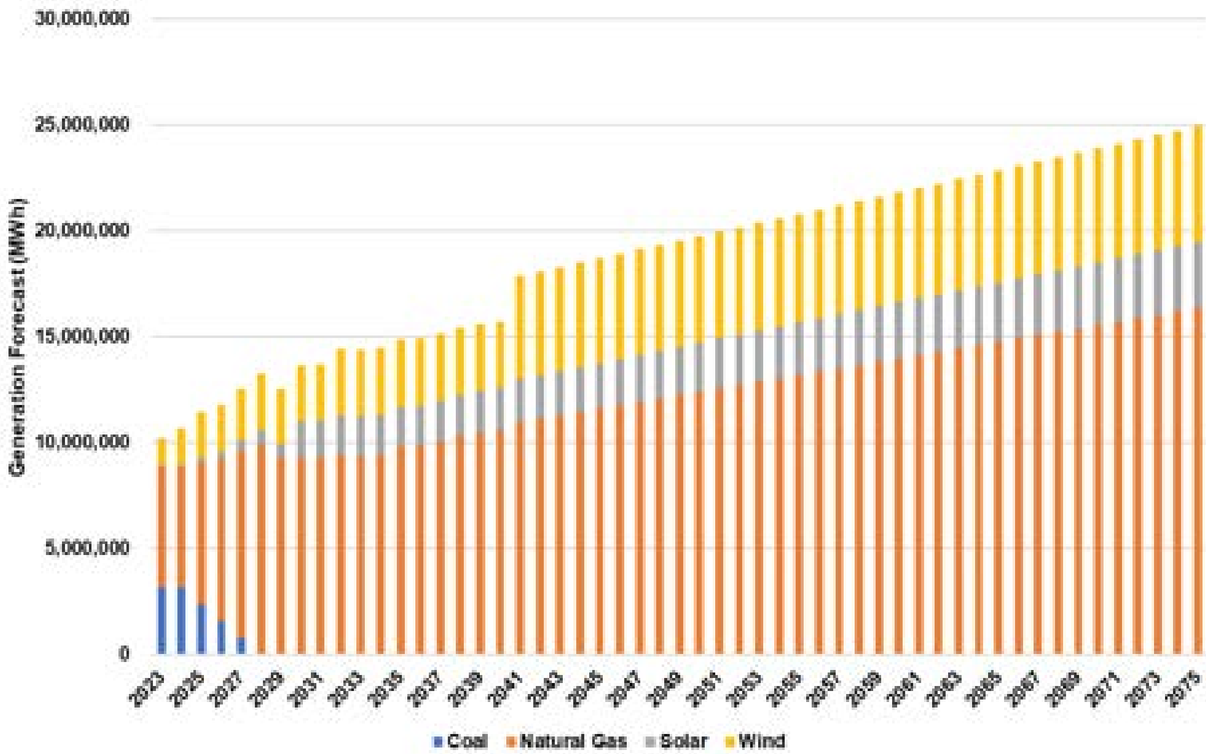
To map out future capacity growth across subbasins, projected trends were combined with data on expected facility openings and closures. Factors such as aging infrastructure, regulatory changes, and planned plant retirements were considered to identify facilities likely to close or open in the future. When coal facilities are planned to close, their capacity is assumed to be replaced with new natural gas, or wind and solar capacity at the same site. This approach is intended to maintain overall energy generation capacity within the subbasins despite the retirement of coal infrastructure. In all other cases, new generation capacity was distributed across the subbasins proportionate to existing capacity (i.e., it was assumed that regions with more existing generative capacity will grow relatively faster while regions with little to no existing generative capacity will see little to no new capacity). This assumption allowed for more capacity growth in regions with more existing capacity.

Future energy generation by producing technology for each subbasin was estimated through use of the established capacity factors (Table C-15). The capacity factors sourced from the EIA combined with projected capacity growth (Table C-16), determined the expected generation output for each technology in the subbasins. The results of these calculations are shown as estimates of energy-generation capacity by technology in Figure C-18, and actual forecasted generation in Figure C-19, below.



Key:
MGD = megawatt hour

Figure C-18. Estimated Energy Generation Capacity by Technology, 2024-2075 (MWh)



Key:
MWh = megawatt hour

Figure C-19. Actual Energy Generation by Technology, 2024-2075 (MWh)

Estimating water demand for the energy production sector for each subbasin from 2024 through 2075 involved using technology-specific water withdrawal intensity factors (gal/kWh). These factors represent the amount of water withdrawn, measured in gallons per kilowatt-hour of electricity generated (see Table C-13). The water withdrawal intensity factors were estimated based on historical EIA cooling data (EIA 2023b). The corresponding water demand from the energy production sector was calculated by applying these factors to the projected generation by technology in each subbasin. For example, if a subbasin is projected to generate 1,000,000 kilowatt-hours of electricity using a specific technology with a withdrawal factor of 20 gal/kWh, the estimated water demand for that subbasin and energy producing technology would be 20,000,000 gallons. Figure C-20 illustrates the energy mix by technology, averaged across the study region.

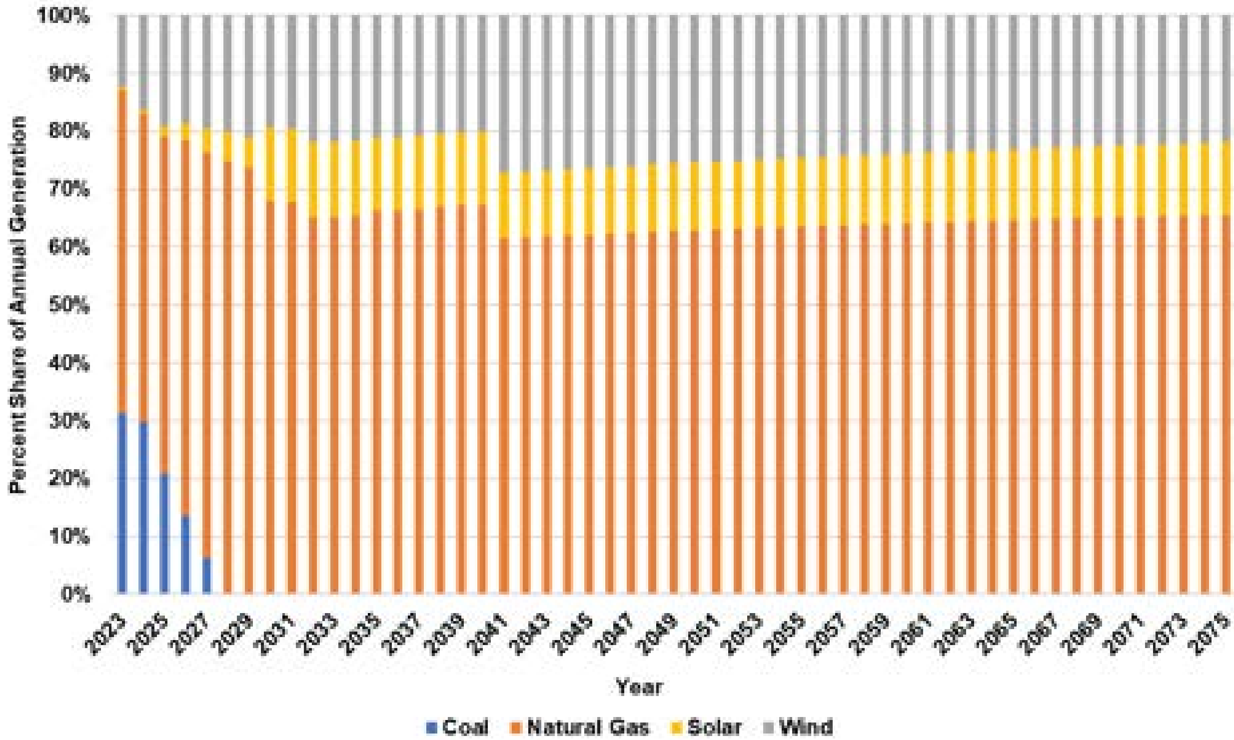
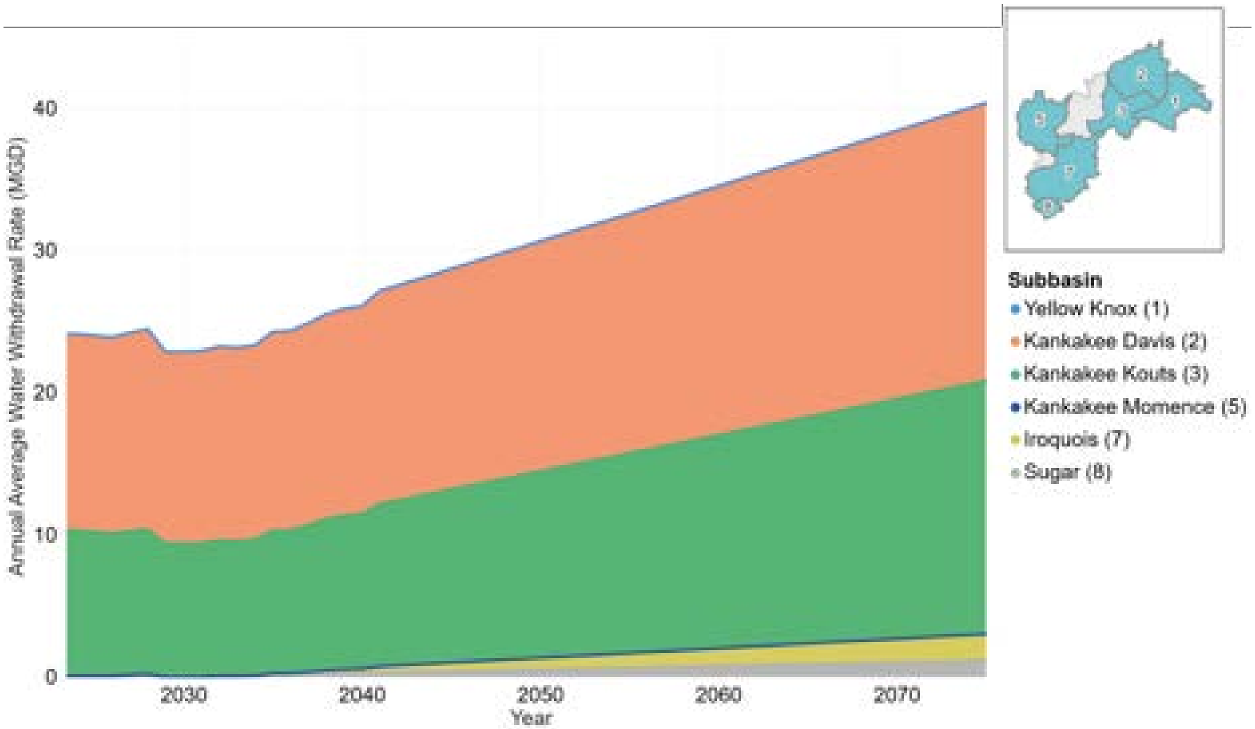


Figure C-20. Percent Share of Annual Energy Generation by Technology, 2024-2075

The process of applying the water withdrawal factors to each subbasin and energy producing technology provided water demand estimates from the energy production sector for the entire study region from 2024 through 2075. Figure C-21 illustrates the projected water demand by subbasin across all generation types. In summary, overall energy generation is anticipated to increase over the projection period which will also increase annual water demand. The Study Area is expected to increase its adoption of both renewable and non-renewable technologies over the course of the projection period. This trend reflects the region’s continued reliance on natural gas while also aligning with broader state and national trends toward the expansion of renewable energy production.



Key:
MGD = million gallons per day

Figure C-21. Projected Energy Production Water Demand by Subbasin, 2024-2075, MGD

C.3.3 PUBLIC SUPPLY WITHDRAWALS

The term public supply (PS) is used to describe the water withdrawn by public or private water utilities to meet community water demand. While a broad range of factors may influence public supply water withdrawal rates, this study was limited to those factors for which consistent historical records and forecasted data were available. As a result, the modeling focused on variables such as weather and population trends which could be reliably projected into the future, while time trends control for unaccounted for economic factors. The sections that follow describe the context of public supply water demand in the region and the forecasting methodology, including the data sources, climate and seasonal variables, population variables, and regression model structure.

C.3.3.1 Context

The Kankakee Basin is largely rural, with a few small cities (population less than 50,000) on the northern border of the basin. Figure C-22 shows the location of public supply wells and the public water utility service area boundaries. Table C-17 lists the major population centers. The region presented unique challenges for demand forecasting related to the varied rate of population change throughout each county within and outside of the basin. This section details the methods used to forecast water demand within Kankakee Basin.

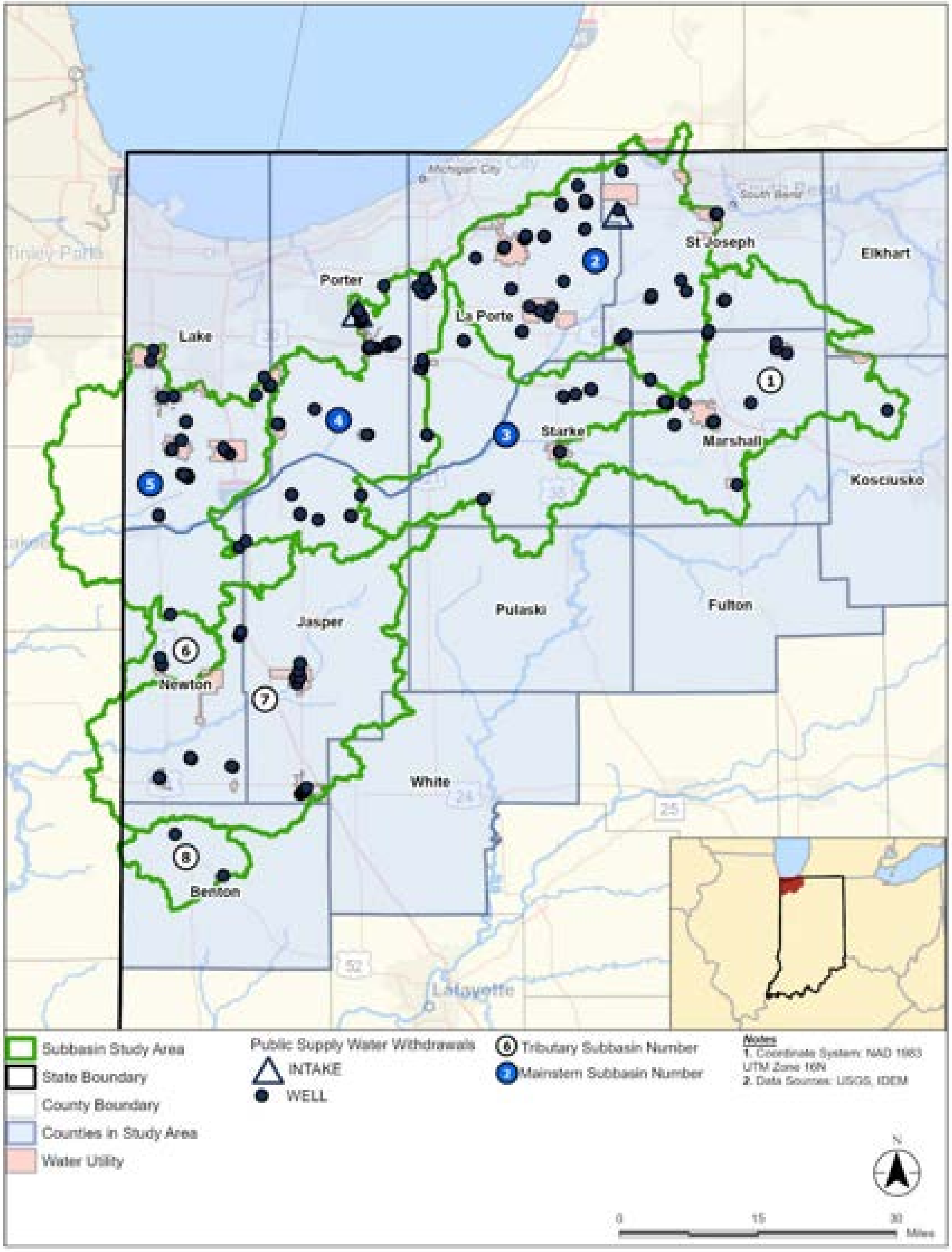


Figure C-22. Public Supply Water Withdrawal Locations Within the Study Area (Water Utility Service Areas Shaded Peach)

Historical and Future Water Demand Methodology by Sector
December 2025

Table C-17. Major Public Water Utilities in the Study Area

Utility Name	Principal City Served	County	Principal City Population	Subbasin	Primary Water Source
Apple Valley Utilities, Inc.	Hebron	Lake	3,712	5	Groundwater
Aqua Indiana Incorporated	St. John	Lake	21,639	5	Groundwater
Argos Water Works	Argos	Marshall	1,822	1	Groundwater
Bremen Water Department	Bremen	Marshall	4,660	1	Groundwater
Crown Point Water Works	Crown Point	Lake	34,042	5	Surface Water
Earl Park Municipal Water Utility	Earl Park	Benton	334	8	Groundwater
Fowler, Town of	Fowler	Benton	2,286	8	Groundwater
Goodland Water Works	Goodland	Newton	923	7	Groundwater
Hamlet Water Works	Hamlet	Starke	910	3	Groundwater
Indiana-American Water Co Inc	Roselawn	Newton	3,231	4, 5	Groundwater
Kentland Water Works	Kentland	Newton	1,759	7	Groundwater
Kingsford Heights Water	Kingsford Heights	La Porte	1,313	2	Groundwater
Knox Water Works	Knox	Starke	3,843	1, 3	Groundwater
Kouts Water Works	Kouts	Porter	2,261	4	Groundwater
Lacrosse Water Department	La Crosse	La Porte	640	3, 4	Groundwater
Lakeville, Town of	Lakeville	St. Joseph	669	1	Groundwater
La Porte Water Works	La Porte	La Porte	22,125	2	Groundwater
Lowell Water Department	Lowell	Lake	10,911	5	Groundwater
Morocco Water Department	Morocco	Newton	1,169	6	Groundwater
Nappanee Water Utility	Nappanee	Kosciusko	7,040	1	Groundwater
North Judson Water Company	North Judson	Starke	2,094	3	Groundwater
North Liberty Water Works	North Liberty	St. Joseph	1838	2	Groundwater
Plymouth Water Department	Plymouth	Marshall	10,506	1	Groundwater
Remington Water Works	Remington	Jasper	1581	7	Groundwater
Rensselaer Water Department	Rensselaer	Jasper	5,369	7	Groundwater
Valparaiso Department of Water Works	Valparaiso	Porter	34,377	4	Groundwater
Walkerton Water Department	Walkerton	Marshall	2,052	2, 3	Groundwater
Wanatah Water Utility	Wanatah	La Porte	1,248	3, 4	Groundwater
Westville Water Department	Westville	La Porte	5,291	4	Groundwater

Source: U.S. Census Bureau 2023 5-Year Population Estimates; IDNR 2025

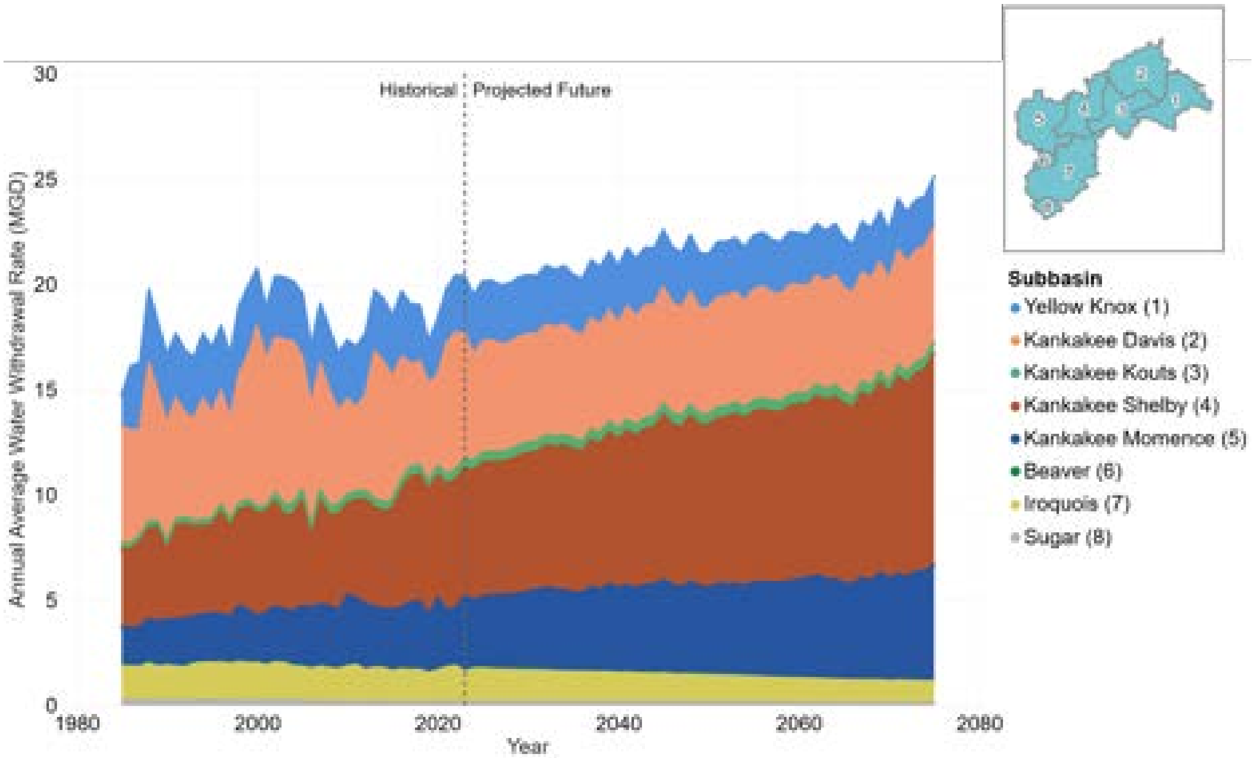
Note: This is not a comprehensive list of all public utilities in the Kankakee Basin. These facilities were identified as having the largest annual water withdrawal rates in the region (IDNR 2025) as well as highlighting the major public water suppliers to the larger population centers in the Study Area.

C.3.3.2 Overview

The 50-year term of the forecast for this study requires a long-term modeling approach. However, the monthly periodicity of the forecast is an additional modeling consideration. After reviewing the literature and initial model testing, PCA framework was adopted to project monthly demand over a 50-year period. The need for this approach is detailed in the IR section (Section C.3.1.4.2.1) above and is further discussed below regarding multicollinearity of weather variables. The geographic scale used for the forecast was at the subregion scale, which include the portions of each county that fall within individual subbasins of the Kankakee Basin. By forecasting monthly demand, the model provides both annual demand estimates as well as information on seasonal variation in monthly demand.

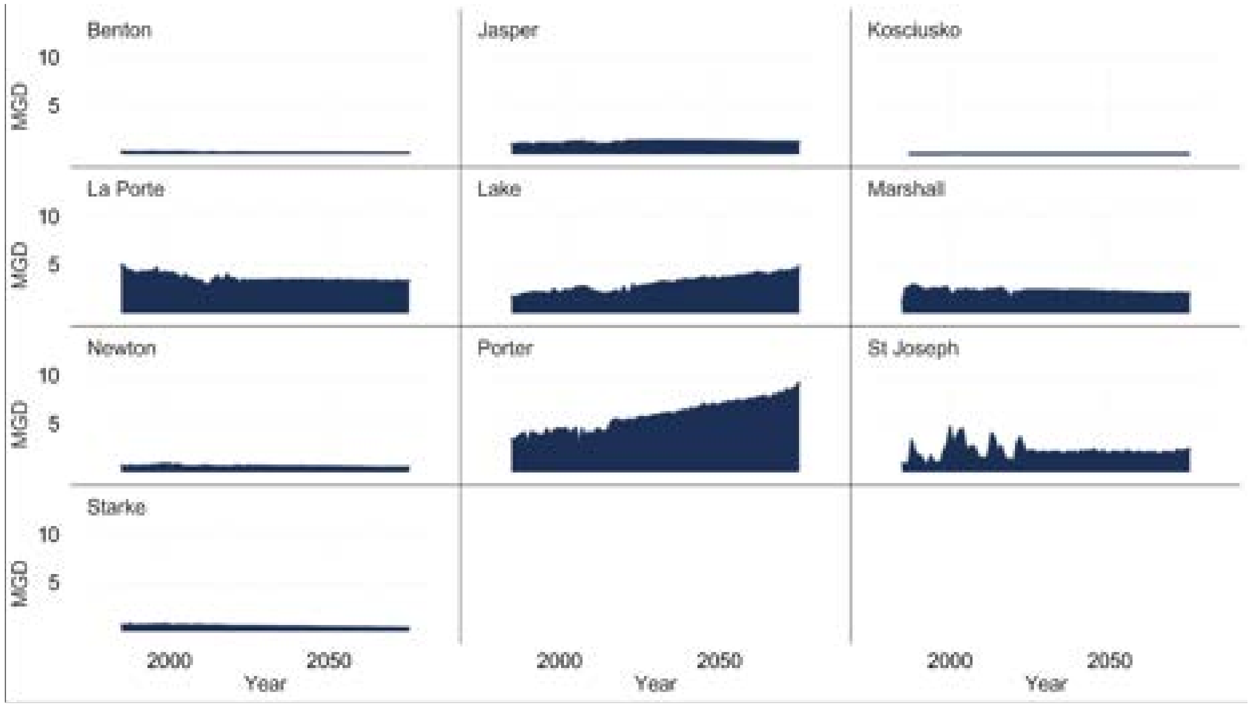
Public supply withdrawals across the Kankakee Basin are projected to remain relatively stable in the near term and gradually increase to about 25 MGD by 2075 from the 2023 annual average of 20 MGD. Growth is concentrated in Kankakee Shelby (Subbasins 4) and Kankakee Momence (Subbasin 5), while several subbasins including Yellow Knox (Subbasin 1), Beaver (Subbasin 6), Iroquois (Subbasin 7), and Sugar (Subbasin 8) show gradual declines (Figure C-23). These differences highlight how basin-wide or county totals mask contrasting subregional patterns, with some areas showing long-run increases and others showing steady or declining trends. As shown in Figure C-24, Lake and Porter Counties account for the majority of total withdrawals and contribute to most of the projected increases, while most other counties are projected to remain stable or decline. This pattern is consistent with the concentrated population growth observed in Kankakee Shelby (Subbasins 4) and Kankakee Momence (Subbasin 5) which largely overlap Lake and Porter Counties.

Seasonal and year-to-year variability remains evident in the monthly series, largely tied to climate conditions captured through PCA. The long-run trajectory reflects the combined effects of population change and climate-driven variation in water demand.

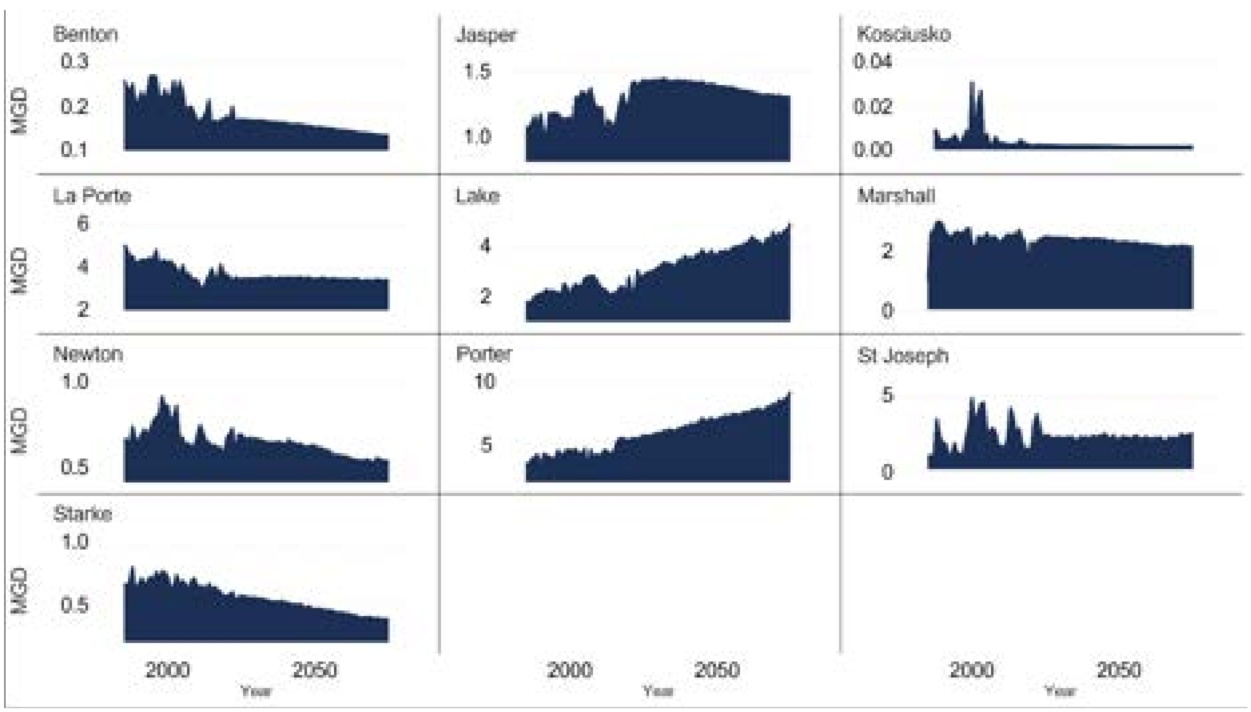


Key:
MGD = million gallons per day

Figure C-23. Public Supply Historical (1985-2023) and Projected Future (2024-2075) Annual Water Demand in Kankakee Basin, by Subbasin (MGD)



Note: the vertical axis scale is fixed for each region.



Note: the vertical axis scale is different for each region.
Key: MGD = million gallons per day

Figure C-24. Historical and Future Projected Annual Public Supply Water Demand by County, Fixed (top) and Variable Scale (bottom), 1985-2075 (MGD)

C.3.3.3 Data Sources

The public supply forecast relied on three primary categories of data: water use, population, and weather and climate data. Each dataset provided complementary information that was necessary to construct historical baselines and forecast demand over the 50-year study horizon.

C.3.3.3.1 Dependent Variable

- **Water Use Data**
  - Historical public supply withdrawals were obtained from the Indiana SWWF database (IDNR 2025).
    - SWWF PS-facility monthly withdrawal totals.
    - Records span from 1985 through 2023.

C.3.3.3.2 Explanatory Variables

- **Population Data**
  - Historical annual population estimates from the ACS DP03 tables at the census tract level from 2009-2023 (U.S. Census Bureau DP03 2023).
  - STATS Indiana (2024) projections were used for county-level forecasts through 2050 for the Indiana portion of the basin.
- **Weather and Climate Data**
  - Precipitation and temperature
    - Historical (1985-2023)
      - NASA Daymet V4 (Thornton et al. 2022)
        - Daily gridded precipitation and temperature data
    - Future (2023-2075)
      - INCCIA (Cherkauer et al. 2021).
        - Scaled historical daily precipitation and temperature data to future periods based on downscaled climate projections from the CESM1-CAM5 GCM under RCP8.5

- Evapotranspiration (PET)
  - Derived from historical and future climate projections (Hargreaves method) (See Section C.2.2 for a detailed summary).

C.3.3.4 Pre-Processing

Several steps of data pre-processing were needed to prepare data for the regressions and forecasting analysis. The pre-processing of population and weather explanatory variables is described in Sections C.2.1 and C.2.2, respectively. This Study took an additional data pre-processing step specifically for PS analysis for both weather and population.

C.3.3.4.1 Population and Water Use Data Pre-processing

Public supply withdrawals and population were aligned to the subregion framework, defined as the overlay of county and subbasin boundaries, where a subregion has a county and subbasin identifier. For subregions where part of the county is located within the Study Area but are outside subbasin boundaries, the subbasin classification “None” was applied. Facility-level SWWF records were aggregated to monthly subregion totals, and only the 2009-2023 period was retained to match the availability of census tract population data.

A public supply ratio per day variable (PSR/day) was constructed as the total monthly public supply withdrawals divided by the subregion population and the number of days in the month. Section C.2.1 explains the methods used to project future populations for the region. This adjustment standardized withdrawals across months of different lengths and ensured that monthly values could be compared on a consistent basis. The PSR/day series was used as the dependent variable in the modeling analysis.

PSR/day variable was used to address challenges resulting from the subregion level population estimate. The dramatic shift in population within three of the counties caused the calculated subregion per capita water use estimates to decrease substantially within a short time period. The sharp decrease the calculated PSR/day value indicated the need to reevaluate the interpretation of the data. Two potential interpretations were identified but were not verified within the study due to limitations described here. One potential interpretation is that the population used water more efficiently. There is no available evidence that supports an increase in water efficiency. An alternative interpretation is that the actual rate of water use remained relatively consistent, but the new subregion population relocated to residences using independent wells and intakes that are not required to report to IDNR.

Multiple methods were assessed to estimate the subregion population that is served by the public water utility at a scale that could be forecasted. The geographic boundary of the public water utility service areas is smaller than the census tracts for most of the region. As census tracts are the smallest unit of population available for the historical population, census tracts did not provide the right scale to estimate population served by a water utility. Additionally, many PS wells are not located within the water utility service boundary. Several of the larger cities overlap the border of the basin boundary, preventing estimation of the population within the city and within the basin using city population estimates.

The self-supply population estimate is based on the number of residential properties from the National Address Database in 2023 (NAD, USDOT 2025). Section C.3.5 further details that methodology. The self-supply baseline population does not include the change in population before the large southward migration in 2020. Therefore, the self-supply population estimate would not support a robust estimation of per capita water use for public supply.

Ultimately, it was determined that within the scope of this study, any estimate of the population served by the water utility would have a high level of uncertainty. The development of the PSR/day estimate was determined as the most appropriate approach.

C.3.3.4.2 Weather Data Pre-Processing: Principal Component Approach

Three monthly weather variables: precipitation, temperature, and evapotranspiration (PET) were included in this analysis using the PCA approach described in Section C.3.1.4.2.1 to address the correlation of temperature and PET. The first three principal components and their squared terms were included as candidate predictors (Table C-18). Together, the first three principal components explained more than 93 percent of the total variability in the weather dataset. The loadings for the first three components are shown in Table C-19. These loadings indicate how much each original weather variable contributes to each component. Larger absolute value indicates greater contribution to each component.

PC1 explained 66% of the total variance and was characterized by strong positive loadings on temperature and evapotranspiration, with weaker positive contributions from precipitation. This indicates that PC1 primarily captures overall temperature and evaporative demand conditions, which are key drivers of water demand. PC2 explained about 20% of variance and was characterized by predominantly negative loadings on precipitation variables, making it primarily a measure of precipitation patterns. PC3 explained another 8%, reflecting additional variation in precipitation intensity and frequency.

For this study, the first three principal components were retained, along with their squared terms, as potential predictors. This provided a compact representation of the weather variables that could be carried into the regression models without the instability caused by including the raw correlated variables directly.

Table C-18. Variance Explained by Principal Components (2009-2023)

Component	Proportion of Variance	Cumulative Proportion
PC1	0.661	0.661
PC2	0.196	0.857
PC3	0.082	0.939

Table C-19. Loadings of Weather Variables on the First Three Principal Components

Variable	PC1	PC2	PC3
Precipitation (average)	0.214	-0.603	0.114
Precipitation (max)	0.193	-0.499	0.640
Precipitation (frequency)	-0.012	-0.578	-0.731

Variable	PC1	PC2	PC3
PET (average)	0.397	0.103	-0.100
PET (max)	0.390	0.066	-0.162
PET (min)	0.382	0.119	-0.052
Temperature (max)	0.386	0.081	-0.063
Temperature (average)	0.400	0.092	-0.014
Temperature (min)	0.389	0.099	-0.009

Note: The green-highlighted cells indicate the variables with the largest absolute loadings within each principal component. These values represent the variables that contribute most strongly to the variance explained by PC1, PC2, or PC3.

C.3.3.5 Analysis

The analysis combined climate predictors with historical withdrawal records to develop consistent projections of future public supply demand. Key design choices in this study were the use of PCA for weather variables and the construction of the PSR/day as the dependent variable in the regression.

The PSR/day variable was introduced to provide a normalized measure of withdrawals that could be linked to population forecasts while avoiding distortions from calendar effects. Unlike a traditional per person demand metric, the PSR/day does not assume that all withdrawals are residential. In many subregions, large industrial or institutional users are served by public supply systems. As discussed in the pre-processing step, some of the population is served by the self-supplied sector. These conditions make a strict per-person interpretation misleading, as it would overstate household use in areas with significant non-residential or self-supplied demand. Instead, the PSR/day captures the long-run relationship between withdrawals and population while embedding the effects of residential, commercial, institutional, and self-supplied demand drivers observed in the historical record.

The following functional form is the generic regression model estimated for each geographic region (Equation 4). Table C-20 below provides the specific variables that were selected for each subregion.

Equation 4. Regression Model for Public Supply Water Withdrawals

$$\left(\frac{PSR}{day}\right)_i = \beta_0 + \beta_1 \cdot PC\ Variable_i + \beta_2 \cdot Feb_i + \beta_3 \cdot Mar_i + \beta_4 \cdot Apr_i + \beta_5 \cdot May_i + \beta_6 \cdot Jun_i + \beta_7 \cdot Jul_i + \beta_8 \cdot Aug_i + \beta_9 \cdot Sep_i + \beta_{10} \cdot Oct_i + \beta_{11} \cdot Nov_i + \beta_{12} \cdot Dec_i + \beta_{13} \cdot \log(indexed\ year_i) + \beta_{14} \cdot step\ variable_i + \varepsilon_i$$

Where:

PSR/day = average daily public supply water withdrawals in MGD

PC Variable = Includes PC_1, PC_2, and PC_3, the first three principal components derived from weather variables (e.g., temperature, precipitation, evapotranspiration), that capture major patterns in climate variation.

Feb-Dec = monthly indicator variables. First month (Jan) is used as a reference variable for other months and is dropped from regression to prevent multi-collinearity.

log(Indexed Year) = logarithm of the year variable indexed to 2009 (e.g., 2009 = 1, 2010 = 2, …). This captures long run-time trends such as technological improvements or conservation adoption.

Step Variable = subregion-specific indicator capturing structural changes (e.g., post-2019 adjustments or regulatory shifts) where historical trends in withdrawals or population changed notably.

ε_i = random error term representing unexplained variation in the model.

The independent (explanatory) variables included the retained principal components and their squared terms, with a log-transformed indexed year term tested in some subregions to capture long-run temporal trends. Similar to the techniques used in population forecasting, this study implemented step variables when there was a spurious time-based trend that occurred with either the SWWF withdrawal data or population history. These shifts likely reflected unobserved causes, such as the pandemic, that produced sudden changes in the underlying data. The step variables allowed the models to account for such shocks without biasing the estimated relationships between the independent variables and long-term withdrawal trends.

Statistical significance and model fit were assessed to identify the most appropriate specification for each subregion. Residual plots and variance inflation factor tests were reviewed to evaluate potential heteroskedasticity, and prediction plots were visually inspected to ensure that the selected regression models produced realistic PSR/day values over time.

While three principal components were retained in the preprocessing step, in practice only the first two typically entered the final regression models as significant predictors. The study also tested whether a month variable could account for additional variation in water use, particularly in cases where the PC variables performed less effectively. However, the month variable and PC variables often could not be used together due to multicollinearity. Table C-20 summarizes the models used for each subregion.

Table C-20. Summary of Public Supply Models for Each Indiana Subregion

Geography (Subregion)		Explanatory Variables		
County	**Subbasin**	**Weather Variables**	**Time Variables**	**Step Variables**
Benton	8	PC2	Month	
Jasper	3	PC1 and $PC1^2$	Log(Indexed_year)	
Jasper	4	PC1	Log(Indexed_year)	Yes; 2017
Jasper	7	PC1, $PC1^2$, PC2, and PC3		
Kosciusko	1		Month, Log(Indexed_year)	
La Porte	2	PC1 and $PC1^2$	Log(Indexed_year)	Yes: 2020
La Porte	3		Month	

Geography (Subregion)		Explanatory Variables		
County	**Subbasin**	**Weather Variables**	**Time Variables**	**Step Variables**
La Porte	4	PC1 and $PC1^2$	Log(Indexed_year)	Yes: 2020
Lake	5	PC1, $PC1^2$, and PC2		Yes: 2020
Marshall	1	PC1, $PC1^2$, and PC2		
Marshall	3	PC1 and $PC1^2$		
Newton	5	PC1 and $PC1^2$		
Newton	6	PC1, $PC1^2$, and PC3		
Newton	7	PC1, $PC1^2$, and PC3		
Porter	4	PC1, $PC1^2$, and PC 2	Log(Indexed_year)	Yes: 2016 and 2020
Starke	1	PC1, $PC1^2$, PC2, and PC3	Log(Indexed_year)	
Starke	3	PC1, $PC1^2$, and PC2		Yes: 2019
St. Joseph	1	PC1, $PC1^2$, and PC2		
St. Joseph	2	PC1, $PC1^2$, and PC2		

Table C-21 below presents the detailed regression results for each Study Area subregion selected projection model, including the independent variables, the coefficients, t-values, p-values, and R-squared results. The regression table demonstrates that the first two principal components (PC1 and PC2) were the most consistently significant predictors of public supply demand across Indiana subregions.

PC1, representing overall temperature and evapotranspiration conditions, appeared in nearly all models, while PC2, dominated by precipitation measures, contributed significantly in several counties. In a few cases, PC3 added explanatory value by capturing residual precipitation variability. Step variables were used selectively to account for abrupt structural changes in withdrawal histories, such as those associated with the COVID-19 pandemic or localized industrial shifts. Where applicable, log-transformed time terms provided an additional means of capturing long-run withdrawal dynamics.

Table C-21. PSR Per Day Model Outputs by Subregion

Independent Variable	Coef.	Std. Error	P-value	Significance
Benton County, Subbasin 8 (Sugar)				
Intercept	89.03	1.50	<0.01	***
PC2	1.22	0.41	0.01289	*
February	3.17	2.33	0.1996	
March	-0.30	2.17	0.8910	
April	13.51	2.60	<0.01	***
May	9.15	2.49	<0.01	**
June	18.20	3.05	<0.01	***
July	11.08	3.41	<0.01	**
August	7.40	2.88	0.0262	*
September	4.90	2.43	0.0694	.
October	-0.76	2.00	0.7107	

Independent Variable	Coef.	Std. Error	P-value	Significance
November	-5.42	1.42	<0.01	**
December	0.45	3.07	0.1479	
Adj. R-SQUARED: 0.369822				
Jasper County, Subbasin 3 (Kankakee Kouts)				
Intercept	81.66	6.57	<0.01	***
PC1	0.94	0.58	0.1295	
$PC1^2$	-0.94	0.25	<0.01	**
log(indexed_year)	36.75	3.42	<0.01	***
I(year >= 2020)	43.24	4.07	<0.01	***
Adj. R-SQUARED: 0.848068				
Jasper County, Subbasin 4 (Kankakee Shelby)				
Intercept	2.06	0.32	<0.01	***
PC1	0.25	0.10	0.2602	*
log(indexed_year)	-0.22	0.20	0.3086	
I(year >= 2017)	9.02	1.19	<0.01	***
log(pmax(1, year - 2016))	3.37	1.23	0.01691	*
Adj. R-SQUARED: 0.924026				
Jasper County, Subbasin 7 (Iroquois)				
Intercept	56.40	1.08	<0.01	***
PC1	1.01	0.14	<0.01	***
$PC1^2$	0.27	0.06	<0.01	**
PC2	0.80	0.29	0.01857	*
PC3	-1.10	0.44	0.0283	*
Adj. R-SQUARED: 0.296366				
Kosciusko County, Subbasin 1 (Yellow Knox)				
Intercept	0.79	0.06	<0.01	***
February	-0.05	0.04	0.2465	
March	-0.03	0.05	0.5679	
April	0.11	0.07	0.1367	
May	0.10	0.06	0.1240	
June	-0.21	0.11	0.0742	.
July	-0.24	0.11	0.0464	*
August	-0.02	0.07	0.7630	
September	0.04	0.05	0.4952	
October	-0.06	0.06	0.2902	
November	0.0004	0.09	0.9966	
December	-0.15	0.07	0.0499	*
log(indexed_year)	-0.11	0.03	<0.01	**

Independent Variable	Coef.	Std. Error	P-value	Significance
Adj. R-SQUARED: 0.280032				
La Porte County, Subbasin 2 (Kankakee Davis)				
Intercept	46.55	12.41	0.0038	**
PC1	1.61	0.24	<0.01	***
$PC1^2$	0.50	0.14	<0.01	**
log(indexed_year)	19.79	6.67	0.0141	*
I(year >= 2020)	-25.61	4.62	<0.01	***
log(pmax(1, year - 2019))	-7.71	2.43	<0.01	**
Adj. R-SQUARED: 0.702783				
La Porte County, Subbasin 3 (Kankakee Kouts)				
Intercept	1.02	0.17	<0.01	***
February	0.11	0.16	0.5257	
March	0.06	0.16	0.7312	
April	0.29	0.18	0.1579	
May	-0.03	0.14	0.8449	
June	-0.65	0.10	<0.01	***
July	-0.66	0.10	<0.01	***
August	0.01	0.24	0.9585	
September	0.05	0.14	0.7353	
October	0.02	0.15	0.9182	
November	0.11	0.16	0.5092	
December	-0.08	0.13	0.5626	
Adj. R-SQUARED: 0.353533				
La Porte County, Subbasin 4 (Kankakee Shelby)				
Intercept	194.83	4.64	<0.01	***
PC1	2.08	0.62	<0.01	**
$PC1^2$	0.67	0.19	<0.01	**
log(indexed_year)	-9.26	2.46	<0.01	**
I(year >= 2020)	-137.74	3.40	<0.01	***
log(pmax(1, year - 2019))	7.38	0.82	<0.01	***
Adj. R-SQUARED: 0.961388				
Lake County, Subbasin 5 (Kankakee Momence)				
Intercept	153.99	1.03	<0.01	***
PC1	5.30	0.35	<0.01	***
$PC1^2$	1.54	0.12	<0.01	***
PC2	3.94	0.64	<0.01	***
Adj. R-SQUARED: 0.751133				

Independent Variable	Coef.	Std. Error	P-value	Significance
Marshall County, Subbasin 1 (Yellow Knox)				
Intercept	64.86	0.98	<0.01	***
PC1	2.18	0.19	<0.01	***
$PC1^2$	0.39	0.05	<0.01	***
PC2	0.82	0.20	<0.01	**
Adj. R-SQUARED: 0.532031				
Marshall County, Subbasin 3 (Kankakee Kouts)				
Intercept	8.78	0.33	<0.01	***
PC1	1.00	0.07	<0.01	***
$PC1^2$	0.05	0.02	<0.01	**
Adj. R-SQUARED: 0.608055				
Newton County, Subbasin 5 (Kankakee Momence)				
Intercept	8.77	0.25	<0.01	***
PC1	0.03	0.03	0.3265	
$PC1^2$	0.04	0.01	0.0219	*
Adj. R-SQUARED: 0.017056				
Newton County, Subbasin 6 (Beaver)				
Intercept	75.66	3.51	<0.01	***
PC1	1.55	0.42	<0.01	**
$PC1^2$	0.74	0.19	<0.01	**
PC3	-9.41	2.37	<0.01	**
Adj. R-SQUARED: 0.190524				
Newton County, Subbasin 7 (Iroquois)				
Intercept	87.04	1.27	<0.01	***
PC1	1.47	0.42	<0.01	**
$PC1^2$	0.78	0.14	<0.01	***
PC3	-1.88	0.97	0.0774	.
Adj. R-SQUARED: 0.297576				
Porter County, Subbasin 4 (Kankakee Shelby)				
Intercept	260.64	8.39	<0.01	***
PC1	8.54	0.94	<0.01	***
$PC1^2$	1.58	0.33	<0.01	***
PC2	4.85	0.95	<0.01	***
I(year >= 2020)	-166.76	4.44	<0.01	***
I(year >= 2016)	54.73	9.57	<0.01	***
Adj. R-SQUARED: 0.897345				
Starke County, Subbasin 1 (Yellow Knox)				
Intercept	107.32	1.61	<0.01	***

Independent Variable	Coef.	Std. Error	P-value	Significance
PC1	2.71	0.32	<0.01	***
$PC1^2$	0.95	0.10	<0.01	***
PC2	2.33	0.48	<0.01	***
PC3	-1.34	0.55	.0293	*
log(indexed_year)	-7.70	1.01	<0.01	***
Adj. R-SQUARED: 0.534773				
Starke County, Subbasin 3 (Kankakee Kouts)				
Intercept	16.56	0.45	<0.01	***
PC1	0.56	0.06	<0.01	***
$PC1^2$	0.14	0.02	<0.01	***
PC2	0.38	0.09	<0.01	***
I(year >= 2019)	-3.53	0.45	<0.01	***
Adj. R-SQUARED: 0.643742				
St. Joseph County, Subbasin 1 (Yellow Knox)				
Intercept	12.53	0.40	<0.01	***
PC1	0.81	0.08	<0.01	***
$PC1^2$	0.18	0.03	<0.01	***
PC2	0.54	0.22	0.0247	*
Adj. R-SQUARED: 0.412366				
St. Joseph County, Subbasin 2 (Kankakee Davis)				
Intercept	55.29	6.36	<0.01	***
PC1	8.92	1.98	<0.01	***
$PC1^2$	2.40	0.53	<0.01	***
PC2	6.17	3.00	0.0647	.
Adj. R-SQUARED: 0.292933				

Notes: The significance symbols correspond to p-values from the regression output. Higher significance (more asterisks) indicates stronger evidence that the variable is statistically associated with the outcome rather than the relationship occurring by chance. *** indicates p-value < 0.001, ** indicates p-value < 0.01, * indicates p-value < 0.05, indicates p-value < 0.10; no symbol indicates p-value ≥ 0.10 (not statistically significant).

Adjusted R^2 summarizes how much variation in withdrawals the model explains after penalizing unnecessary complexity. Values closer to 1 indicate that predictors capture more of the observed ups and downs; values closer to 0 indicate more unexplained variability. Adjusted R^2 is not a stand-alone measure of model quality or forecast accuracy. It is interpreted alongside the practical importance of errors given each subregion’s withdrawal magnitude and data availability.

Low adjusted R^2 values often arise where historical withdrawals are small and/or sporadic. In these settings, the signal-to-noise ratio is low: rounding, reporting gaps, and operational idiosyncrasies (e.g., intermittent wells, short maintenance outages, seasonal start–stop patterns, droughts) can skew the model rather than indicate real trends. Because R^2 is a ratio of explained variance to total variance, even modest absolute errors can appear large when total variance is tiny. In addition, climate-driven predictors and smooth time trends that perform well in larger systems may explain less in very small systems where usage is driven by local, one-off factors not captured in basin-wide covariates. For planning, a low R^2 in a very low-volume subregion is therefore less concerning than a similar R^2 in a high-volume subregion.

In the subregion Newton County-Subbasin 5, the adjusted R^2 is very low at 0.02 indicating that the model explains little of the variability of the data. The average historical withdrawal for the subregion over the last 15 years is approximately 0.05 MGD. The model projects 0.05 MGD in 2075. The model estimates for the projected period assume the historical trends continue, and the project volume from the model is close to the historical average. In the subregion Kosciusko-Subbasin 1, the adjusted R^2 is low at 0.28 indicating that the model does not explain a large portion of the variability of the data. The average historical withdrawal for the subregion over the last 15 years is approximately 0.002 MGD. The model projects 0.001 MGD in 2075. Across the subregions with adjusted R^2 less than 0.5, six of nine have withdrawal magnitudes less than 0.2 MGD, suggesting the projected estimates are sufficient for planning at those scales. Of the remaining three subregions, two have 15-year historical averages under 1.0 MGD. For these subregions, the projected estimate similarly provides sufficient information for planning at this scale.

By contrast, higher-volume systems warrant greater scrutiny because errors matter more. In the subregion La Porte–Subbasin 2, the adjusted R^2 is strong at 0.70 indicating that the model explains the majority of the variability of the data. The average historical withdrawal for the region over the last 15 years is approximately 3.15 MGD. The model projects 3.11 MGD in 2075. The model estimates for the projected period assume the historical trends continue, and the projected volume from the model is close to the historical average. In the subregion Lake-Subbasin 5, the adjusted R^2 is strong at 0.75 indicating that the model does explain the majority of the variability of the data. The average historical withdrawal for the region over the last 15 years is approximately 2.30 MGD. The model projects 4.89 MGD in 2075, largely due to the projected population increase in Lake County. In practice, model fit is weighed against withdrawal magnitude and data quality.

Finally, multiplying forecasted PSR/day values by projected subregion populations produced daily withdrawal forecasts through 2075. These can be aggregated to monthly or annual estimates, as needed for planning purposes. The modeling framework therefore provides a consistent, basin-wide projection of future public supply demand that accounts for climate variability, demographic change, and structural shifts in withdrawal patterns.

C.3.3.6 Illinois Analysis

For the Illinois subregions (Iroquois, Kankakee, and Will Counties), no historical water-withdrawal data were available. The study applied the calibrated model from the nearest Indiana subregion within the same subbasin to estimate the PS demand, adjusting for estimated population. As seen in Table C-22, Iroquois County Subbasin 7 adopted the Newton Subbasin 7 model. This method assumes that cross-border subregions experience similar climate-demand relationships, with Illinois-specific population forecasts providing the scaling factor. While this introduces some uncertainty, it ensures that Illinois subregions are represented within the basin-wide forecast.

Table C-22. Illinois Subregions and the Neighboring Indiana Subregions

Geography			Neighboring Indiana Subregion		
County	State	Subbasin	County	State	Subbasin
Iroquois	Illinois	7	Newton	Indiana	7
Kankakee	Illinois	5	Lake	Indiana	5
Will	Illinois	5	Lake	Indiana	5

The assumption that the Illinois water demand for public supply is similar to the Indiana estimates is supported by a previous water supply planning report conducted by the State of Illinois (Kelly et al. 2019) finding that the region in the study area is largely rural. The areas with higher populations are located outside of the boundaries of the Study Area of this Study.

C.3.4 INDUSTRIAL WITHDRAWALS

The IN withdrawals in the Kankakee Basin are defined by withdrawals classified in the SWWF database by the IN water-use sector code (IDNR 2025). Withdrawals classified as IN in the SWWF database are owned and operated by the industrial facility that uses the water as well as utilities that designate water use for industrial activities. The IN water withdrawal forecast uses a different approach to forecasting compared to other sectors due to a lack of available explanatory data, which led to a need to present the methods in a different structure. Figure C-25 shows the locations of wells and surface water intakes used for industrial production.

In addition, this study reclassified two ethanol production facilities which were originally categorized under energy production into the industrial sector, as they do not generate electricity but produce ethanol fuel for external markets. Therefore, these two ethanol plants align more accurately with the IN sector, so the forecasted industrial water demand incorporates the usage data from withdrawals classified as IN, along with the water demand from the two ethanol production facilities. Throughout the report, all analysis of IN water withdrawals from SWWF include these two ethanol production facilities.

Several water utilities (private and public) supply water to industrial customers; however, these withdrawals are classified in the SWWF database as public supply. Nevertheless, these customers could not be reclassified as IN for the study, because there are no individual records of the industrial facility name or the volume of deliveries to the facility in the SWWF database. The future water demand forecast method did not extract IN demand from PS, and to avoid double counting future IN demand, it was assumed that the PS forecast would continue to include any embedded industrial demand in the future.

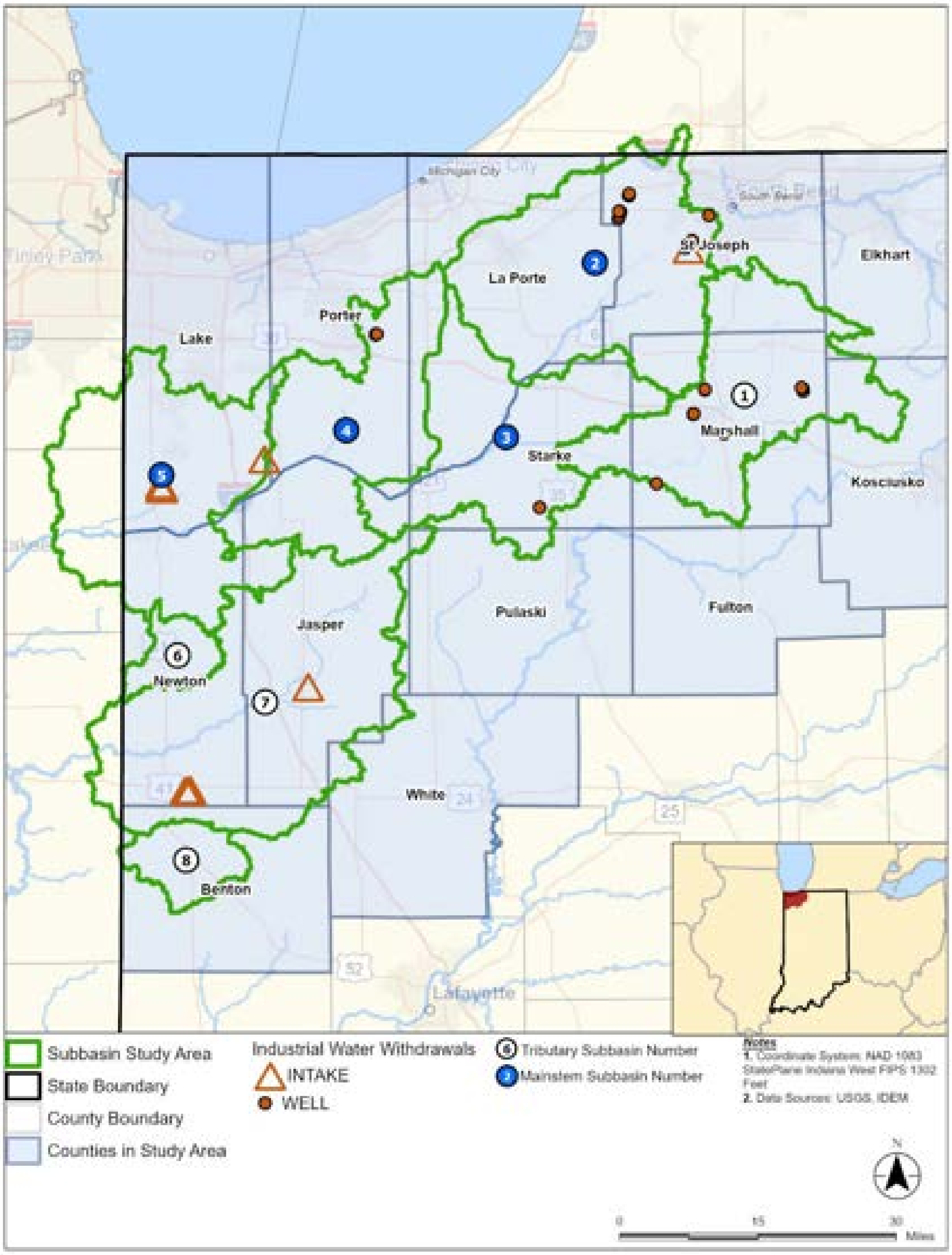


Figure C-25. Historical Industrial Water Withdrawal Locations, Groundwater Wells and Surface Water Intakes

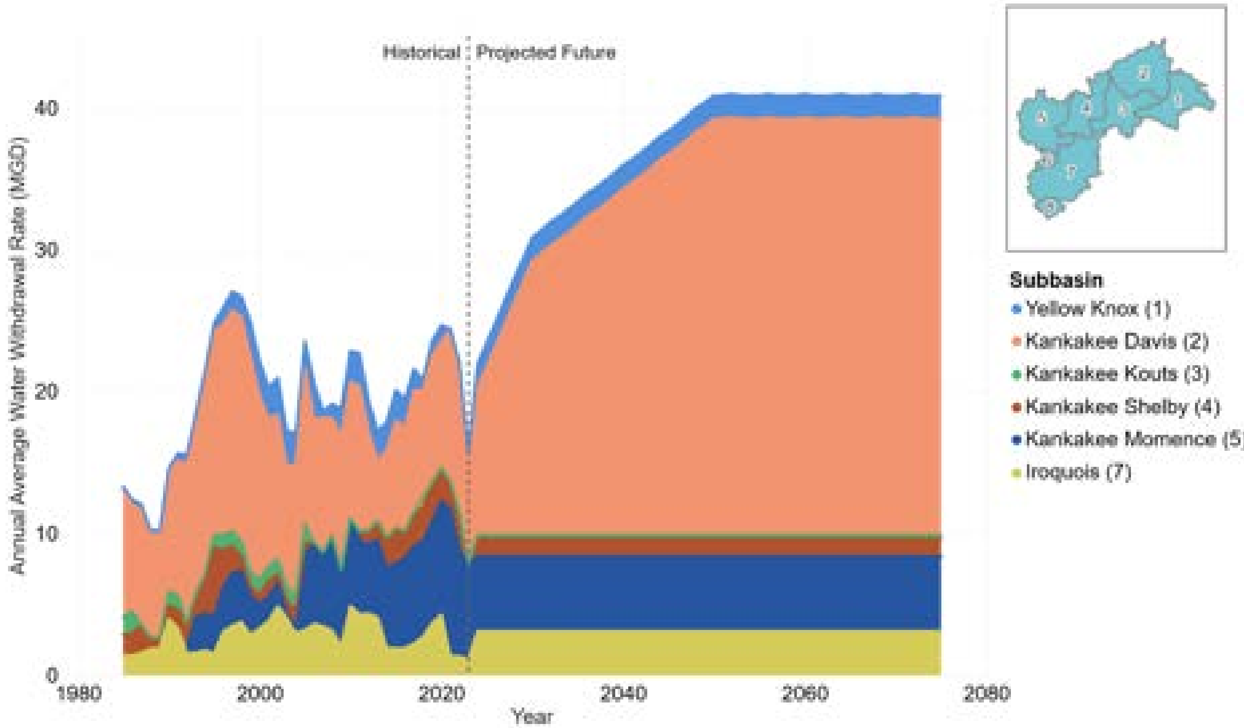
C.3.4.1 Overview

Table C-23 summarizes the IN water withdrawals in decadal increments for the Indiana portion of the Kankakee basin from 1985-2023. The average annual IN water use, as reported in the SWWF database, has been relatively consistent for the past three decades, ranging between 19.9 and 22.6 MGD. Annual withdrawals for the IN sector are projected to increase to about 41 MGD by 2075, up from the 2023 average of 16 MGD (Figure C-26). Mining and manufacturing constitute the largest IN water withdrawals over the 1985-2023 period, and ethanol production constitutes the second largest water withdrawal. Other types of water withdrawals include agribusiness, with some water use from chemicals and fertilizer production.

Table C-23. Historical Industrial Water Withdrawals by Industry, 1985-2023 in Ten Year Averages, MGD and Percent of Total

Industry	1985-1994	1995-2004	2005-2014	2015-2023
Mining and Manufacturing (MGD)	9.1	16.5	15.1	16.3
Percent of Total	*64*	*73*	*76*	*77*
Ethanol Production (MGD)	4.9	5.9	4.8	5.0
Percent of Total	*35*	*26*	*24*	*23*
Other (MGD)	0.2	0.2	0.0	0.0
Percent of Total	*1*	*1*	*0*	*0*
Total (MGD)	**14.3**	**22.6**	**19.9**	**21.3**

Source: IDNR 2025
Notes:
Period 2015-2023 is nine years. Withdrawals only include IN plus reclassified ethanol facilities reporting to IDNR; no Illinois data are included.
Key:
MGD = million gallons per day

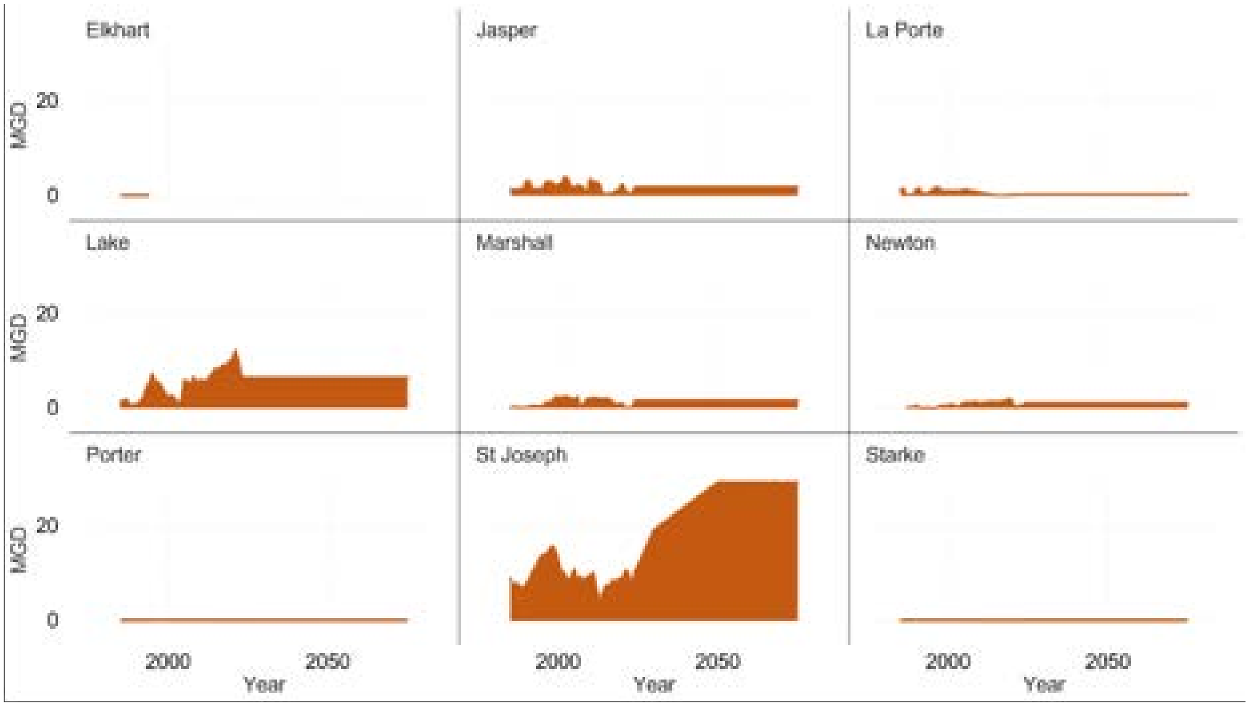


Key:
MGD = million gallons per day

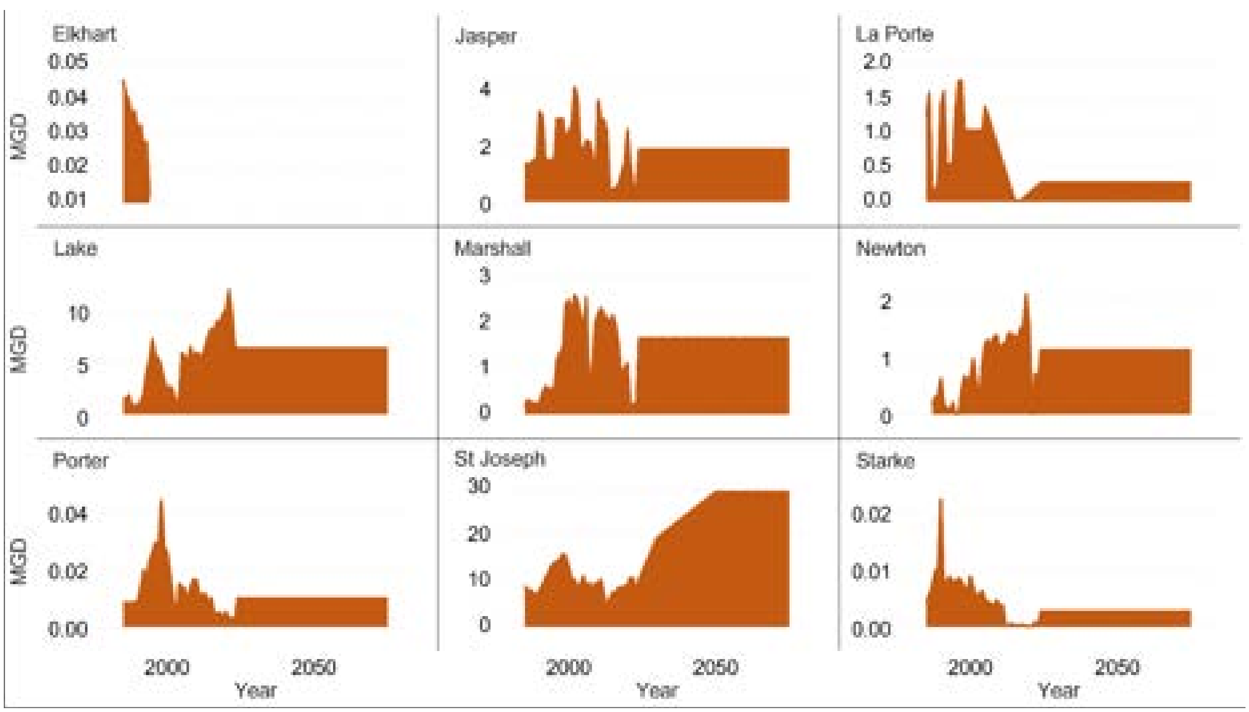
Figure C-26. Industrial Historical (1985-2023) and Projected Future (2024-2075) Annual Water Demand in Kankakee Basin, by Subbasin (MGD)

The historical IN water use and the future projected water demand were estimated at the subregion level--the portion of the subbasin within each county. Subregion estimates were aggregated by subbasin and county. Economic planning decisions are often made at the county level; this study likewise used counties to structure the discussion. The top plot shows the demand with a fixed vertical scale to show the relative magnitude of demand for both Primary Study Area Counties as well as supplemental counties. The majority of historical and future projected demand comes from St. Joseph and Lake Counties (Figure C-27, top).

Due to data availability discussed in detail below, this study predicts that future water use remains consistent with average historical use, except for St. Joseph County which has published specific projections of expanded water demand related to development of the Indiana Enterprise Center.



Note: the vertical axis scale is fixed for each region.



Note: the vertical axis scale is different for each region.
Key: MGD = million gallons per day

Figure C-27. Historical and Future Projected Annual Industrial Water Demand by County, Fixed (top) and Variable (bottom) Scale, 1985-2075 (MGD)

C.3.4.2 Analysis

Projecting future IN water demand requires insight into local economic development that is and will occur in the region. This includes information about the industries that are seeking to develop facilities in the region as well as industries that are being actively pursued by local economic development entities. In addition, an understanding of the expected water use of new industrial businesses is required to produce an accurate forecast, which can prove difficult to discover. What follows is a description of the data sources and analysis undertaken to develop IN projections at the subregion level.

The future demand estimates are based on historical water withdrawal trends, interviews with local agencies, and publicly announced development. Historical water withdrawals have fluctuated throughout the period from a low of 10.1 MGD in 1989 to a high of 26.9 MGD in 1997. Water-demand fluctuations within each subregion guided the selection of forecasting methods. This study projects continued water demand across all subregions; however, the available data do not support forecasting future interannual variation. Consequently, the study adopted a methodology that averages historical water use data from 2000 onward for each subregion. One exception applies to St. Joseph County, where published data on water utility expansion necessitated a modified forecast approach.

Details of the methods used to estimate future projections for the Primary Study Area Counties are presented below. All counties are reviewed, five are discussed in more detail, and the two counties that represent the majority of the historical water use in the Kankakee Basin receive the most focus.

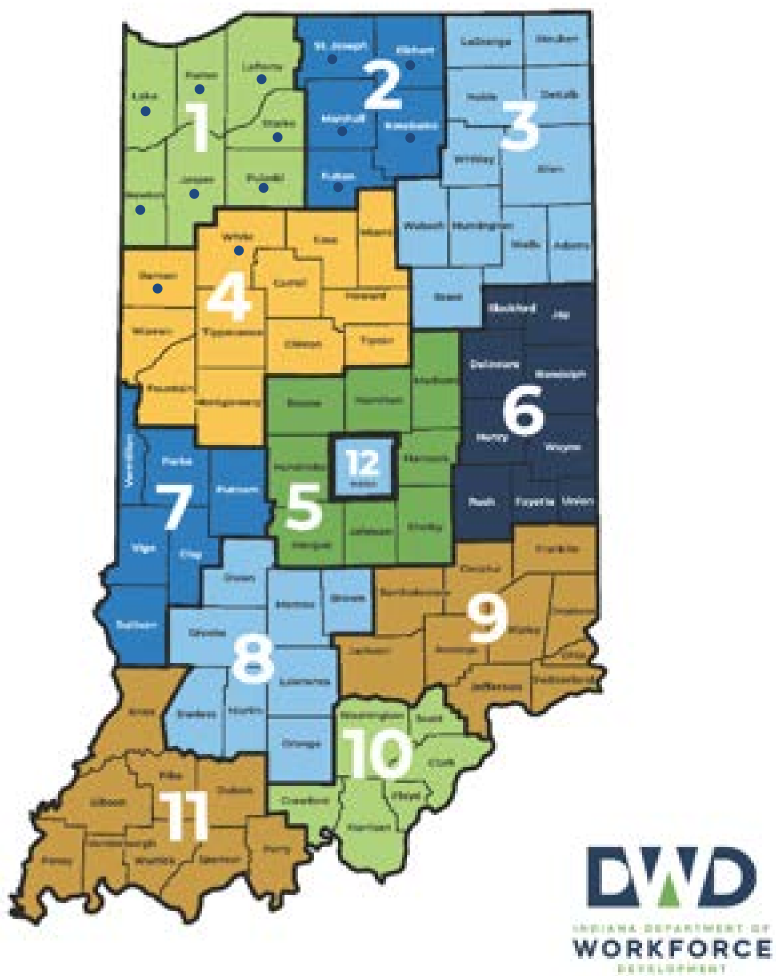
C.3.4.3 Study Area Counties

Information about development plans within Primary Study Area Counties was obtained directly from interviews with local entities, published reports, and news articles. Local agencies contacted include:

- La Porte County Office of Economic Development
- St. Joseph County Division of Economic Development
- Town of New Carlisle

The state of Indiana Department of Workforce Development (IDWD 2024) publishes estimates of future job growth by economic growth region (EGR) (Figure C-28). The counties with industrial water uses are located within two EGRs. While the EGRs do not exactly correspond to the Kankakee Basin boundaries, they still provide insight into the region’s economic conditions and drivers.

In the following sections, a discussion of economic development, industrial sectors, and water demand provides a high-level understanding of the regional trends in industrial development. Counties with higher industrial water use are reviewed in more detail to understand regional trends in each subregion’s historical and forecasted water demand.



Note: dark blue dots indicate counties within Kankakee Basin

Figure C-28. Indiana Department of Workforce Development, Map of Economic Growth Regions

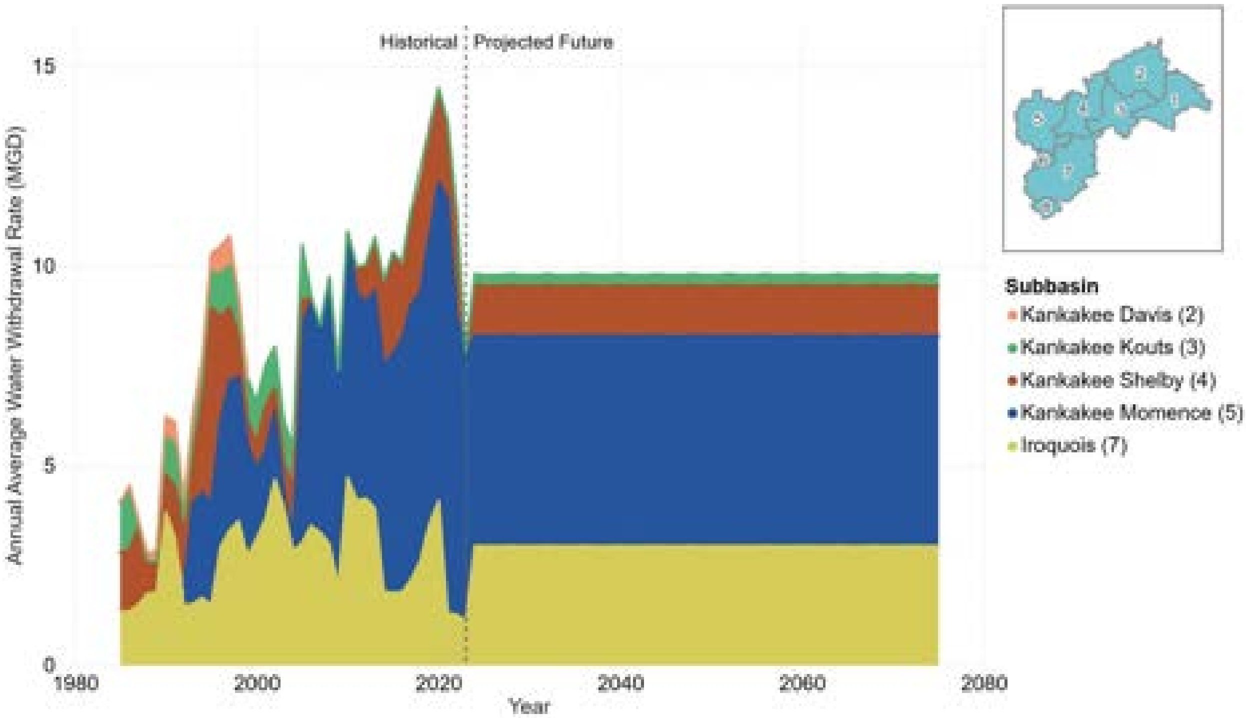
C.3.4.3.1 Economic Growth Region 1 (EGR 1)

EGR 1 includes Jasper, Lake, La Porte, Newton, Porter, Pulaski, and Starke Counties. EGR 1 includes the state's most industrialized area around the Lake Michigan Rim in Lake County which has different economic characteristics than most of the rest of the region. EGR 1 reports on the top 10 industrial sectors ranked by highest annual average employment. Of these industries, two are generally large water users as reflected in the SWWF historical data: manufacturing (number 2) and construction (number 6). Manufacturing includes metals manufacturing (steel mill), minerals manufacturing (e.g., concrete, cement, clay, stone), and chemical manufacturing (e.g., ethanol, rubber, fertilizer). Manufacturing has experienced small but consistent growth in jobs over the past 5 years, while construction has had small but consistent growth in the number of establishments over the same period (IDWD 2024).

The largest industrial water user in the region is mining (industrial minerals, aggregate, stone). Water withdrawals from mining have fluctuated in EGR 1 over the last two decades with periods of high growth. Data on mining jobs and wages is often considered proprietary in this region and is not reported by Indiana Department of Workforce Development. The number of mining establishments is reported in the Industry Sector Snapshot for each EGR (IDWD 2024). During Q1 2019, there were 22 establishments reported for EGR 1. By the end of Q3 2024, the number of mining establishments had decreased to 14, representing a 36% decrease over those five years, though 1/3 of the establishments were located along Lake Michigan Rim.

Mining is a cyclic industry, as determined by mineral prices and the productive life of a mine. Figure C-29 shows that there have been at least seven notable peaks in IN water withdrawals in EGR 1 during the historical period (1985-2023). Figure C-29 shows a stacked plot by subbasin with Kankakee Momence (Subbasin 5) having the highest volume of historical water withdrawals in EGR 1. A dip in annual average withdrawals of 0.4 MGD in 2004 preceded a spike in 2005 of 5.5 MGD. Water withdrawals peaked at 10.4 MGD in 2021. Iroquois (Subbasin 7) historically had dramatic annual average fluctuations between 1.1 MGD and 4.9 MGD. Kankakee Shelby (Subbasin 4) withdrawals have similarly fluctuated between 0.5 MGD and 4.8 MGD over the period, with fewer high periods.

The forecasted water demand for the portion of EGR 1 within Kankakee Basin assumes that withdrawals will remain fixed at 9.8 MGD over the forecast period, which is the average level of withdrawals over the 2000-2023 period. The forecast by subregion is discussed in more detail in the county-specific sections below. While historical trends indicate an increase in water demand over the historical period, the overall fluctuations and limited data available about the industries present led this study to use a simplified average water use forecast. This method and background is described further below.



Note: EGR 1 includes Jasper, Lake, La Porte, Newton, Porter, Pulaski, and Starke Counties

Figure C-29. Historical and Forecasted Water Withdrawals Within EGR 1 for Kankakee Basin, by Subbasin

Though not currently a large water user, the information industry has the potential to be a large water user in the future. Information includes computing infrastructure, data processing, and related services. The number of establishments in the information industry grew by 28% between Q1 2019 (174 establishments) and Q3 2024 (222 establishments). The information industry includes data centers, which are large water users.

In EGR 1, the subregions within Lake, Jasper, and Newton Counties exhibit the highest levels of IN water use (see Figure C-30). This report provides a detailed discussion of water use in Lake County, with brief commentary on Jasper and Newton Counties.

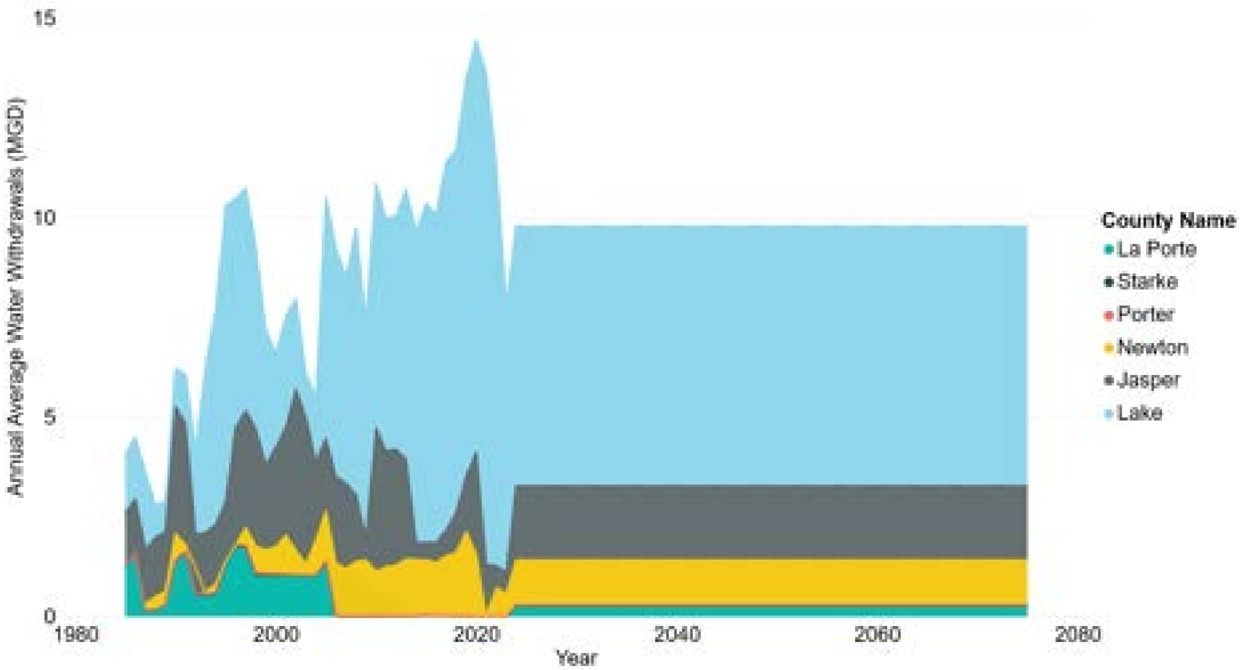


Figure C-30. Historical and Forecasted Water Withdrawals within EGR 1 for Kankakee Basin, by County

C.3.4.3.1.1 Lake County

Lake County represents the highest water user within EGR 1 and the second highest in Kankakee Basin. Located adjacent to Lake Michigan and the Illinois state border, the majority of water withdrawals are from Kankakee Momence (Subbasin 5) (Figure C-31). This study assumes that water demand will be held constant from 2024 onward, reflecting the average annual usage observed between 2000 and 2023. The analysis below provides supporting evidence for this projection.

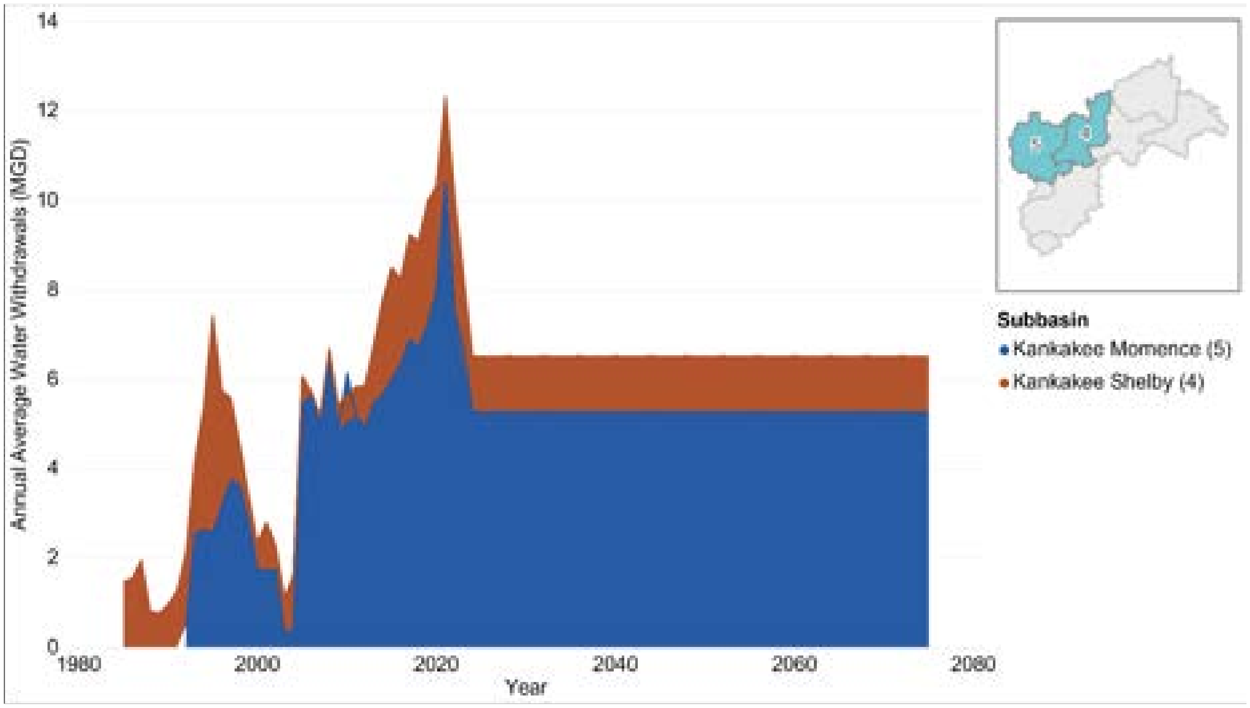


Figure C-31. Historical and Forecasted Water Withdrawals, Lake County, by Subbasin

Figure C-32 identifies the facilities with the highest use in Lake County. All four facilities reporting water use in the county are mining and construction companies. Since 2005, U.S. Aggregates, a mining company, has made water withdrawals that accounted for over 80% of the total IN withdrawals for the county. In 2020, U.S. Aggregates completed a major water-use expansion of 10.4 MGD, which likely contributed to the peak seen in 2021(U.S. Aggregates 2025). The projections assume that stone-quarry mining will continue in the county throughout the forecasted period. As discussed above, it is likely that there will be periods of increased water demand due to mining followed by dips when a mine approaches the end of its productive life. Dates of future mine openings and closures are proprietary information that was not available for this study. Therefore, this study does not attempt to estimate the future dates of mine openings and closures. Instead, the withdrawals are held fixed during the forecast period at the level of the annual average withdrawals from 2000 to 2023. Overall, water withdrawal for the county is estimated to be 6.5 MGD for the following 50 years.

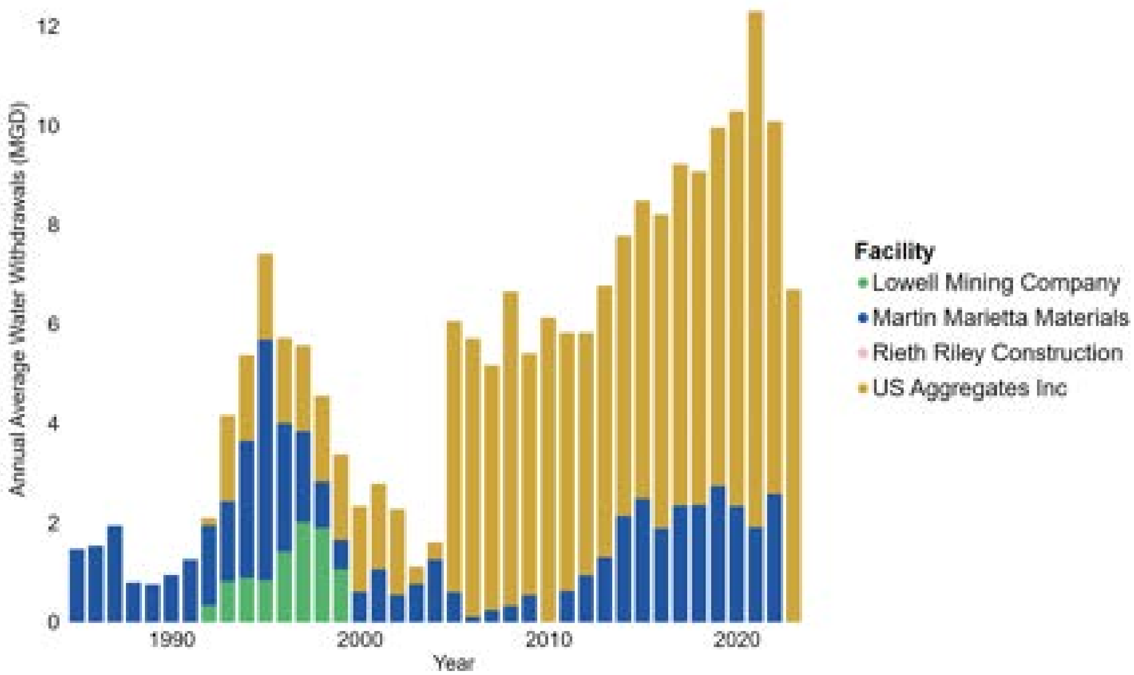


Figure C-32. Historical Water Withdrawals in Lake County, by Facility

In May of 2025, Lake County commissioners planned to develop amendments to the Unified Development Ordinance for regulation of data center zoning (Gallenberger 2025). While these changes may lead to the development of data centers in the future in Lake County, to produce a conservative forecast, this study did not speculate about any additional growth for the information technology industry (data centers) for the forecasted period.

C.3.4.3.1.2 Jasper County

Jasper County has the second highest water withdrawal rates historically in EGR 1 and the third highest within Kankakee Basin, sourcing water from Iroquois (Subbasin 7). Most of the water use is from mining companies, reflecting the regional industry composition. Additionally, Jasper County is home to Iroquois Bio Energy Company, an ethanol production facility; though not a large water user, the facility has averaged around 0.5 MGD for the past 15 years. The forecasted water demand assumes a constant level of water withdrawals of 1.9 MGD for Jasper County, which is the average rate of IN water withdrawal for the county from 2000 to 2023.

C.3.4.3.1.3 Newton County

Newton County has the third highest water withdrawal rates historically in EGR 1 and the fifth highest within Kankakee Basin, sourcing water from Iroquois (Subbasin 7). It is recognized for its significant sand and gravel resources, and the largest water user is a mining company. The forecasted water demand estimate is based on the average historical demand of 1.1 MGD during 2000 to 2023, assuming a similar rate of water use for the county subregion.

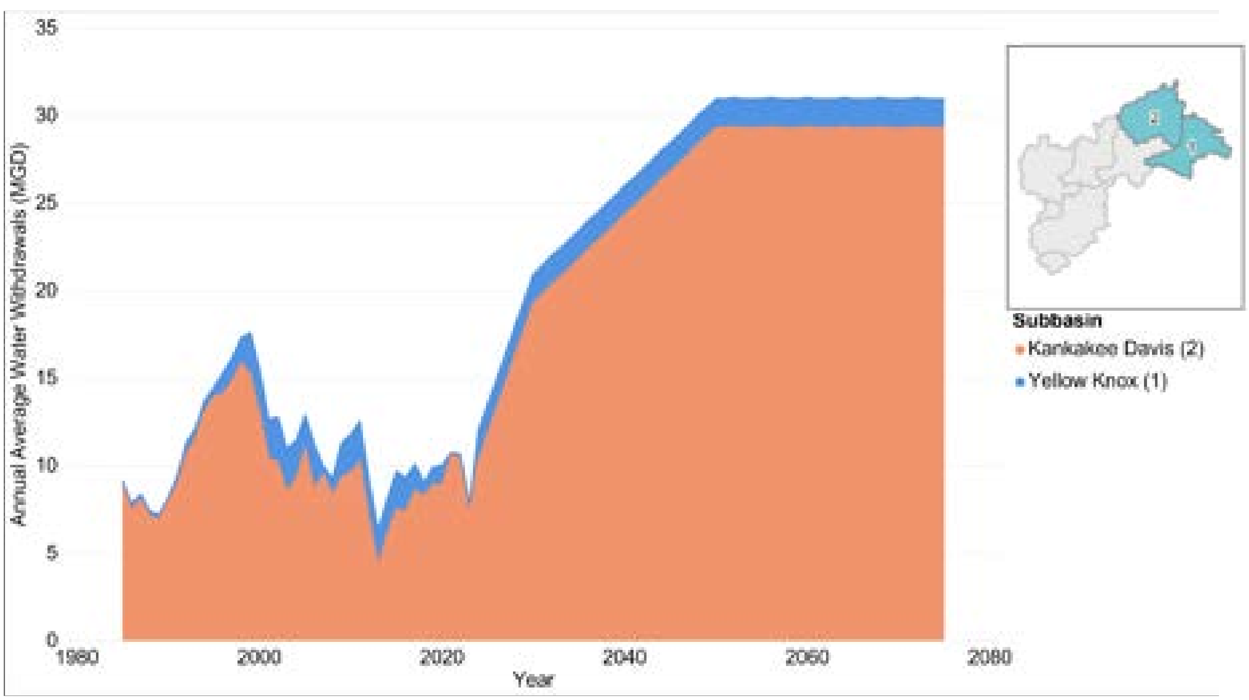
C.3.4.3.2 Economic Growth Region 2 (EGR 2)

EGR 2 includes Elkhart, Fulton, Kosciusko, Marshall, and St. Joseph Counties. EGR 2 identifies the top 10 industrial sectors by annual average employment. Of these industries in the region, manufacturing is the top industry and also the largest water user of the counties in the Kankakee Basin, as reflected in the SWWF historical data. Manufacturing includes metals manufacturing (e.g., steel mills), automobile manufacturing, and chemical manufacturing (e.g., ethanol, rubber, fertilizer) (NAICS 2022).

The Industry Sector Snapshot indicates that the number of manufacturing establishments has remained fairly consistent, showing a small increase of 2% between Q1 2019 (1,463) and Q3 2024 (1,491).

Though not historically a large water user in this region, the number of establishments in the information industry grew at a rate of 51 percent between Q1 2019 and Q3 2024, from 150 to 226. The information industry includes data centers, which are often large water users. Data center development in the region is growing as supported by announcements discussed below.

Figure C-33 shows a stacked plot of water withdrawals by subbasin for the historical and projected period. The majority of water demand is within Kankakee Davis (Subbasin 2). Historical water withdrawals peaked in 1998 at 15.8 MGD with smaller fluctuations before and after that peak, hovering around 8-10 MGD. Substantial water demand growth is expected within this subbasin, as discussed in detail below. The remaining portion of water use in the region occurs within Yellow Knox (Subbasin 1), averaging less than 2 MGD since 2000.



Note: EGR 2 includes Elkhart, Fulton, Kosciusko, Marshall, and St. Joseph Counties.

Figure C-33. Historical and Forecasted Water Withdrawals within EGR 2, by Subbasin

Within EGR 2, St. Joseph County exhibits the highest historical water use (see Figure C-34) with minimal additional water use in Marshall County. This section provides a detailed discussion of IN water use in St. Joseph County with some additional comments about Marshall County.

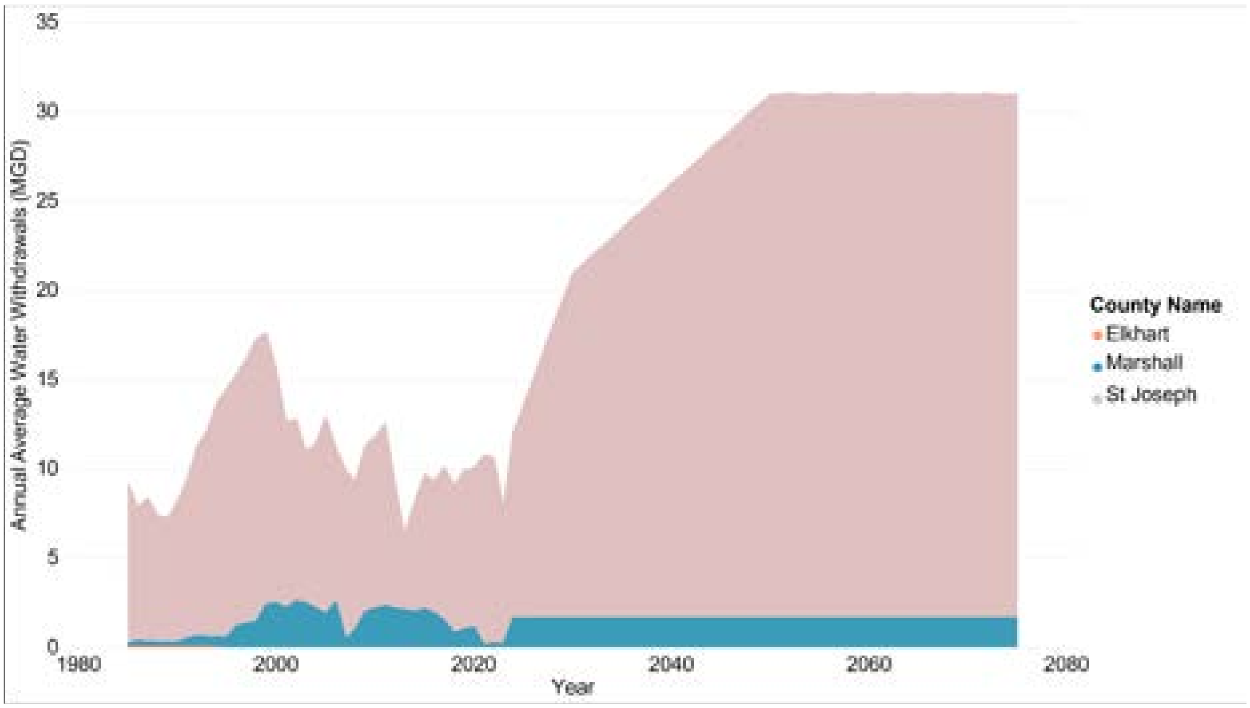


Figure C-34. Historical and Forecasted Water Withdrawals Within EGR 2, by County

C.3.4.3.2.1 St. Joseph County

St. Joseph County represents the highest IN water use within EGR 2 and within the entire Kankakee Basin. Located adjacent to the Michigan state border, the county's water is completely sourced from Kankakee Davis (Subbasin 2) (Figure C-35). The water demand forecast is based on historical trends and published information about an expansion of the water utility in the Town of New Carlisle.

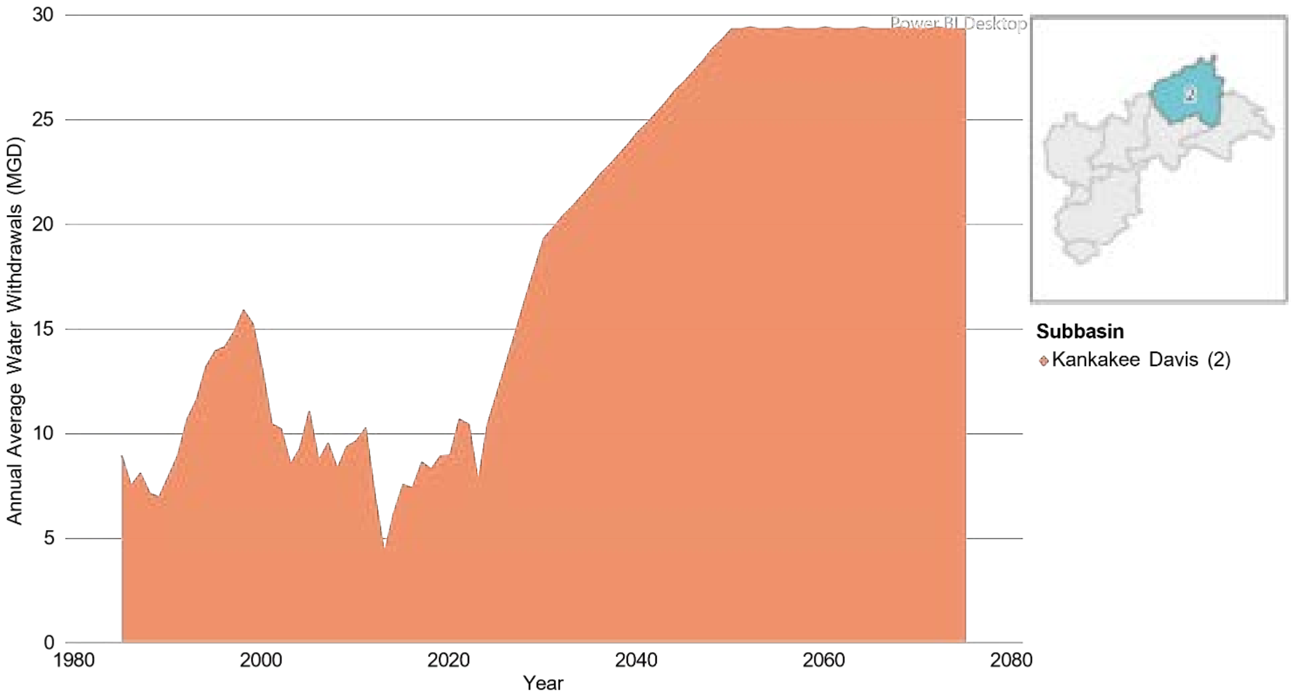


Figure C-35. Historical and Forecasted Water Withdrawals, St. Joseph County, by Subbasin

Figure C-36 identifies the individual facilities with the highest use in St. Joseph County (according to self-reported SWWF data). The two facilities with the highest IN water demand historically are South Bend Ethanol LLC (representing 54% of the County's withdrawals since 2000), and the Town of New Carlisle (40% of the County's total water withdrawals). Within the SWWF database, the Town of New Carlisle reports facility water use under two main sectors: public supply and industrial. The town also reported one year of water withdrawals under energy production and less than one year for miscellaneous. Energy production water withdrawals are sourced from separate wells. The two largest IN water users in the county are discussed in more detail below. The remaining top IN water withdrawals are from other manufacturing and mining facilities.

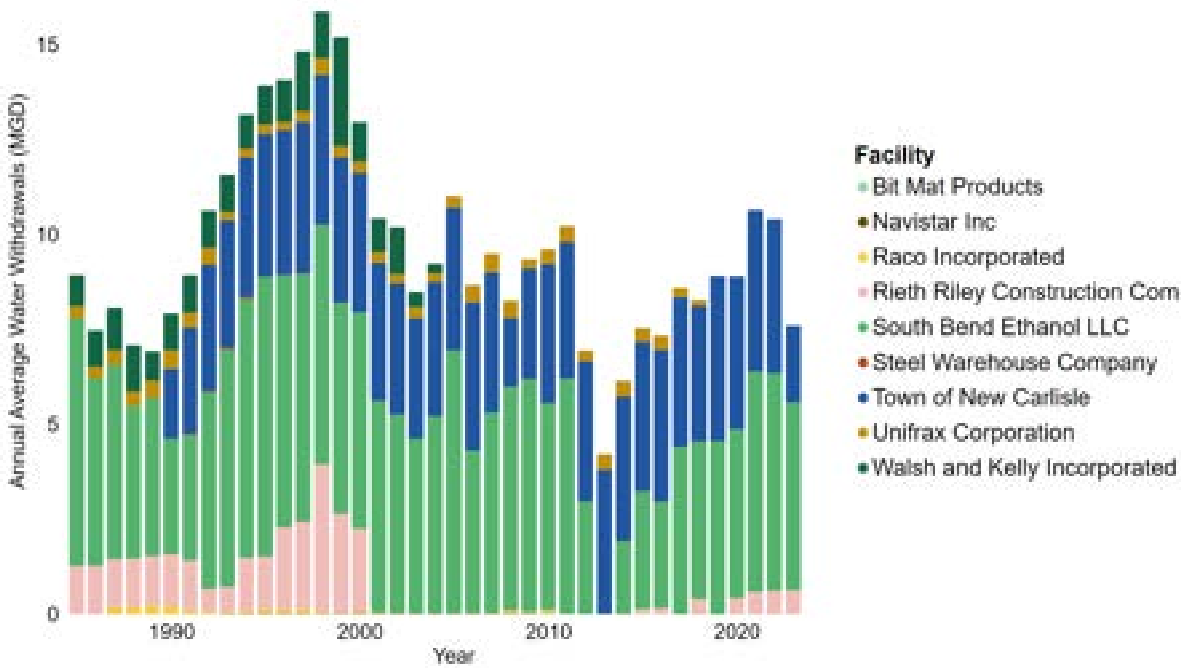


Figure C-36. Historical Water Withdrawals in St. Joseph County, by Facility

The Town of New Carlisle

Projected increases in water demand from the Town of New Carlisle make up the majority of the increase in IN water demand for the Kankakee Basin. The New Carlisle Economic Development Area, owned by St. Joseph County and established in 1987, has attracted significant industrial activity representing an important part of the region's history and economic growth over the past 38 years (St. Joseph County Redevelopment Commission circa 2023). The area houses two steel plants, developed in 1987 and 1999. Several other manufacturing and agribusiness facilities are located within the area.

In 2017, St. Joseph County advanced a new industrial mega-development site - the Indiana Enterprise Center (IEC) - bordering the Town of New Carlisle to the east and served by the town water utility. In 2023, a 3.5-billion-dollar electric vehicle battery manufacturing facility was announced at the site (St. Joseph County Redevelopment Commission circa 2023). The facility is expected to create 1,700 jobs, which would be a significant boost to the town with a current population of 2,100. Increased residential water demand required for an increased population in the region would likely be served by the town water utility. Note that the water demand projections do not specifically factor in population growth for the town associated with this significant economic growth; the public supply projections incorporate broader population forecasts for the region based on historical population trends.

In 2024, the State announced plans for an $11 billion data center (State of Indiana, Office of the Governor 2024) in the IEC. This is the largest capital investment announcement in Indiana's history, and an estimated 1,000 jobs are expected to be created (Semmler 2024). Recognizing water infrastructure as a limiting factor, the county, town, and data center jointly developed plans to expand water utility capacity. The town and county approved a memorandum of understanding to source up to 24 MGD from groundwater in the Kankakee Basin (Holguin 2025).

Since the Town of New Carlisle provides water for the IEC, the town water services department and the St. Joseph County Division of Economic Development were contacted to verify anticipated future water use and to understand the expected time frame for the increase in withdrawals. The key points from the interviews include:

- The town identified that 24 MGD is the current capacity from a dense, localized set of groundwater wells within the surficial aquifer of the Kankakee Basin. Any additional capacity would need to be evaluated outside of the current wellfield areas.
- Due to the current understanding of the aquifer characteristics, more wells within the current geographic boundary would not necessarily yield more water.
- The maximum capacity of the wellfield is designed to meet seasonal peak demand, and it is not currently expected there would be sustained average withdrawals at that rate.
- The entire 24 MGD is not currently allocated to any of the currently planned facilities. Only a portion of that capacity is allocated to existing and currently planned development. The excess capacity is reserved for future projects that may be sited in the area.

Table C-24 outlines the historical average and projected water withdrawal rates for the town and county. The town expects that within the next five years (i.e., by 2030), average water demand will reach 14 MGD, and within the following ten years (i.e., by 2040), average water demand may reasonably be expected to reach 19 MGD. The town also anticipates that by 2050, the currently available maximum capacity of the utility for IN withdrawals of 24 MGD would be used. The Town of New Carlisle historical average water withdrawal for the past 24 years is 3.6 MGD. The forecasted water demand due to the IEC expanded capacity was added into the projection incrementally over those periods to the baseline average water withdrawal to reach a total annual average future projection of 24 MGD, based on information from the utility described above.

St. Joseph County's annual average water withdrawals since 2000 were 8.9 MGD, which includes 3.6 MGD from the Town of New Carlisle. Exclusive of projected water demand growth from the IEC and the historical IN demands for the Town of New Carlisle, the 5.3 MGD of demand in the rest of St. Joseph County is projected to continue to into the future. Including the planned increase from the Town of New Carlisle, water demand is estimated to increase to 29.3 MGD by 2050 for the entire county. By 2050, the Town of New Carlisle would constitute an estimated 82% of the IN water demand for the county, up from an average of 40% during the historical period.

Table C-24. Historical and Projected Average Water Withdrawal Rates, Town of New Carlisle and St. Joseph County (MGD)

Location	2000-2023 Average Historical Water Withdrawal Rate (MGD)	2030 Projected Withdrawal Rate (MGD)	2040 Projected Withdrawal Rate (MGD)	2050 Projected Withdrawal Rate (MGD)	2075 Projected Withdrawal Rate (MGD)
Town of New Carlisle	3.6	14	19	24	24
Rest of St. Joseph County	5.3	5.3	5.3	5.3	5.3
Total for St. Joseph County	8.9	19.3	24.3	29.3	29.3

Key:
MGD = million gallons per day

It is possible that the 24 MGD projected maximum demand for the IEC may be reached sooner than 2050 or that the town will further expand the water utility's capacity in the future. There are conflicting factors that may limit and/or encourage further growth. For example, the St. Joseph County Area Plan Commission and voted against rezoning land just outside of the IEC for another data center (Kate 2025). The town council argued that the proposal went against the New Carlisle 2040 Comprehensive Plan. The rezoning petition went to the county council for a vote where it was also denied (Hall 2025). While it seems that growth in this area is inevitable, the town is on the border of another watershed and the water sourced for future projects may come from outside the Kankakee Basin.

This study notes the forecasted IN water demand for the Town of New Carlisle is not only for industrial use. The town reports some historical water use for other sectors separately. The town's reported residential water use is classified separately under public supply (PS), but the expanded capacity of the town water utility includes requirements of current water demand for energy production (EP) in the IEC. The St. Joseph Energy Center (SJEC) located within the IEC came online in 2018 and serves the electricity needs of a battery plant and data center as well as the residential community. SJEC's water demand for its current capacity and some room for growth is accounted within the Town of New Carlisle water utility's expanded capacity.

Some of the water used for SJEC was reported under EP in the SWWF database, and all historical and future water demand for SJEC is estimated within the energy production sector. The projected water demand for the entire subbasin is based on electricity generation forecasts published by Purdue (SUFG 2023) which embeds water and electricity demand supplied by SJEC. The energy production sector forecast for the subbasin factors in growth expectations for the region broadly, beyond just the single SJEC facility. The energy production sector projection captures any increases in water demand beyond the current electric generation capacity of the facility.

South Bend Ethanol

South Bend Ethanol LLC has had the highest average water withdrawal rates since 2000 in the subregion at 4.6 MGD. The plant was acquired by Verbio in 2023 and thereafter announced plans to expand the biorefinery with a $230 million investment to integrate renewable natural gas production. Communications with the facility indicated that water reuse was a priority in the expansion plans (Verbio 2023). Specifics of water withdrawal changes were not available. This study did not assume an increase in water use from this facility. The forecasted water demand assumes that water withdrawals will remain at 4.6 MGD.

C.3.4.3.2.2 Marshall County

Marshall County has had the second highest water withdrawal rates in EGR 1 and the fourth highest in the entire Kankakee Basin, sourcing water from Yellow Knox (Subbasin 1). Industries within the region include mining and manufacturing, with a steel facility as the highest water user. Marshall County Commissioners passed several ordinances creating a two-year moratorium on solar, battery storage, data centers, and carbon capture (Bottorff 2025). The forecasted water demand assumes demand will remain at historical averages of 1.7 MGD during 2000-2023.

C.3.4.3.3 Illinois Analysis

For the Illinois subregions (Iroquois, Kankakee, and Will Counties within Iroquois (Subbasin 7) and Kankakee Momence (Subbasin 5), no historical SWWF data were available. The region of Illinois within the basin is primarily rural and it is assumed that IN water use is negligible. This assumption is supported by a previous water supply planning report conducted by the State of Illinois (Kelly et al. 2019). The report found limited industrial water use in the region. Quarries were the largest water use in the area, but the currently existing quarries in the region are located outside of the boundaries of the Study Area of this Study.

In these cases, the study used a proxy approach by applying the average annual IN water demand since 2000 from a nearby Indiana subregion. Table C-25 lists the data used for each Illinois subregion. An exception was made for the Illinois subregion within Kankakee Momence (Subbasin 5), as it was determined that the Lake County subregion was not representative of the highly rural area in Illinois. The region of Illinois was reviewed for the presence of mines and large manufacturing facilities and none were identified. It was assumed that a small water use facility would be an appropriate proxy for the subregion. While this introduces some uncertainty, it ensures that the Illinois subregions are represented within the basin-wide forecast.

Table C-25. Illinois Subregion Data and Methodology Summary

Subregion	Indiana Proxy Subregion	Data and Method Used
Illinois, Iroquois, Subbasin 7	Newton, Iroquois, Subbasin 7	SWWF database, historical withdrawal for entire proxy subregion 2000-2024 multiplied by percentage of land area within Illinois compared to entire land area of Iroquois Subbasin 7.
Illinois, Kankakee Momence, Subbasin 5	Newton, Iroquois, Subbasin 7	SWWF database, historical withdrawal for fertilizer facility within proxy subregion 2000-2024

Key:
SWWF = significant water withdrawal facility

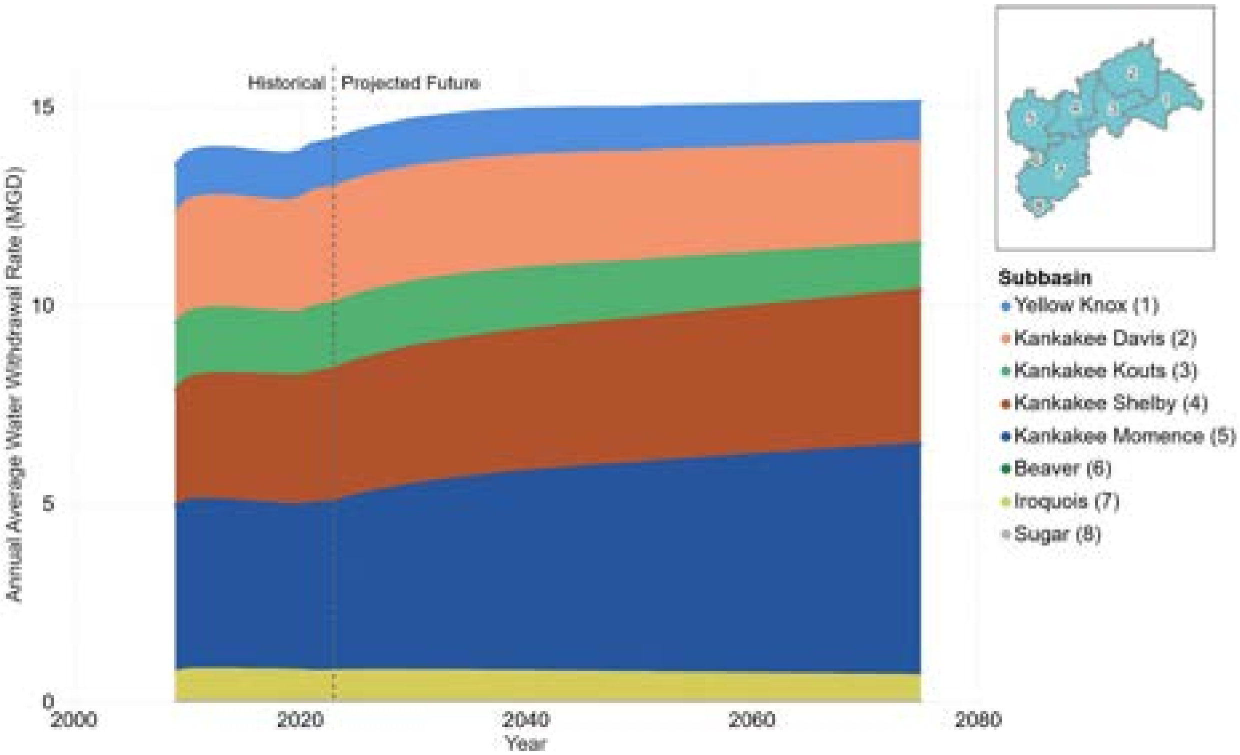
C.3.5 SELF-SUPPLIED RESIDENTIAL WITHDRAWALS

Residents within the Study Area that supply water independently for domestic use (e.g., use privately owned domestic wells) were identified separately from residents on public water systems for purposes of projecting future water demand. Residents that source their own water from private wells and who use septic tanks for wastewater disposal are classified as “self-supplied” (SS) and do not report water use to the IDNR SWWF database. An alternative approach was used estimate historical SS demand to forecast water demand for the sector. The sections that follow summarize the results, describe the data sources of addresses within the basin, the per capita water usage rates, and the forecasting methodology.

C.3.5.1 Overview

The self-supplied population within the eight subbasin Study Area was analyzed in relation to anticipated population changes and trends within the Study Area. Shifts in the self-supplied population are influenced by overall population growth or decline, urbanization trends, urban expansion, and improvements in water infrastructure. Thus, a reduction in self-supplied users within an area does not necessarily indicate a population decline.

SS withdrawals across the Kankakee Basin are projected to remain relatively stable throughout the study period with a gradual increase to about 15 MGD by 2075 from 14 MGD in 2023. Figure C-37 shows the historical and projected SS withdrawals by subbasin.

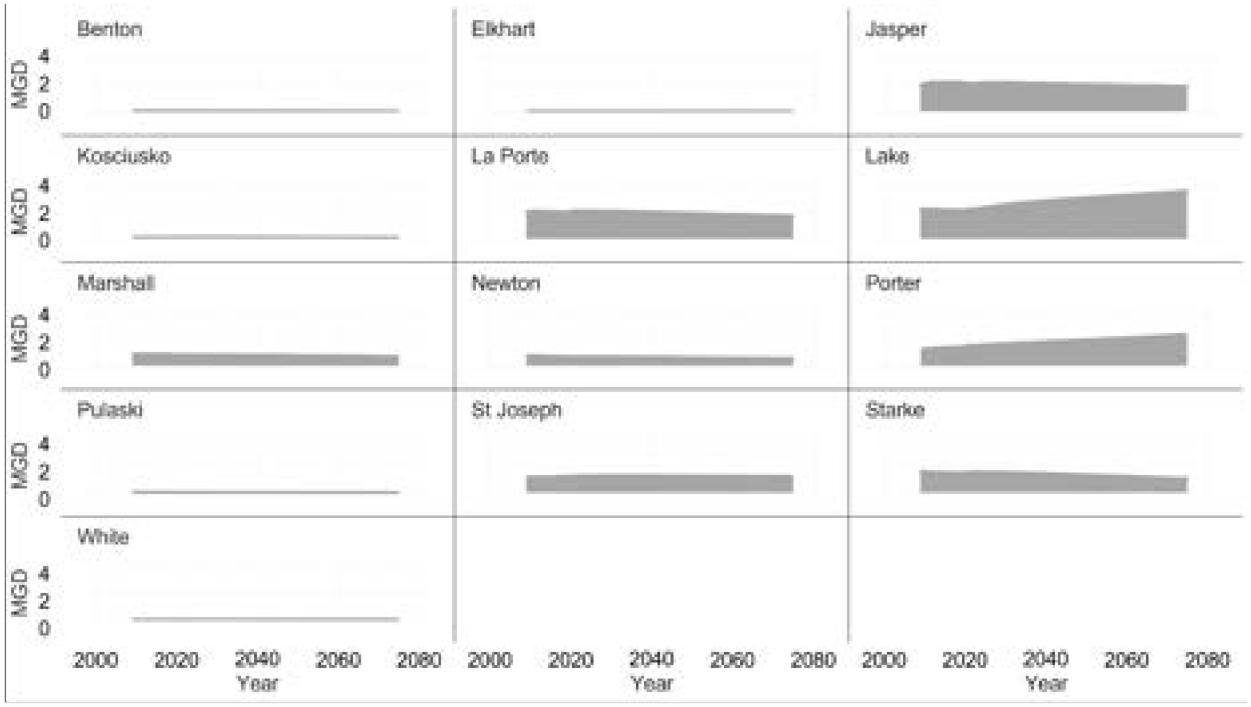


Key:
MGD = million gallons per day

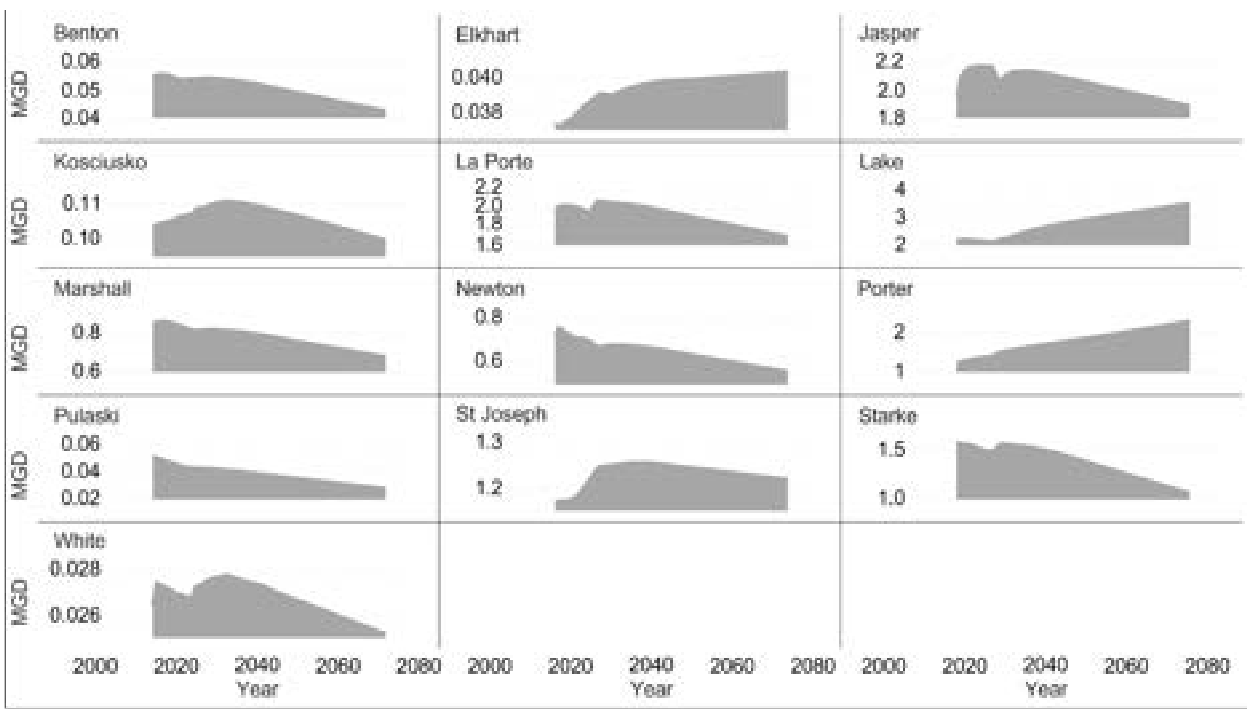
Figure C-37. Self-Supplied Residential Historical (1985-2023) and Projected Future (2024-2075) Annual Water Demand in Kankakee Basin, by Subbasin (MGD)

The historical self-supplied water use and the future projected demand by county are shown in Figure C-38. 2023 county water demand ranges from 0.03 MGD to 2.22 MGD. By 2075, annual county-level water demand is estimated to range from 0.03 MGD to 3.51 MGD.

Future projected demand was estimated in this study on a subbasin level. Projected water demand from self-supplied users in the Study Area was mapped to county-level estimates for the plots below. What follows in this section is a detailed description of how the future projection was estimated on a subbasin level.



Note: the vertical axis scale is fixed for each region.



Note: the vertical axis scale is different for each region.
Key: MGD = million gallons per day

Figure C-38. Historical and Future Projected Annual Water Demand of Self-Supplied Residential Users by County, Fixed (top) and Variable (bottom) Scale, 1985-2075 (MGD)

C.3.5.2 Data Sources

The self-supplied forecast relied on three primary categories of data: water use, population, and residential addresses.

- **Water Use Data**
  - Historical public supply withdrawals were obtained from the Indiana SWWF database (IDNR 2025).
  - Water use data from the U.S. Geological Survey (USGS).
- **Population Data**
  - National Address Database (NAD) from the U.S. Department of Transportation (US DOT).
  - Historical annual population estimates from the ACS DP03 tables at the census tract level from 2009-2023 (U.S. Census Bureau 2023).
  - STATS Indiana (2024) projections were used for county-level forecasts through 2050 for Indiana.

C.3.5.3 Pre-Processing

To estimate water demand from the self-supplied population within the Study Area, the self-supplied population in the region was established for 2023. Once the 2023 self-supplied population was identified, other data were incorporated to create a historical water use dataset dating back to 2007. The SWWF and NAD databases were pre-processed to estimate annual water use from self-supplied residential users from 2007-2023. The data pre-processing steps are described in further detail below.

The NAD provides point location information for a variety of address types across the country (US DOT 2025). It includes address points for residential houses, commercial businesses, industrial sites, and multi-family housing units. To eliminate any addresses located within a water utility service area boundary, the point location data from the NAD was mapped onto known water utility service areas, as shown in Figure C-39. Addresses located outside of a service boundary were classified as unserved or "self-supplied" and included in the subsequent analysis of self-supplied water demand.

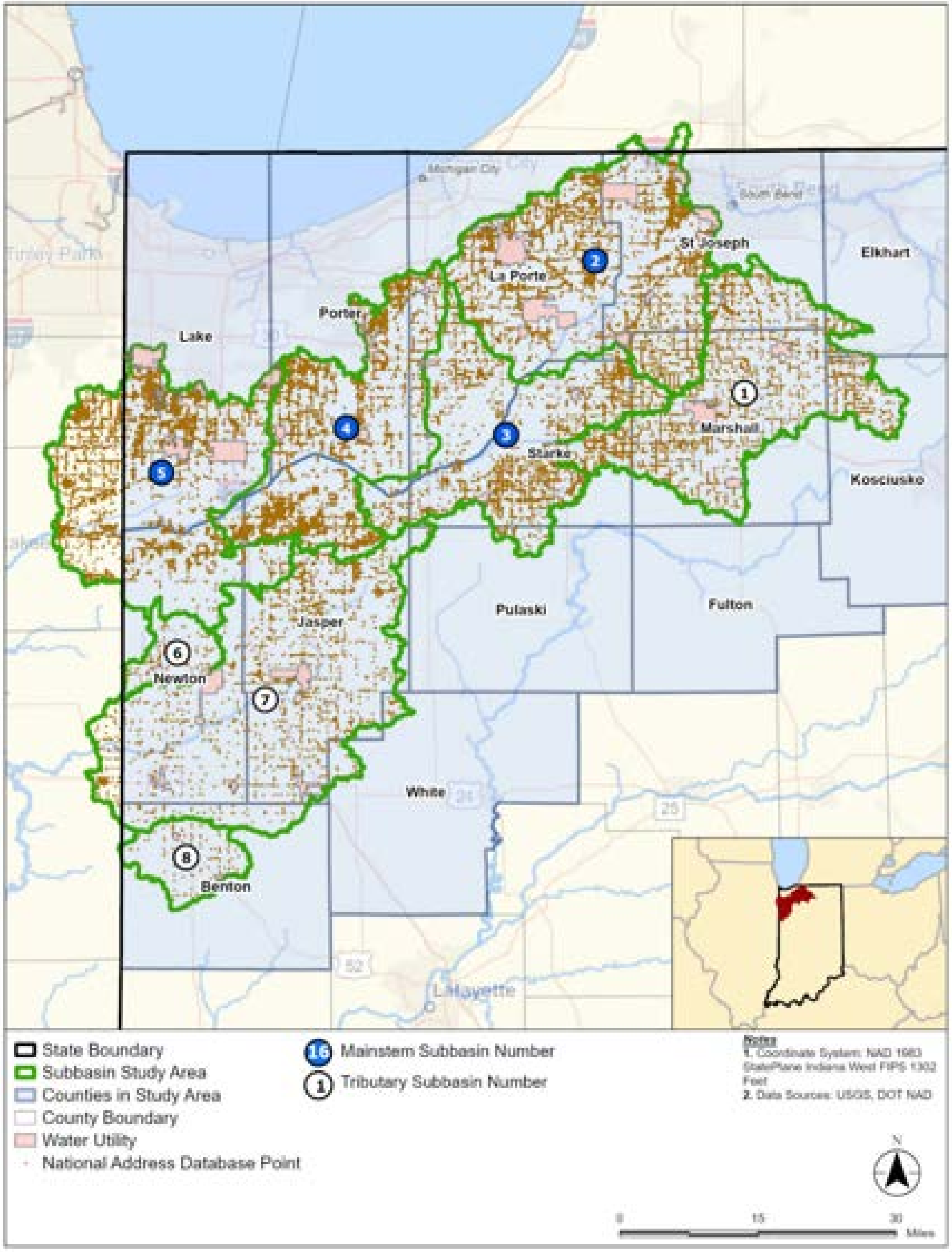


Figure C-39. Overlay of the National Address Database Data Points and Public Supply Service Boundaries

Through geospatial analysis, each self-supplied address was mapped to a specific census tract. The U.S. Census Bureau provides data on the average number of people per household at the census tract level (U.S. Census Bureau 2023). To estimate the self-supplied population from the count of households, each household was multiplied by the 2023 five-year average household size, based on the census tract in which each address is located. Figure C-40 presents the estimated 2023 self-supplied residential population by subbasin for both the Indiana and Illinois subbasins within the Study Area.

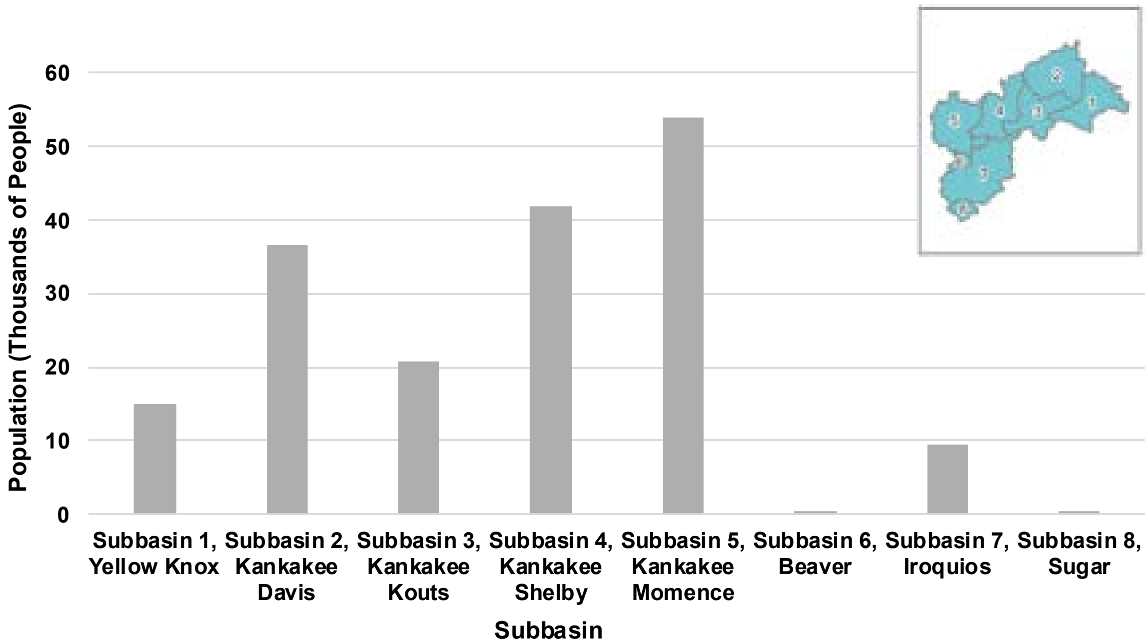
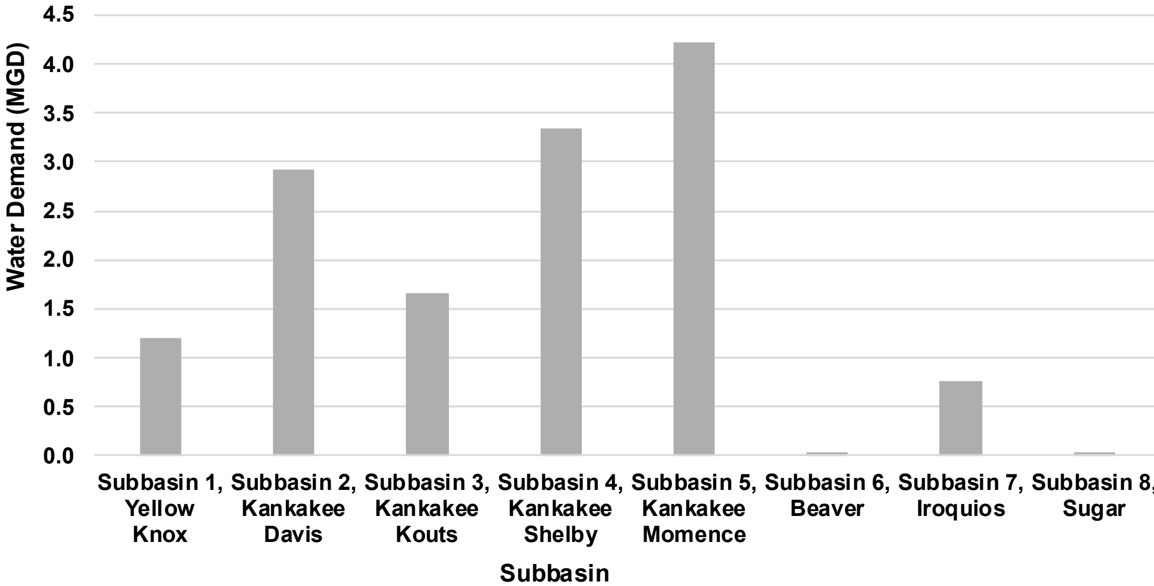


Figure C-40. 2023 Self-Supplied Population by Subbasin (thousands of people)

To estimate self-supplied residential water usage for 2023, the self-supplied population in each subbasin was multiplied by the average amount of daily per-capita water use defined by 2015 USGS data specific to Indiana and Illinois, estimated to be around 76 gallons per day per capita (GPCD) in Indiana and 80 GPCD in Illinois (Dieter et al. 2018). For subbasins that span both Indiana and Illinois, the self-supplied population within each state was proportionally multiplied by its respective per capita water use rate. Using point location data from the NAD to establish the basis for the 2023 self-supplied population, it was feasible to identify the Indiana and Illinois proportions of self-supplied users within a subbasin. Figure C-41 presents the estimated self-supplied water demand by subbasin for 2023.



Key:
MGD = million gallons per day

Figure C-41. 2023 Self-Supplied Residential Water Demand by Subbasin (MGD)

Historical public water supply withdrawal data, as reported in the SWWF database, was reviewed to estimate a monthly demand proportion pattern for residential self-supplied water users, by subbasin. Once the monthly demand pattern was determined, it was applied to the historical and projected annual water demand estimates. Table C-26 shows the percentage of the estimated annual water demand used in each month.

Table C-26. Self-Supplied Monthly Water Use Factors as a Percent of Annual Demand

Subbasin ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	8%	7%	8%	8%	9%	10%	9%	10%	9%	8%	8%	7%
2	6%	5%	6%	6%	9%	12%	10%	12%	7%	9%	9%	10%
3	7%	7%	8%	8%	10%	10%	9%	9%	9%	8%	8%	8%
4	8%	7%	8%	8%	10%	10%	9%	9%	8%	8%	8%	7%
5	6%	5%	6%	6%	10%	11%	9%	11%	11%	9%	8%	8%
6	8%	7%	9%	10%	12%	11%	9%	8%	7%	7%	6%	6%
7	8%	7%	8%	8%	9%	10%	10%	9%	8%	8%	8%	8%
8	8%	7%	8%	9%	9%	9%	8%	8%	8%	8%	7%	10%

Note: The monthly water use factors were developed with the historical public supply withdrawals reported to SWWF (IDNR, 2025). Withdrawals were aggregated by both for each subbasin and compared to the total demand in that time period.

C.3.5.4 Analysis

Historical self-supplied annual water demand was estimated based on population within the Study Area. Population trends within the subbasins were calculated and then used to estimate the self-supplied population in past years by assuming that the self-supplied population followed the same rate of change as the overall population.

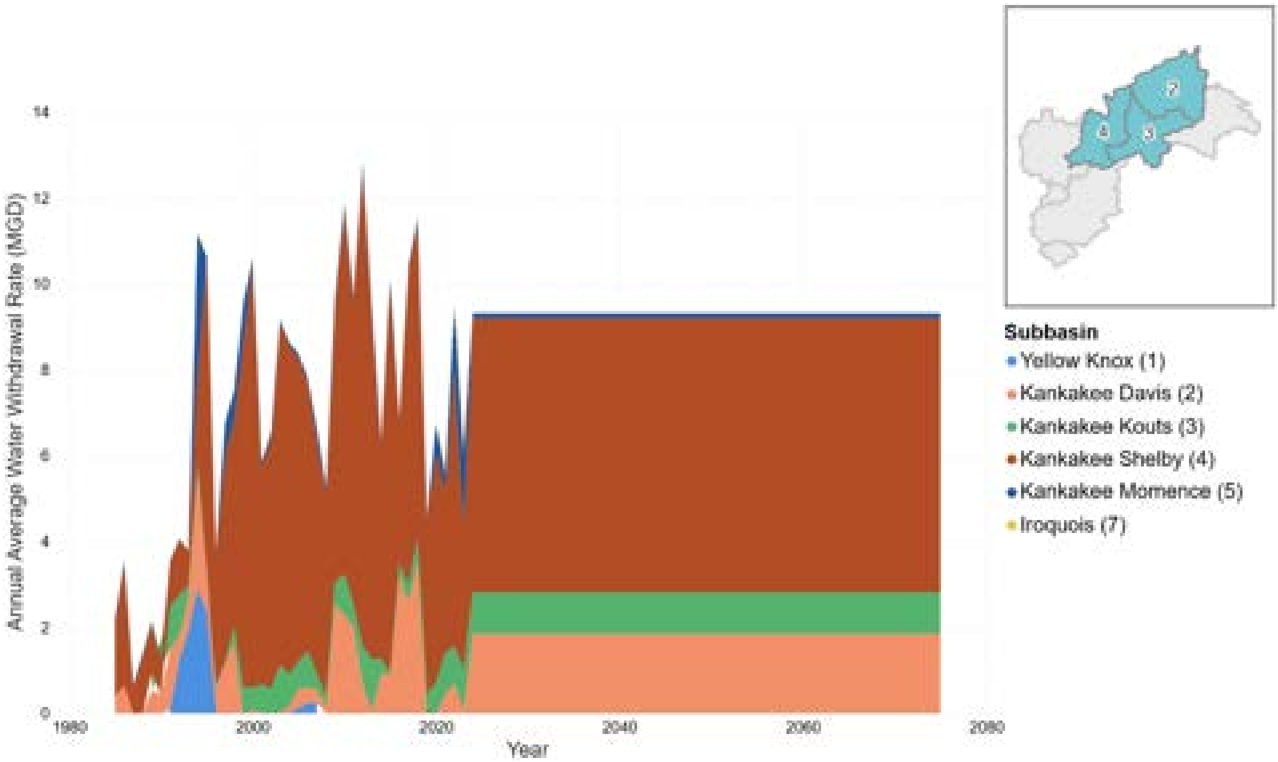
To estimate annual historical water use, the number of self-supplied users was multiplied by a per-capita daily water use rate to calculate total daily demand, which was then annualized by multiplying by 365 days. The per-capita daily rate that was used is an average amount of daily per-capita water use, estimated to be around 76 GPCD in Indiana, and 80 GPCD in Illinois (Dieter et al. 2018). Once the annual water demand was calculated, it was disaggregated into monthly demand using the monthly water use factors described in Table C-26 above.

Estimating historical self-supplied water demand was necessary because self-supplied use data is not reported in the IDNR SWWF database. Once historical estimates were established, self-supplied residential future water demand from 2024–2075 was estimated by linking the rate of population change to the study region’s 2023 self-supplied population estimate, and then to forecasted population over time. Population projections for self-supplied users are based on the population forecast developed for populations supplied by public water utilities (Section on Public Supply Withdrawals). It is assumed that forecasted population changes in the Study Areas will be the same across self-supplied and publicly supplied users. The self-supplied residential annual population change rate through 2075 informed the analysis of the self-supplied population within the study region.

In interviews with local experts and after reviewing publications from counties within the study region, information was gained concerning regions of the state that are experiencing economic and population growth. For some of these areas, residential population levels are anticipated to increase, as described in the section on Common Predictive Variables (Section C.2.1). For those subbasins, such as the Kankakee Momence (Subbasin5) encompassing Lake and Newton Counties, it is expected that the water demand from the self-supplied population will increase. However, there are other regions in the study area where population is expected to decline. In those cases, such as the Kankakee Davis (Subbasin 2), which covers portions of La Porte, St. Joseph, and Marshall Counties, the water demand from the self-supplied population is expected to experience a slight decline. Other regions in this analysis, such as Beaver (Subbasin 6) and Sugar (Subbasin 8), in Newton and Benton Counties, respectively, should anticipate little-to-no change in water demand of self-supplied residential users. It is expected that the self-supplied population in these rural regions will remain relatively constant. Overall, total annual water use from self-supplied users across the Study Area is expected to increase over the forecast period.

C.3.6 MISCELLANEOUS WITHDRAWALS

The facilities that are named in the SWWF database under the miscellaneous withdrawal water use sector include Westville Correctional Facility, Indiana Department of Natural Resources, Lake County Parks and Recreation, fire departments, country clubs, and temporary water withdrawals such as for construction dewatering. MI water demand made up less than 5% of all historical water withdrawals. This study reclassified Westville Correctional Facility, which was originally categorized under EP, into the MI sector, as its primary purpose is not electricity generation. MI withdrawals across the Kankakee Basin are assumed to remain constant over the forecast period at 9 MGD. This is based on the average withdrawals from 2014-2023. Figure C-42 shows the trends by subbasin.



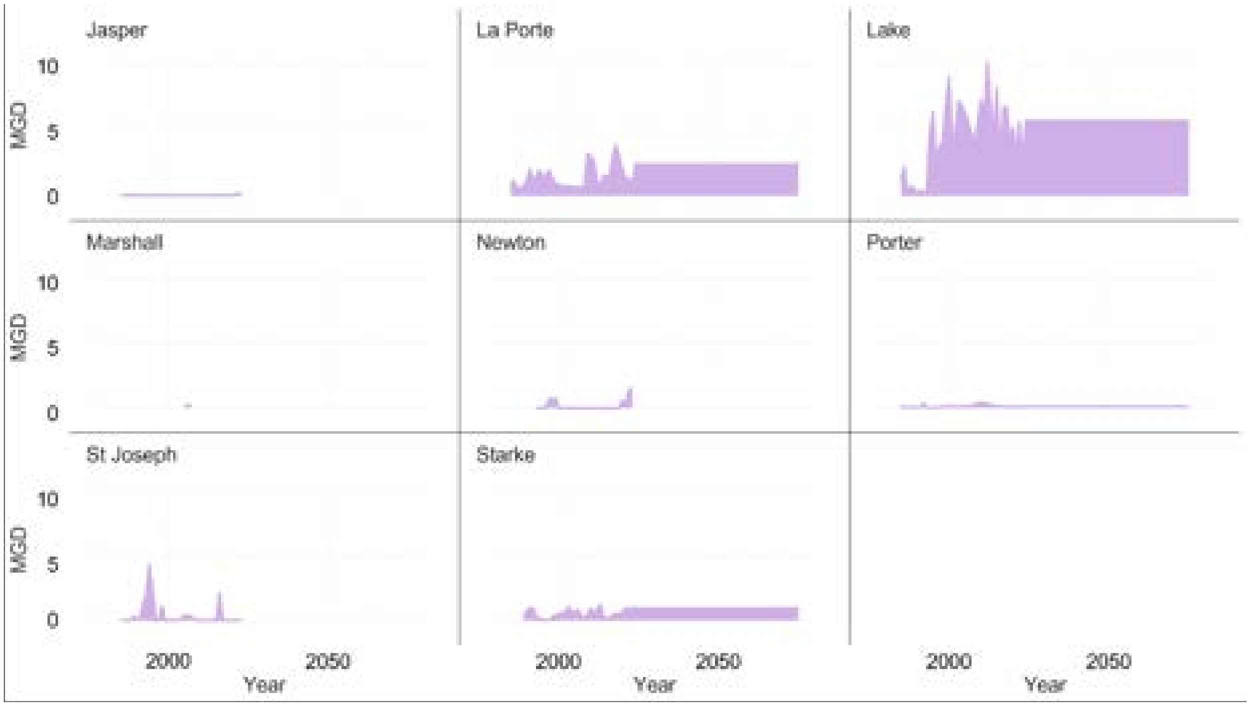
Key:
MGD = million gallons per day

Figure C-42. Miscellaneous Historical (1985-2023) and Projected Future (2024-2075) Annual Water Demand in Kankakee Basin, by Subbasin (MGD)

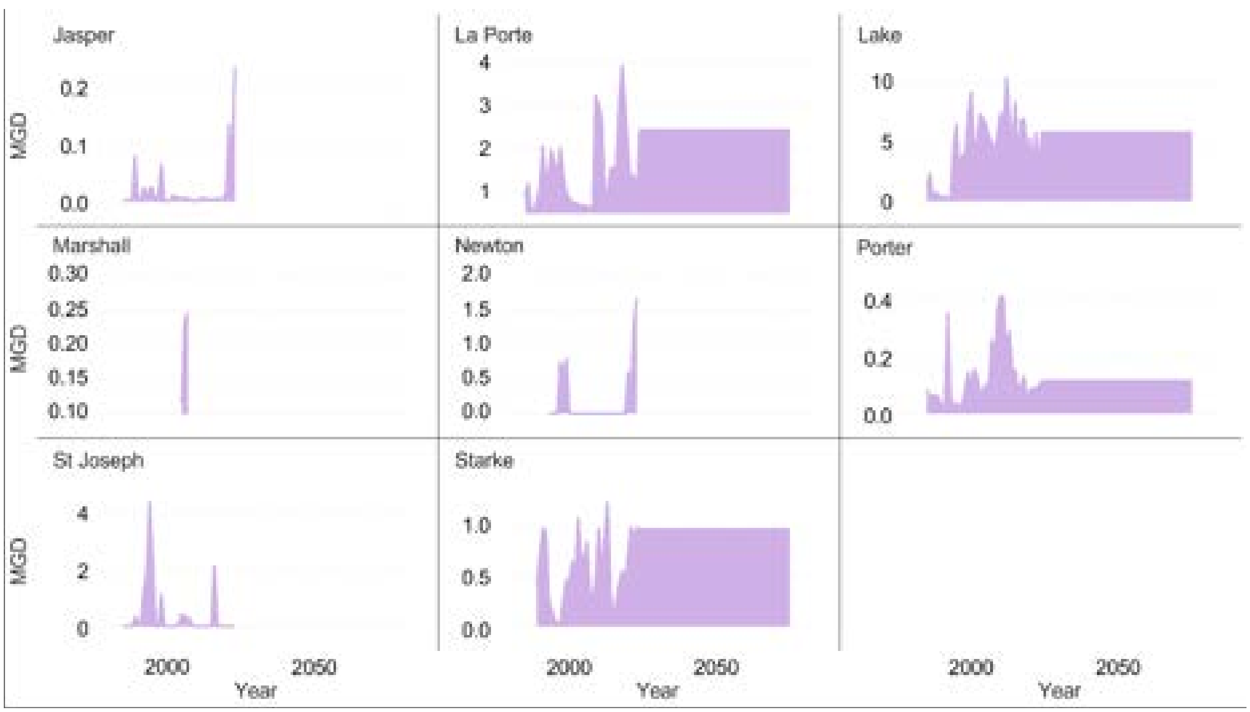
The highest MI water demand is from Lake County Parks and Recreation for water for waterfowl habitat in the Grand Kankakee Marsh, which is responsible for 70% of total MI water withdrawals since 2000. The total annual historical withdrawals peaked at just over 12.8 MGD in 2012 and fell to 6.4 MGD by 2014. During the last year of the historical record (2023), water withdrawals were 6.3 MGD. The future projection assumes that withdrawals will remain fixed at this level (Figure C-43).

The historical MI withdrawal data displayed very noisy fluctuations, with no discernable pattern. The methods used to estimate limited and noisy data made several assumptions. Facility-level withdrawals were aggregated to monthly subregion totals with the period from 2014-2023, serving as the baseline for defining long-run averages. Each subregion was evaluated for data sufficiency, requiring a minimum number of reported months before being included in the forecast. A month was considered “qualified” only if reported withdrawals exceeded 0.001 MGD, and a subregion was included only if it had at least three qualified observations in every calendar month, or at least 40 qualified months across the last 10 years. In addition, targeted outlier filters were applied to exclude values outside the expected range for specific county–subbasin pairs (for example La Porte-Kankakee Davis (Subbasin 2)). Monthly use rates greater than 6 MGD were excluded from observation records. These checks ensured that forecasts were based only on consistent records while preventing sparse or anomalous data from distorting the results.

For subregions meeting these criteria, mean monthly withdrawals over 2014-2023 were used to calculate seasonal shares. The sum of these monthly means defined the mean annual total, and each month’s share was applied to future periods. Forecasts from 2024-2075 were generated as the product of the projected annual total and monthly shares, preserving the observed seasonal pattern of MI use. A few facilities did not report withdrawals some years and months, for example, the Westville Correctional Facility and the City of La Porte did not report withdrawals in 2019 or 2020. Months with insufficient or absent history were conservatively assigned zero share, ensuring that projections did not introduce demand unsupported by data. This produced stable long-run estimates that maintained the variability characteristics of the MI sector.



Note: the vertical axis scale is fixed for each region.



Note: the vertical axis scale is different for each region.
Key: MGD = million gallons per day

Figure C-43. Historical and Future Projected Annual Miscellaneous Water Demand by County, Fixed (top) and Variable Scale (bottom), 1985-2075 (MGD)

C.3.7 CONCENTRATED ANIMAL FEEDING OPERATIONS (CAFO) WITHDRAWALS

C.3.7.1 Overview

Indiana is home to a robust agricultural sector with many CFOs and CAFOs that contribute substantially to the state's economy (Figure C-44). These large-scale livestock facilities house hundreds to thousands of cattle, hogs, and poultry within confined spaces that are designed to streamline livestock feeding and waste management and improve overall production efficiency. CAFOs are not a specific source type within IDNR SWWF database. An alternative approach was used to estimate historical CAFO demand and future water demand.

The feeding operations are subject to state and federal regulations, including permitting requirements for operation management. As discussed in the analysis below, current trends in the agricultural industry indicate an expansion of CFO and CAFO activity will occur during the forecast period in Indiana and the entire study region (including portions of the Study Area in Illinois).

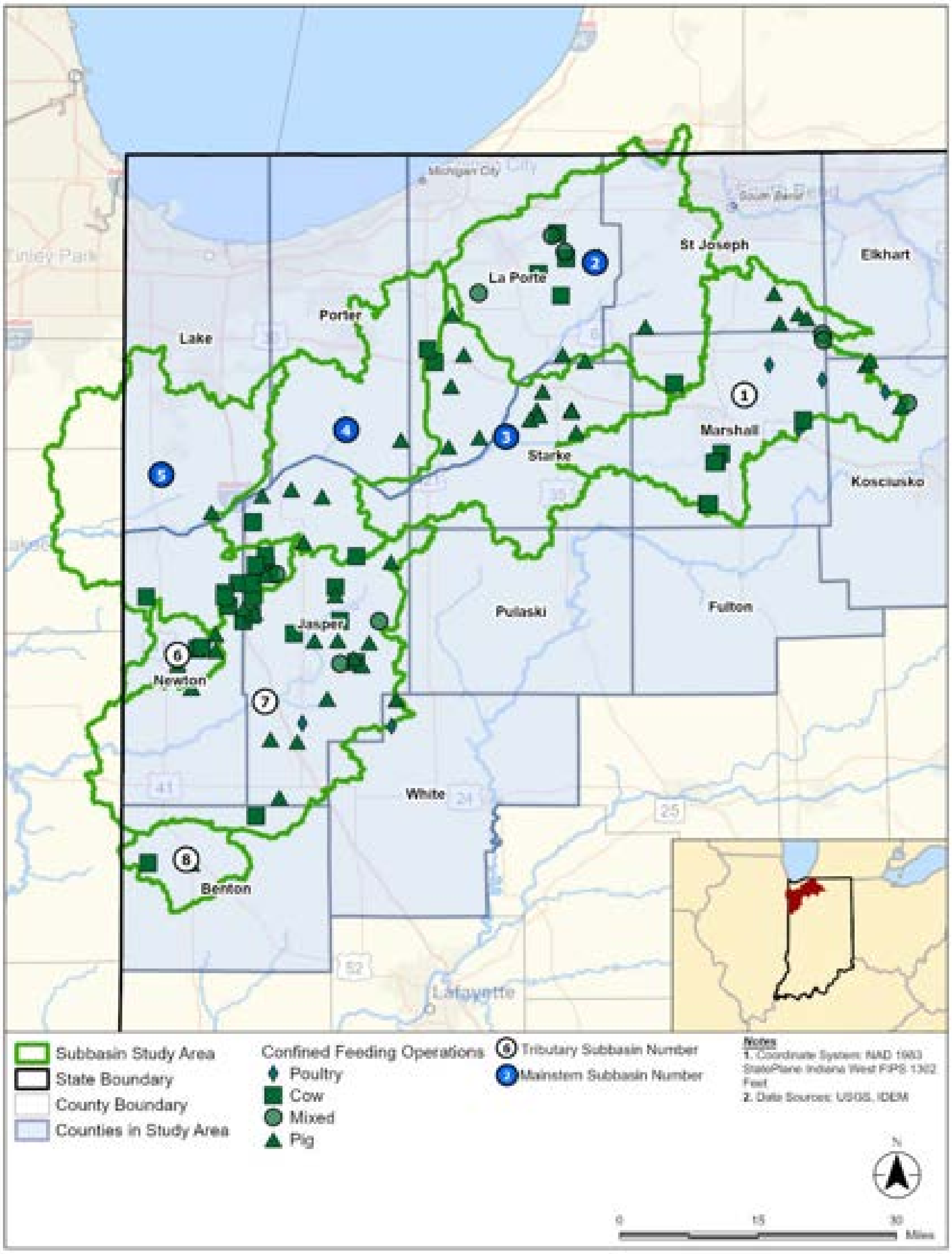
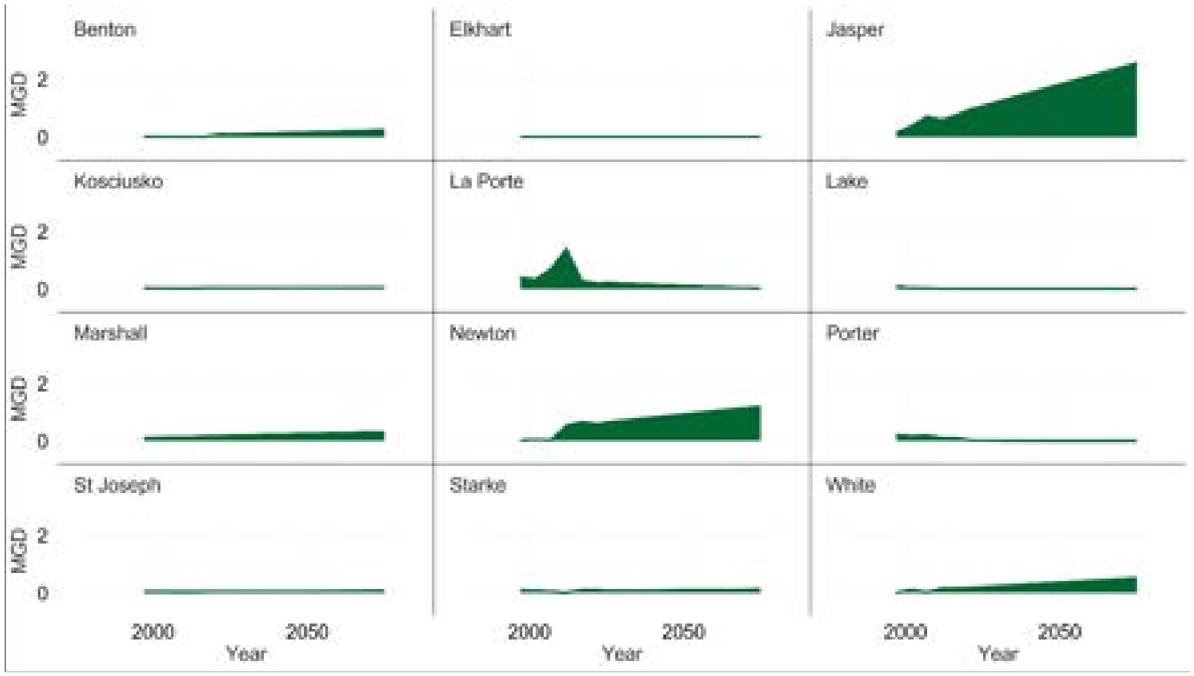
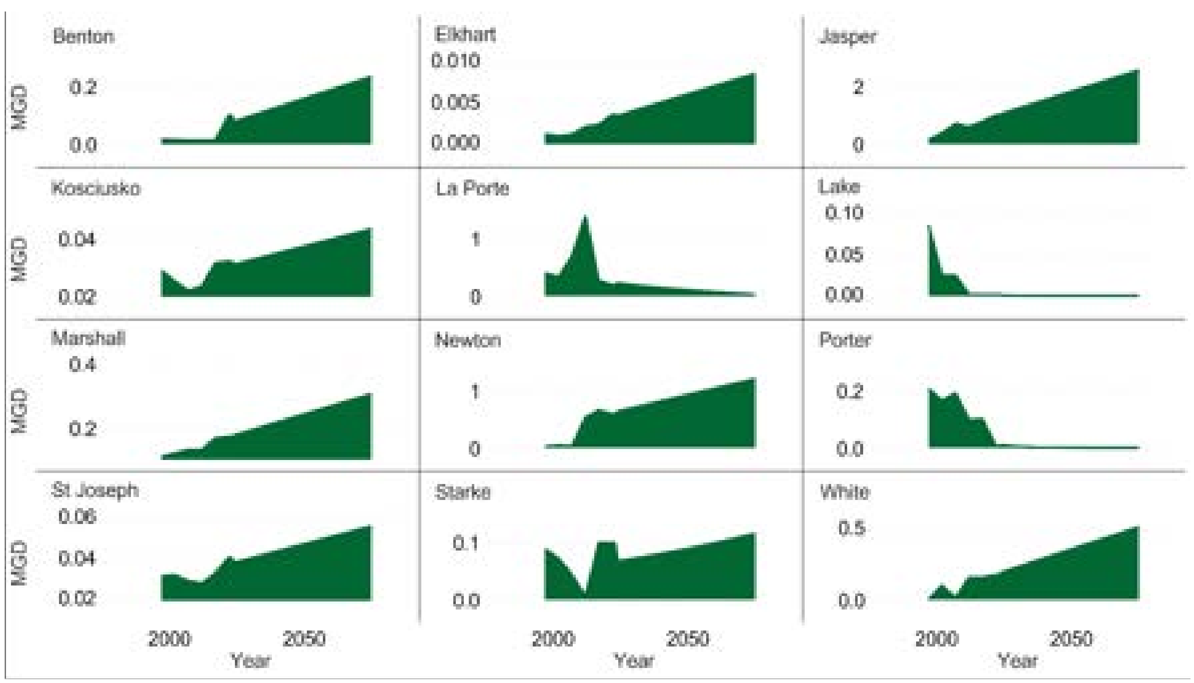


Figure C-44. Locations of Concentrated Animal Feeding Operations and Concentrated Feeding Operations Study Region, By Animal Type

Future CAFO and CFO demand was projected on a subbasin level. Conversion to county-level estimates was done to provide visibility to county-level water resource managers, growers, and agricultural managers regarding the projections for their areas (Figure C-45). The majority of the future projected demand comes from Jasper County. However, all three counties are projected to experience an increase in annual water demand over the period of study. The magnitude of 2075 annual demand ranges from approximately 0.05 MGD to 3.39 MGD. What follows in this section is a detailed description of how the future projection was estimated on a subbasin level.



Note: the vertical axis scale is fixed for each region.



Note: the vertical axis scale is different for each region.
Key:
CAFO = concentrated animal feeding operation
CFO = confined feeding operation
MGD = million gallons per day

Figure C-45. Annual Historical and Future Projected CAFO and CFO Water Demand by County, Fixed (top) and Variable Scale (bottom), 1985-2075 (MGD)

C.3.7.2 Data Sources

Data used for estimating water demand from CFOs and CAFOs was sourced from various organizations, including the SWWF database, the Indiana Department of Environmental Management (IDEM OQL), and the Environmental Protection Agency (EPA).

The data sources used for the modeling are:

- **Water Use Data**
  - CAFOs and CFOs Overview (IDEM OLQ 2024b)
  - Pending and Issued CFO Permits (IDEM OLQ 2024a)
  - Annual count of animal by type 1997-2022, United States Department of Agriculture Census of Agriculture (USDA NASS Quick Stats database)
  - Daily water use by animal type (sources vary)
  - Indiana SWWF database (IDNR 2025)
- **Explanatory Variables**
  - Annual time trend (1997-2022)

C.3.7.3 Pre-Processing

Understanding the number and scale of feeding operations within the study region is essential for accurately estimating water demand in this sector. Projecting water demand from CFOs and CAFOs depends heavily on reliable current and historical demand estimates. This required establishing a baseline animal count for 2023, incorporating historical changes in animal populations, and utilizing per-animal daily water demand factors by animal type to estimate water demand.

Under the Clean Water Act of 1972, any water user that discharges pollutants from a point source into a water body must have a National Pollutant Discharge Elimination System (NPDES) permit (EPA 2024). Animal Feeding Operations that meet the regulatory definition of a CAFO are regulated under the NPDES permitting program (EPA 2024); in the state of Indiana, if the confined feeding operation does not need a NPDES CAFO Permit it may obtain a CFO permit (IDEM OQL 2024b). However, “non-discharging” CAFOs[1] do not need to report wastewater volumes through the NPDES. Most facilities stopped reporting after a 2008 federal appeals court ruling, and Indiana implemented their rule changes in response in 2012 IC 13-18-10 and 327 IAC 19). Therefore, no comprehensive historical water demand data are available

[1] A “non-discharging” CAFO is a feeding operation whose permit prevents the farm from discharging certain levels of animal waste. Since the waste from these feeding operations is heavily regulated, if a farm has a “non-discharging” permit, it does not need to report water use to the NPDES (Conservation Law Center 2024)

for CFOs and CAFOs in the study region.[2] Instead, historical water use was estimated based on calculating a baseline water demand, and back calculating historical demand based on changes in animal counts in the Study Area. The baseline water demand was based on the current number of CFOs and CAFOs, and the current number and type of animals produced in the Kankakee Basin.

The IDEM, Office of Land Quality (OLQ) publishes the locations of all regulated CFOs in Indiana, including facility attributes such as the permitted number and types of animals at each location, in a publicly available geodatabase (IDEM OLQ 2024). In addition to the IDEM OLQ database, pending and issued permit lists for CFOs and CAFOs were downloaded from the Indiana Department of Environmental Management (IDEM OQL 2024a). The IDEM OLQ geodatabase was compared to the active list of pending and issued permits for CFOs and CAFOs to establish a baseline count of CFOs and CAFOs in the Kankakee Basin. The pending and issued CFO and CAFO permit lists were compared to the geodatabase of facilities because it contained the most up-to-date information on facility expansions, closures, and openings. As of 2023, there are over 100 feeding operations located in the Kankakee Basin.

The initial step in estimating historical water demand involves analyzing the current water demand from active feeding operations within the Study Area. Data for Indiana's CFOs and CAFOs from 2023 provide detailed counts of the number and types of animals per farm. These data were pre-processed to estimate the annual water use from active feeding operations in 2023. The steps are summarized below.

The combined CFO and CAFO database from IDEM OQL data identified 106 farms across all eight of the subbasins in the Study Area, including detailed counts of animals by type. Using GIS analysis, these farms were organized by subbasin, allowing for an assessment of animal numbers and types within each subbasin.

Water use estimates by animal type were then multiplied by the corresponding animal counts per subbasin to calculate the total annual water demand for each subbasin in 2023. See Table C-27 for assumptions about water use by animal type and sources. This study assumes that the per animal water use estimates represent all historical use rates and will not change in the future. Table C-28 displays the estimated count of livestock by subbasin in the Study Area for CFOs and CAFOs. Of note in Table C-28 is the chicken population in the Iroquois Subbasin. Rose Acre Farms is one of the country's largest egg producers and operates multiple facilities in the Iroquois Subbasin with millions of chickens at various facilities. These facilities account for a large share of the Iroquois Subbasin's chicken population.

Table C-27. Concentrated Animal Feeding Operation Estimated Water Use per Day per Animal

Animal	Water Use	Units	Source
Hogs	1.50	Gallons per day per animal	University of California Agriculture and Natural Resources 2011
Cattle	15.00	Gallons per day per animal	Meehan, Stokka, & Mostrom 2021
Poultry	0.07	Gallons per day per 1,000 birds	Watkins and Tabler 2009

[2] Additionally, NPDES data reflect how much wastewater is *discharged* by each facility, which contrasts with the objective of this portion of the demand analysis where water demand estimates reflect water *withdrawals*.

Table C-28. 2023 Animal Count by Species by Subbasin (Millions) – Indiana

Subbasin Number and Name	Species			
	Hogs	Cattle	Chickens	Total
Subbasin 1, Yellow Knox	26,934	11,401	290,000	328,335
Subbasin 2, Kankakee Davis	17,450	7,827	0	25,277
Subbasin 3, Kankakee Kouts	81,005	2,000	0	83,005
Subbasin 4, Kankakee Shelby	16,501	4,670	0	21,171
Subbasin 5, Kankakee Momence	12,426	29,852	0	42,278
Subbasin 6, Beaver	10,282	2,400	0	12,682
Subbasin 7, Iroquois	106,083	48,411	4,834,340	4,988,834
Subbasin 8, Sugar	2,640	6,500	0	9,140
Total	273,321	113,061	5,124,340	5,510,722

Source: IDEM OQL 2024a

Combining the estimated water use by animal type shown in Table C-27 with the estimated number of animals by Indiana subbasin in Table C-28 yields an estimate of the total water use associated with CFOs and CAFOs within each subbasin. The total estimated water use in the Study Area in 2023 is also shown in Table C-29.

Table C-29. 2023 CAFO Water Demand by Subbasin, MGD

Subbasin	Water Demand (MGD)
Subbasin 1, Yellow Knox	0.23
Subbasin 2, Kankakee Davis	0.14
Subbasin 3, Kankakee Kouts	0.15
Subbasin 4, Kankakee Shelby	0.09
Subbasin 5, Kankakee Momence	0.47
Subbasin 6, Beaver	0.05
Subbasin 7, Iroquois	1.21
Subbasin 8, Sugar	0.10
Total	**2.45**

Key:
CAFO = concentrated animal feeding operation
MGD = million gallons per day

After establishing a baseline water use estimate, historical water demand in the Study Area was estimated using historical animal count data. The United States Department of Agriculture publishes the Census of Agriculture every five years, which reports animal counts by type and county. This data provides insight into historical trends in animal populations in the study area beginning in 1997. This data was used to calculate individual rates of change in animal populations for use in the historical water demand estimates. For example, a rate of change was calculated for cattle in Jasper County from 1997-2002, 2002-2007, and subsequent periods through 2022. Growth between the five-year increments was assumed to be linear.

The calculated annual rates of change were applied to the baseline animal counts developed from the IDEM OQL geodatabase. Using GIS analysis, facilities (and subsequent animal counts) were assigned to a subbasin but were also identified within county boundaries. This process ensured that baseline animal counts could be combined with the historical rate-of-change data by county, while maintaining subbasin delineations. Applying historical rates of change by animal type to the baseline estimates produced historical animal counts by type for the Kankakee Basin. These counts were then multiplied by daily water use rates by animal type, as detailed in Table C-29 above, to generate annual water use estimates for the study area from 1997 through 2022. The annual historical water use estimates from CAFOs and CFOs by subbasin is illustrated in Figure C-46 below. Between 2012-2017 historical data were inconsistent and showed an abrupt decline.

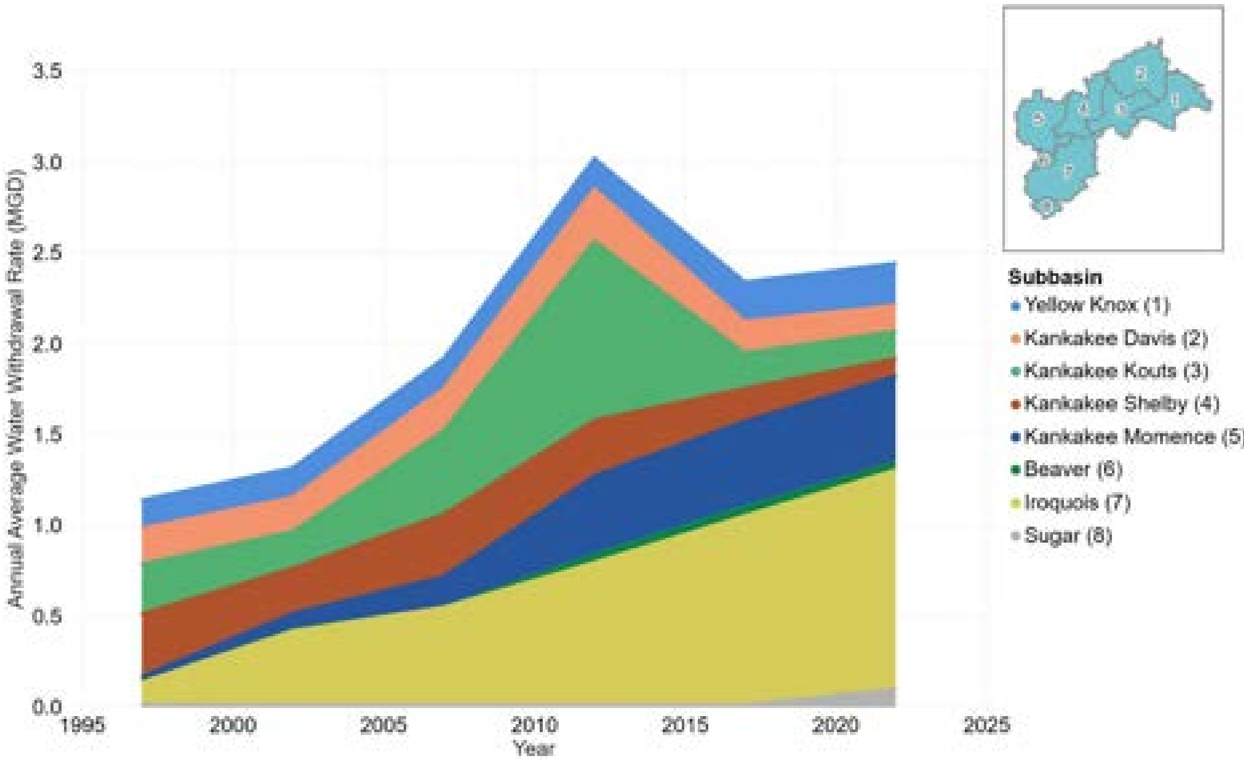


Figure C-46. Estimated Historical Concentrated Animal Feeding Operation Water Use by Subbasin 1997-2023

Although the SWWF database does not report water withdrawals for CFOs or CAFOs as an independent water use sector, several permitted CFO and CAFO facilities are classified as irrigation and rural users in the SWWF database. However, not all the facilities in IDEM OQL's CFO and CAFO permit database that were identified to be within the Study Area were also found in the SWWF database. Ultimately, monthly water use patterns were developed from the identified facilities in the SWWF database and used to estimate monthly water use patterns for all CFOs and CAFOs within the Study Area. Summer water demand may have been overestimated because the irrigation monthly demand pattern may not accurately reflect true CFO and CAFO monthly demand patterns. The CFO and CAFO facilities that did report in the SWWF database may be reporting water use for both animals and irrigation.

Table C-30 summarizes the average monthly water use demand pattern for the CAFOs reported in the SWWF database. The spike in water use for July and August is consistent with reports and studies about water use for CAFOs increasing in the summer months. This monthly demand pattern was assumed for all CAFOs in the Study Area from 1997- 2023 as well as the CAFO water demand projection from 2024-2075, as described in Section 4.3.

Table C-30. Concentrated Animal Feeding Operation Average Monthly Water Use Pattern

Month	Percent of Annual Use
January	6.9
February	6.6
March	7.3
April	7.2
May	7.8
June	8.9
July	12.4
August	12.4
September	9.0
October	7.2
November	7.1
December	7.1

Source: Indiana SWWF database (IDNR 2025)

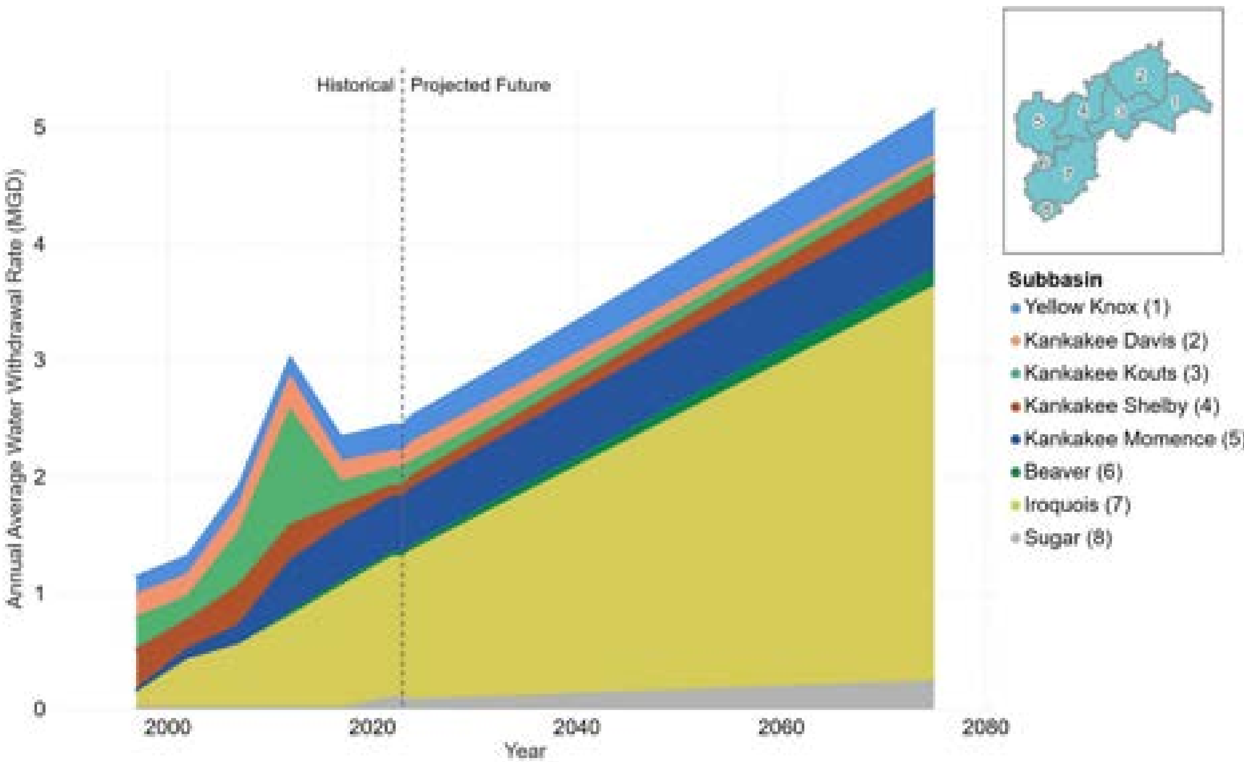
C.3.7.4 Analysis

Future CAFO water demand was projected using a time trend analysis. As described above, historical water use for CAFOs was estimated using a baseline count of animal types and numbers within the Study Area. Trends in animal counts were developed from Census of Agriculture data and applied to the baseline to reflect historical changes from 1997 to 2022. Establishing the type and number of animals in each region by year allowed calculation of annual water demand using per-animal daily water use estimates. The historical water use estimates informed the linear regression model used to project CFO and CAFO water use through 2075.

In the analysis of natural baseflow (part of the water-availability analysis), it is assumed that self-supplied CAFOs in the Study Area consume about 80% of the water that they pump, and that 20% is returned to the ground through infiltration. These numbers are supported by Shaffer and Runkle (2007), who indicate that the median consumption for livestock farms in Ohio is 76%. Because Indiana tends to have slightly more seasonal variability (more extreme peak usage during summer months) than Ohio according to data used in this study, a slightly higher consumptive value of 80% and a return value of 20% was assumed.

Data pre-processing and historical demand estimates formed the foundation for projecting annual water demand from CFOs and CAFOs within the study region. Given the available data and industry research on CFO and CAFO development, a linear regression was selected as the most suitable approach for projecting future water demand. Due to the limited historical data on animal counts the forecast was adjusted to avoid over-estimating growth by using a log transformed year variable for most subbasins. Only Kankakee Momence (Subbasin 5) in Newton County did not employ a log transformed year variable. This approach bases projected changes in annual CAFO and CFO water demand on existing demand data and observed relationships within the data. As illustrated in Figure C-47, total annual CAFO and CFO water use across the study region is projected to increase from 2024-2075 from approximately 2.53 MGD to 5.15 MGD. The implied annual growth rate is 2.0%.

The state of Indiana, as well as the Study Area, has been experiencing an increased consolidation of CFO and CAFO facilities, where the number of farms decreases while farm size and animal populations increase (MacDonald et al. 2020). This consolidation trend is illustrated in Figure C-47, with the concentration of a large proportion of total water demand in Iroquois (Subbasin 7) over the forecast period. Iroquois (Subbasin 7) includes large parts of Jasper and Newton Counties, along with smaller portions of White, Pulaski, and Benton Counties. Jasper and Newton Counties have robust agriculture industries: Jasper ranks fifth in the state for livestock, poultry, and related products, while Newton ranks just below, in sixth (USDA 2022a and 2022b). Both counties have notable concentrations of large CAFO facilities, including some of the state's largest permitted dairy cattle facilities. Only two operations house all of the chickens in those counties (Indiana Business Research Center 2008). Given the counties' existing infrastructure and regional development efforts aimed at supporting agriculture, continued consolidation of CFOs and CAFOs in these counties is expected (WVPA 2025).



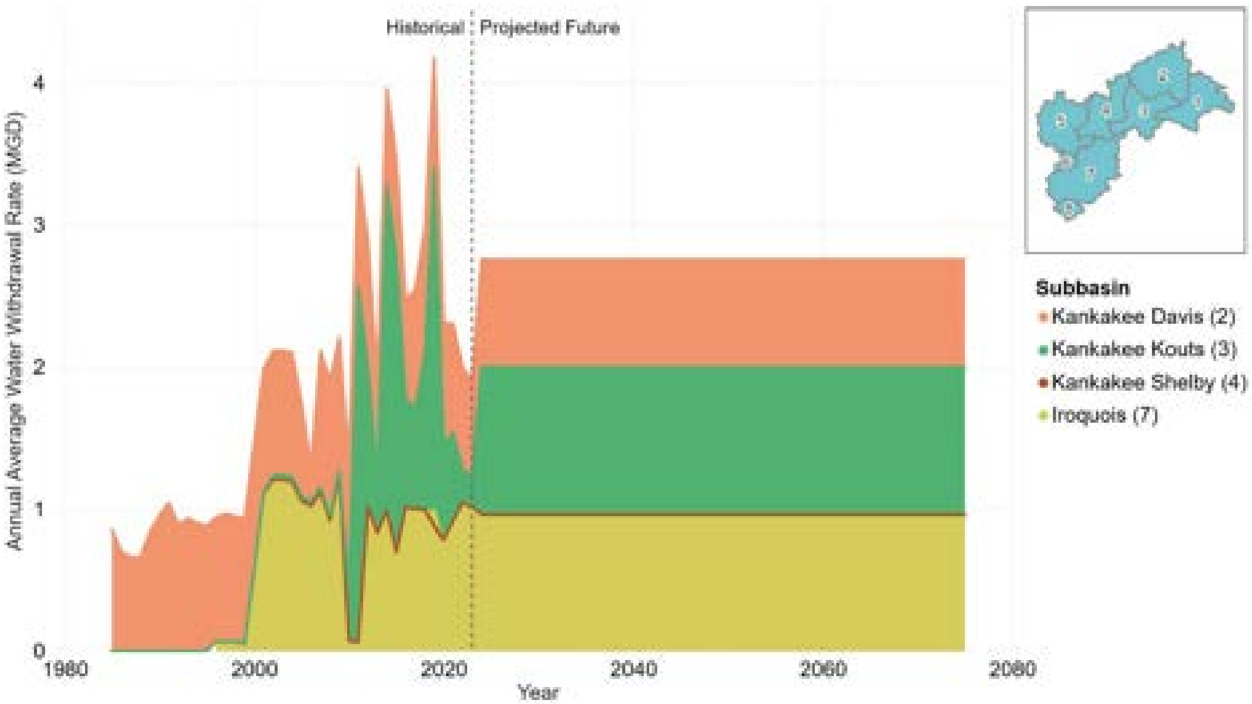
Key:
CAFO = concentrated animal feeding operation
CFO = confined feeding operation
MGD = million gallons per day

Figure C-47. Estimated Historical and Projected CFO and CAFO Water Demand, by Subbasin 1997-2075 (MGD)

C.3.8 RURAL WITHDRAWALS

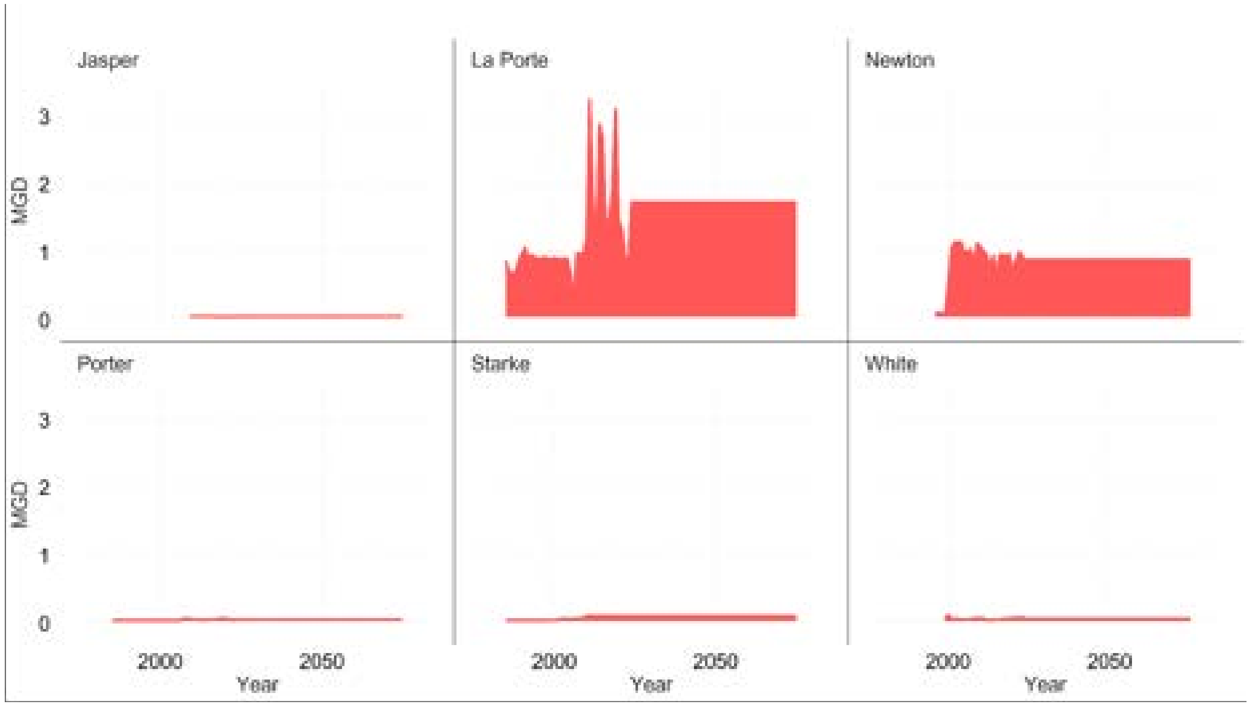
The facilities that are named in the SWWF database under the RU withdrawal water use sector include Indiana Department of Natural Resources and several agricultural users including livestock operations. All of the livestock operations that have active permits and were reported through the CAFO sector were excluded from this analysis in order to avoid double counting. The reported annual historical withdrawals peaked at just under 4.2 MGD in 2019 and fell to 1.9 MGD in 2023, the last year of the historical record.

The future projection assumes that withdrawals will remain at 2.76 MGD based on the average from 2000 to 2023 (Figure C-48 and C-49).

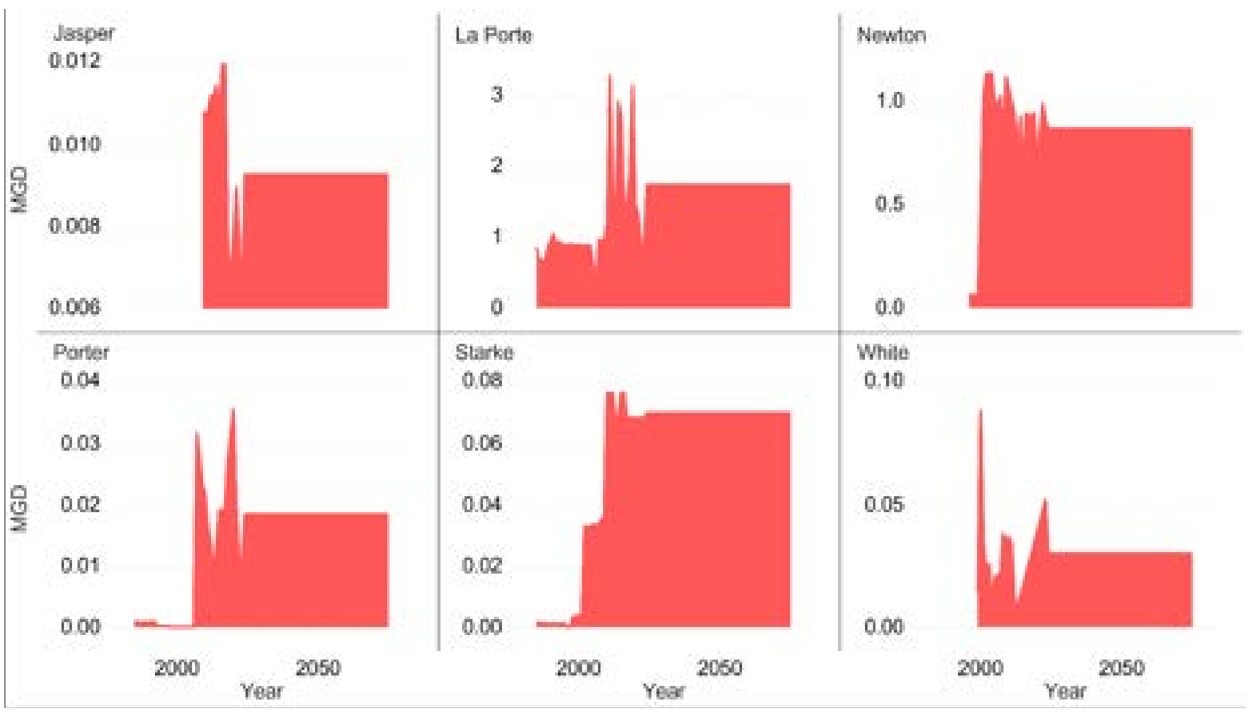


Key:
MGD = million gallons per day

Figure C-48. Rural Historical (1985-2023) and Projected Future (2024-2075) Annual Water Demand in Kankakee Basin, by Subbasin (MGD)



Note: the vertical axis scale is fixed for each region.



Note: the vertical axis scale is different for each region.
Key: MGD = million gallons per day

Figure C-49. Historical and Future Projected Average Annual Rural Water Demand by County, Fixed (top) and Variable Scale (bottom), 1985-2075 (MGD)

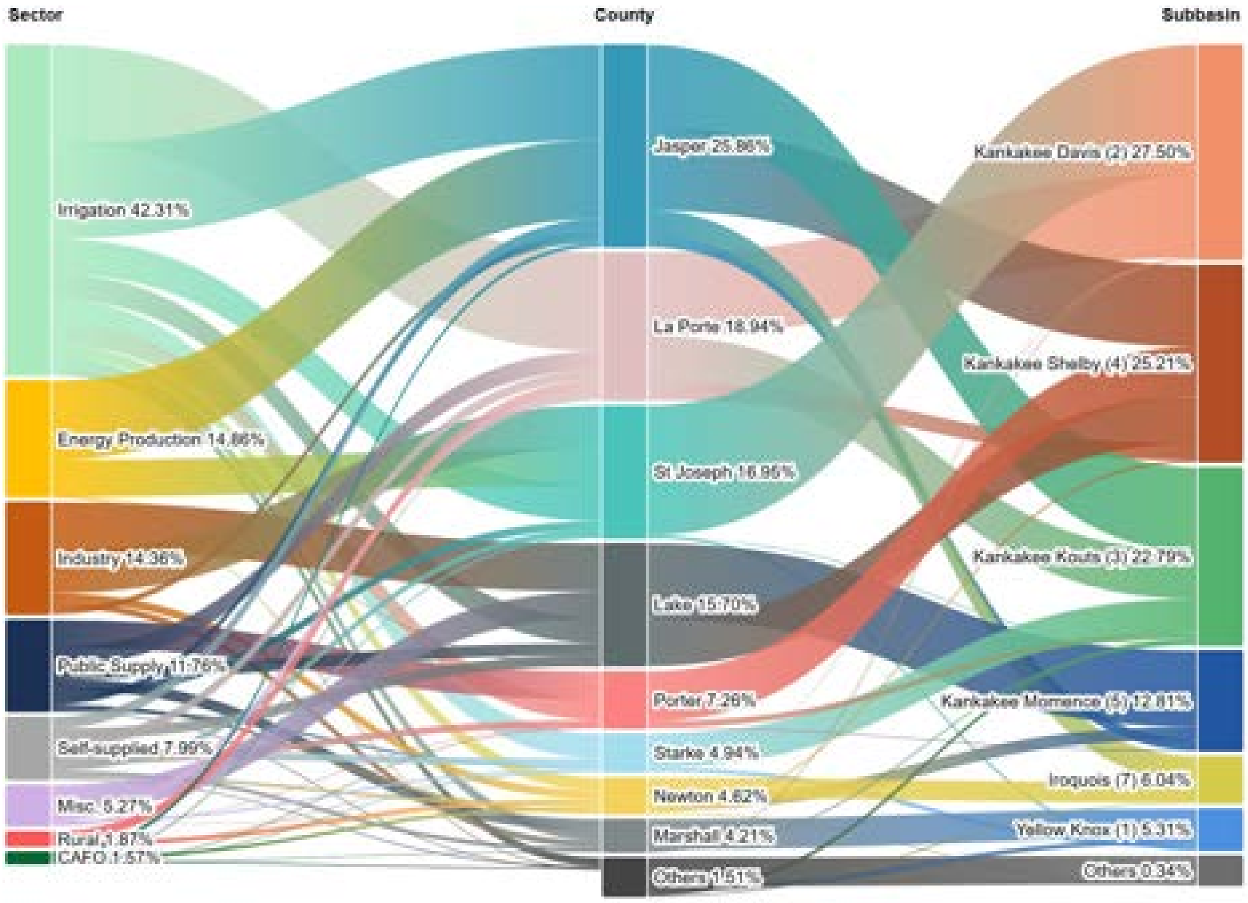
C.4 Summary of Current and Projected Future Water Demand by County, Subbasin, and Water Use Sector

Over the course of time, the water withdrawals in both the place of use and the water use sector have seen and are expected to see some change. This section provides a comparison of the percentage of total volumes of withdrawals by region and water-demand sectors for three different five-year periods of time: the current (2016-2020) period (Figure C-50 and Table C-31), the projections for 2041-2045 (Figure C-51 and Table C-32), and the projections for 2066-2070 (Figure C-52 and Table C-33).

During the period 2016-2020, IR was the largest single water use sector in the basin (Figure C-50 and Table C-31), accounting for 42% of the 5-year total withdrawals. Those IR withdrawals are concentrated in Jasper and La Porte Counties and Kankakee Davis (Subbasin 2), Kankakee Shelby (Subbasin 4), and Kankakee Kouts (Subbasin 3). The EP and IN sectors are the next largest water use sectors with 15% and 14% of withdrawals, respectively. EP is concentrated in Jasper and St. Joseph Counties, Kankakee Davis, and Kankakee Kouts, while IN is concentrated in St. Joseph and Lake Counties, Kankakee Davis, and Kankakee Momence (Subbasin 5).

In the period 2041-2045, IR remains the largest water use sector and is forecast to continue to withdraw 42% of total basin water (Figure C-51 and Table C-32). The counties with the largest percentage of total withdrawals shifted with St. Joseph representing the largest user at 27%, largely coming from Kankakee Davis (Subbasin 2) which is projected to have at 36% of withdrawals. That shift is driven by growth in the IN sector, which becomes the second largest water use sector in the region at 19%. The local water utility in the Town of New Carlisle (St. Joseph County) expanded their capacity to drive economic development with current plans for a data center and battery plant. The expanded capacity will not be fully utilized by those facilities in 2041-2045, and the region is encouraging other industries to build there as well.

In the period 2066-2070, the distribution of forecasted water withdrawals remains consistent between sector and location. IR remains the largest water use sector at 39% of forecast withdrawals, followed by IN at 19% (Figure C-52 and Table C-33). EP is also expected to grow to 17% of forecast withdrawals. IR water use is expected to continue increasing, but IN and EP will increase at a faster rate between 2045-2066. IN water use increase is based on the same local water utility capacity expansion described above, with the expectation that the expansion will be fully utilized by 2050. The county water use rates remain relatively consistent with St. Joseph, Jasper, and La Porte representing 28%, 22%, and 16% of total forecast water withdrawals, respectively. Similarly, the same subbasins represent a majority of the water withdrawals with Kankakee Davis (Subbasin 2), Kankakee Shelby (Subbasin 4), and Kankakee Kouts (Subbasin 3) forecasted to use 37%, 21%, and 19% of total forecast water withdrawals, respectively.

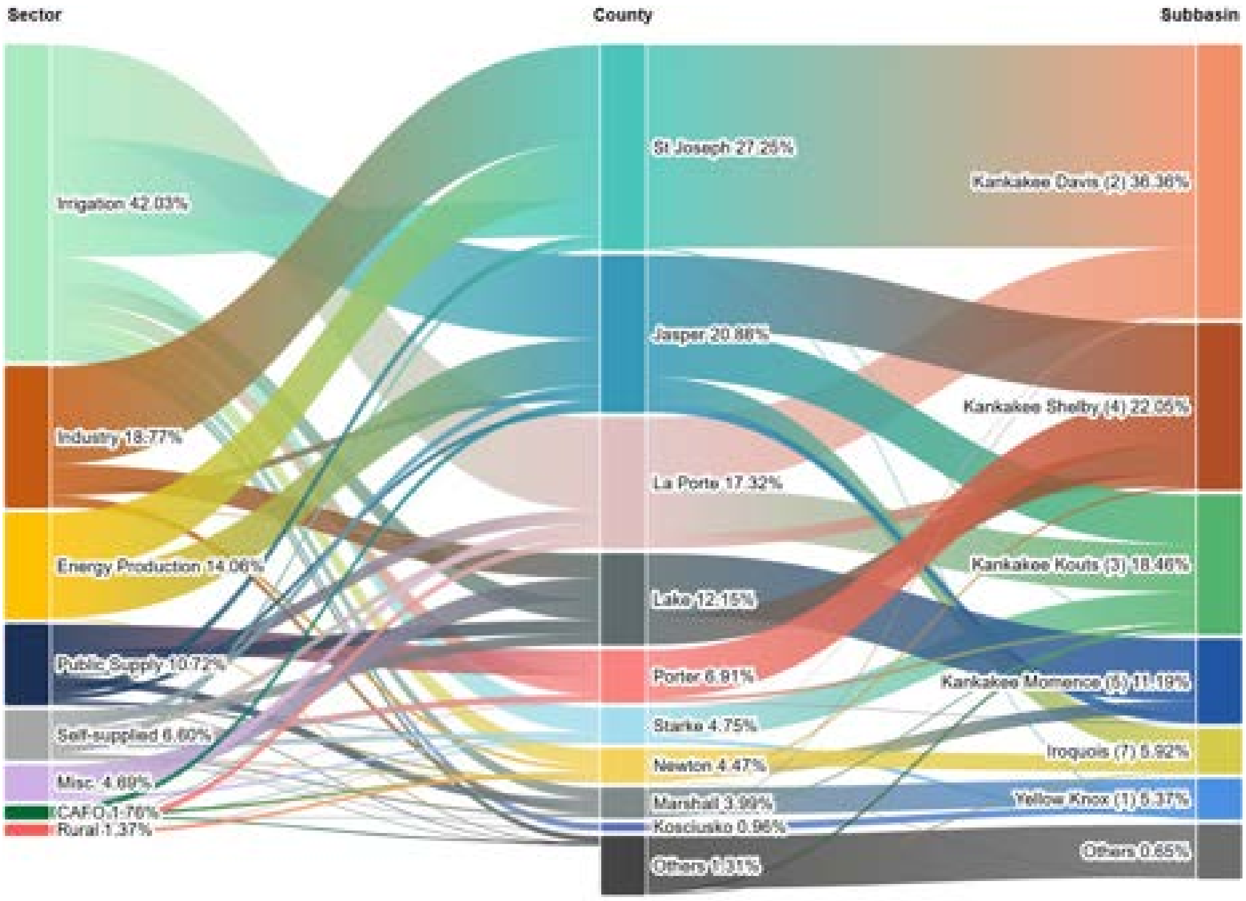


Note: Other counties making up less than 1 each include Kosciusko, Pulaski, Benton, White, and Elkhart. Other subbasins making up less than 1 each include Sugar (Subbasin 8) and Beaver (Subbasin 6).

Figure C-50. Five-Year Water Demand Totals for 2016-2020, by Sector, County and Subbasin

Table C-31. Percent of Total Water Withdrawals: Top 3 Sectors in the Top 5 Counties and Subbasins for 2016-2020

County	Sector	Percent	Subbasin	Sector	Percent
Jasper	Irrigation	12%	Kankakee Davis (2)	Irrigation	10%
	Energy Production	10%		Industry	6%
	Self-supplied	1%		Energy Production	5%
La Porte	Irrigation	13%	Kankakee Shelby (4)	Irrigation	14%
	Public Supply	2%		Public Supply	4%
	Self-supplied	1%		Misc.	4%
St. Joseph	Industry	6%	Kankakee Kouts (3)	Irrigation	10%
	Energy Production	5%		Energy Production	10%
	Irrigation	5%		Self-supplied	1%
Lake	Industry	6%	Kankakee Momence (5)	Industry	5%
	Misc.	3%		Irrigation	5%
	Irrigation	3%		Self-supplied	2%
Porter	Public Supply	4%	Iroquois (7)	Industry	2%
	Irrigation	3%		Irrigation	2%
	Self-supplied	1%		Public Supply	1%



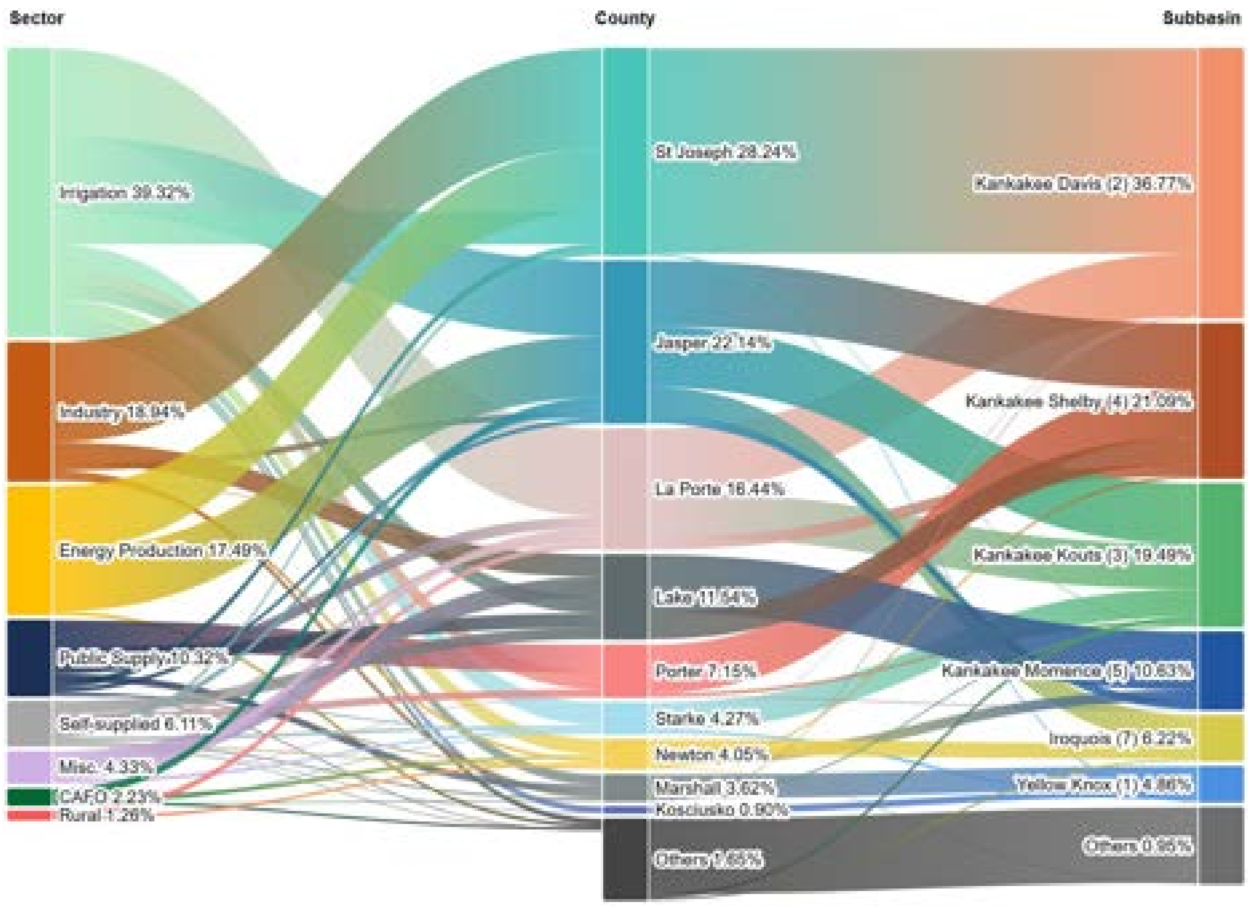
Note: Other counties making up less than 1 each include Kosciusko, Pulaski, Benton, White, and Elkhart. Other subbasins making up less than 1 each include Sugar (Subbasin 8) and Beaver (Subbasin 6).

Figure C-51. Five-Year Water Demand Totals for 2041-2045, by Sector, Study Area County, and Subbasin

Table C-32. Percent of Total Water Withdrawals: Top 3 Sectors in the Top 5 Counties and Subbasins for 2041-2045

County	Sector	Percent	Subbasin	Sector	Percent
St. Joseph	Industry	13%	Kankakee Davis (2)	Industry	13%
	Energy Production	8%		Irrigation	10%
	Irrigation	5%		Energy Production	8%
Jasper	Irrigation	11%	Kankakee Shelby (4)	Irrigation	13%
	Energy Production	6%		Public Supply	4%
	Self-supplied	1%		Misc.	3%
La Porte	Irrigation	12%	Kankakee Kouts (3)	Irrigation	10%
	Public Supply	2%		Energy Production	6%
	Misc.	1%		Self-supplied	1%
Lake	Industry	3%	Kankakee Momence (5)	Irrigation	5%
	Misc.	3%		Industry	3%
	Irrigation	3%		Public Supply	2%
Porter	Public Supply	3%	Iroquois (7)	Irrigation	2%
	Irrigation	2%		Industry	2%
	Self-supplied	1%		CAFO	1%

Key:
CAFO = concentrated animal feeding operation



Note: Other counties making up less than 1 each include Kosciusko, Benton, Pulaski, White, and Elkhart. Other subbasins making up less than 1 each include Sugar (Subbasin 8) and Beaver (Subbasin 6).

Figure C-52. Five-Year Water Demand Totals for 2066-2070, by Sector, Study Area County, and Subbasin

Table C-33. Percent of Total Water Withdrawals: Top 3 Sectors in the Top 5 Counties and Subbasins for 2066-2070

County	Sector	Percent	Subbasin	Sector	Percent
St. Joseph	Industry	14%	Kankakee Davis (2)	Industry	14%
	Energy Production	9%		Irrigation	10%
	Irrigation	4%		Energy Production	9%
Jasper	Irrigation	10%	Kankakee Shelby (4)	Irrigation	12%
	Energy Production	8%		Public Supply	4%
	CAFO	1%		Misc.	3%
La Porte	Irrigation	12%	Kankakee Kouts (3)	Irrigation	10%
	Public Supply	2%		Energy Production	8%
	Misc.	1%		Self-supplied	1%
Lake	Industry	3%	Kankakee Momence (5)	Irrigation	4%
	Misc.	3%		Industry	2%
	Irrigation	2%		Public Supply	2%
Porter	Public Supply	4%	Iroquois (7)	Irrigation	2%
	Irrigation	2%		CAFO	1%
	Self-supplied	1%		Industry	1%

Key:
CAFO = concentrated animal feeding operation

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APPENDIX D

Historical and Projected Future Water Demand by Subbasin

Kankakee Basin Regional Water Study

Appendix D – Historical and Projected Future Water Demand Summaries by Subbasin

December 2025

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ABBREVIATIONS

IR	irrigation
MGD	million gallons per day
PS	public supply
SS	self-supplied

Appendix D Historical and Projected Future Water Demand Summaries by Subbasin

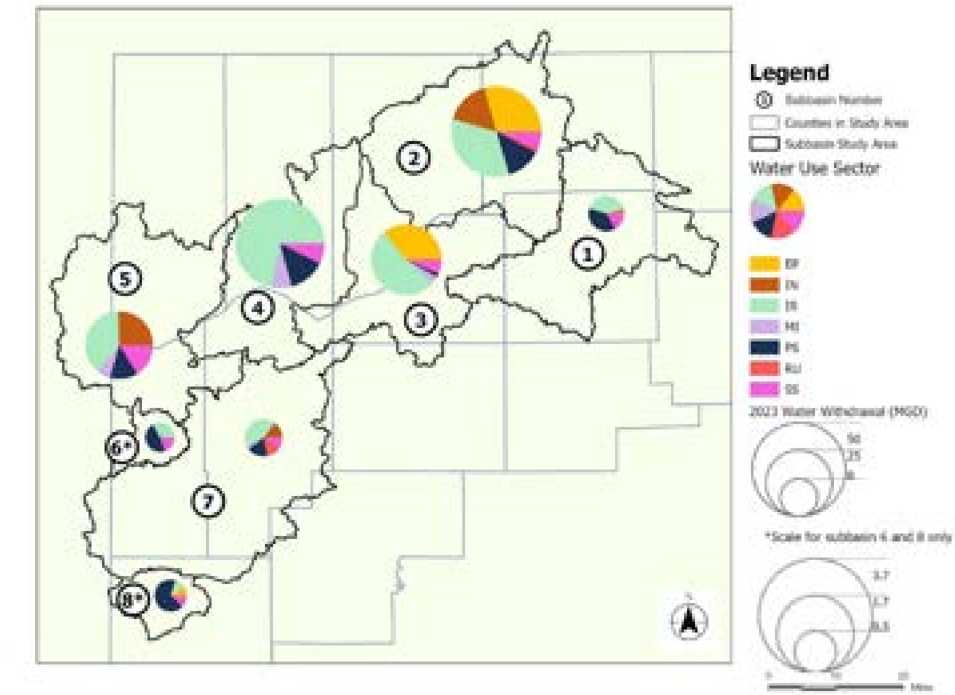
This Appendix summarizes the historical and projected water demand in the Kankakee Basin by subbasin. The first section in the Appendix summarizes and compares subbasin water withdrawals within the Kankakee Basin, including a discussion of Basin-wide seasonal use patterns. The second section in the Appendix presents subbasin-specific details of water withdrawals.

For a summary of water demand by water use sector, see Chapter 4. For a detailed description of the methods used to project future water demands by use sector, see Appendix C.

D.1 Kankakee Basin Water Withdrawals, Comparing Subbasins

The eight subbasins within the Kankakee Basin vary in size, demographics, types of economic sectors, and water use (see Figure D-1). For example, Yellow Knox (Subbasin 1) comprises a relatively large geographic segment of the Kankakee Basin; however, the volume of 2023 annual withdrawals was less than subbasins nearly the same size. Yellow Knox (Subbasin 1) water use sectors were nearly evenly divided between, irrigation (IR), public supply (PS), and self-supplied (SS). Comparatively, Kankakee Shelby (Subbasin 4), while approximately the same geographic size as Yellow Knox (Subbasin 1), had a relatively larger volume of annual water withdrawals in 2023, with IR as the largest water use sector by far. The water demand is not the same magnitude or use type across subbasins.

In addition to the difference in the magnitude and sector types of historical water withdrawals, the future forecast for subbasins also takes into account the variation in sector types, as well as demographic and economic changes that might occur within the subbasins. The future water demand projections represent a future condition that incorporates both historical trends and known, announced development plans that might change water withdrawal. Figure D-2 shows the total annual water withdrawal from 1985 through 2075. Total basin water demand in 2023 was over 165 million gallons per day (MGD), projected to increase to 244 MGD. However, the rate of growth varies across subbasins. For example, water demand in Yellow Knox (Subbasin 1) is projected to remain near 2023 levels, while water use in Kankakee Davis (Subbasin 2) is expected to increase above 2023 levels. Details of historical and projected water use within each subbasin is presented in the second section of this Appendix following a summary of the basin-wide seasonal trends of water use.



Subbasin Key

ID	Name	ID	Name
1	Yellow Knox	5	Kankakee Momence
2	Kankakee Davis	6	Beaver
3	Kankakee Kouts	7	Iroquois
4	Kankakee Shelby	8	Sugar

Sector Key

ID	Sector	ID	Sector
EP	Energy production	RU	Rural
IN	Industrial	SS	Self-supplied
IR	Irrigation		
PS	Public supply		

Figure D-1. Water Withdrawals by Subbasin and Water Use Sector, 2023

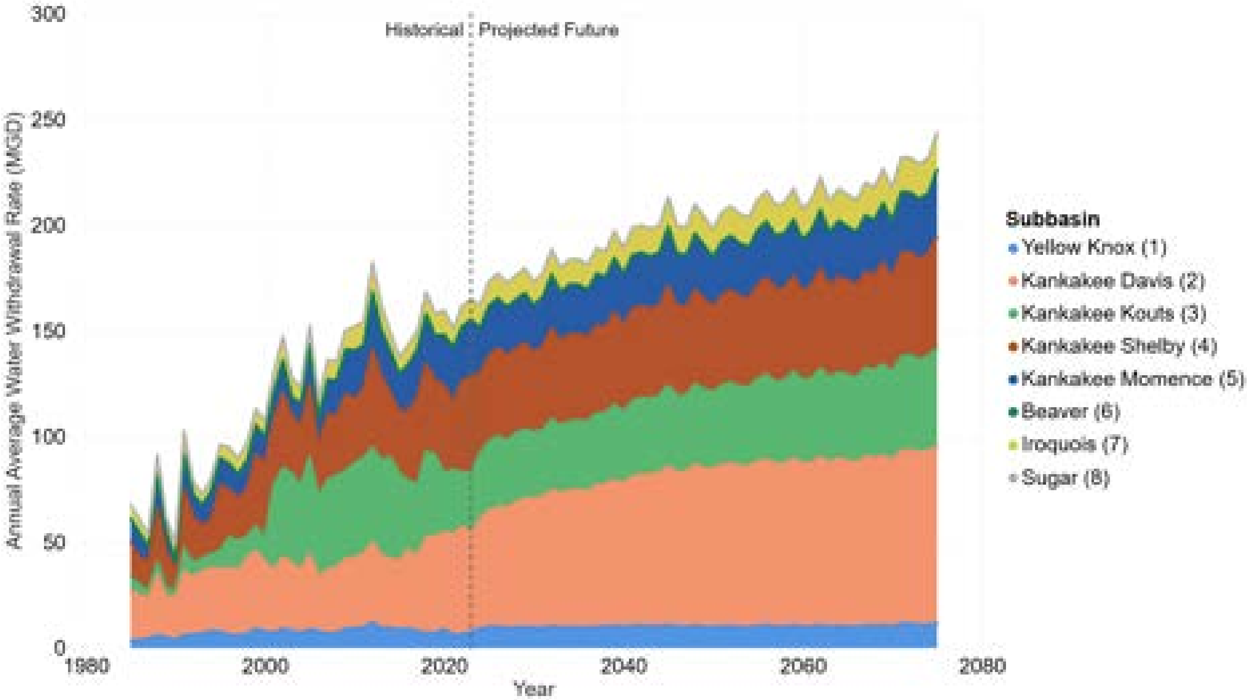


Figure D-2. (1985 to 2023) and Projected Future (2024 to 2075) Annual Average Water Demand in Kankakee Basin, by Subbasin, Millions of Gallons per Day

Water withdrawals within the Kankakee Basin exhibit seasonal trends - the highest withdrawals in the summer months (June – August) and the lowest withdrawals in the winter months (December - March) (Table D-1). This seasonal trend is largely driven by irrigation water demand during the growing season. The **historical maximum average monthly water withdrawal** across all subbasin was 375 MGD in July during the period 2011-2015 which coincides with an extreme regional drought in 2012 (National Weather Service n.d.).

Table D-1. Annual Average Historical and Projected Future Monthly Water Demand by 5-Year Period, All Water Use Sectors, All Subbasins, Millions of Gallons per Day

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	21	24	23	49	74	113	234	135	48	36	29	24
1986-1990	26	28	26	33	52	112	180	149	55	40	30	27
1991-1995	32	34	36	47	83	169	219	198	71	56	45	38
1996-2000	41	42	51	53	78	147	260	238	102	75	62	51
2001-2005	68	69	73	79	101	202	327	317	145	93	84	73
2006-2010	76	77	78	81	108	211	337	284	134	101	94	74
2011-2015	74	76	77	87	126	246	375	360	162	116	100	81
2016-2020	79	80	81	85	122	220	366	365	171	112	100	84
2021-2025	81	83	79	84	128	249	368	376	194	114	100	92
2026-2030	95	98	92	91	153	253	384	390	200	130	114	104
2031-2035	98	105	94	106	173	265	402	378	205	137	117	106
2036-2040	106	107	99	102	175	270	412	400	214	138	124	113

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2041-2045	112	114	105	117	190	310	429	421	237	140	124	118
2046-2050	116	119	108	108	194	295	425	424	221	154	128	125
2051-2055	118	124	114	108	193	294	424	435	245	162	133	129
2056-2060	124	124	119	112	198	305	430	442	252	166	138	130
2061-2065	124	129	117	126	211	314	441	422	258	169	139	131
2066-2070	129	129	119	120	211	312	454	441	260	167	142	134
2071-2075	131	133	121	142	234	366	481	469	275	168	141	137

Note: Darker colored shading indicates the highest withdrawal rates and the lighter shading indicates the lowest.

Table D-2, presents the average annual withdrawals and future projected daily water demand for five-year periods from 1985 to 2075. Note that the initial period (1985) is a one-year average. Additionally, the percent of total withdrawals in a period for each subbasin indicates the proportion of the subbasins where the majority of withdrawals have occurred or are expected to occur.

Through the first part of the historical record (1985 to 2000), Kankakee Davis (Subbasin 2) had the highest withdrawals at 34 MGD (33% of total Kankakee Basin water demand in the period) from 1996 to 2000 and Kankakee Shelby (Subbasin 4) had the second highest withdrawals at 27 MGD (27% of total) during the same period. By 2001 to 2005, Kankakee Kouts (Subbasin 3) saw a dramatic increase in withdrawals from 12 MGD (9% of total) in 1996 to 2000 to 42 MGD (31% of total), becoming the highest withdrawals in the basin.

Kankakee Momence (Subbasin 5) historically had the fourth highest withdrawals (except for 1985) and that continues through the entire projected future period.

Iroquois (Subbasin 7) and Yellow Knox (Subbasin 1) have similar withdrawal volumes through the entire historical and projected future period as the fifth and sixth highest withdrawal subbasins.

Beaver (Subbasin 6) and Sugar (Subbasin 8) have the lowest withdrawal rate which remains consistent through the historical and projected future periods at less than 1% of the total withdrawal in the basin when summed together.

Table D-2. Average Historical and Projected Future Water Demand by 5-Year Period, by Subbasin, All Water Use Sectors, Millions of Gallons per Day and Percent of Total within Kankakee Basin

Period	Unit	Subbasins							
		1	2	3	4	5	6	7	8
1985	**MGD**	3.3	24.0	6.4	16.3	11.2	0.1	6.4	0.3
	% of Total	*5%*	*35%*	*9%*	*24%*	*16%*	*0%*	*9%*	*0%*
1986-1990	**MGD**	4.7	21.7	4.3	15.6	9.8	0.1	7.1	0.2
	% of Total	*7%*	*34%*	*7%*	*25%*	*15%*	*0%*	*11%*	*0%*
1991-1995	**MGD**	7.0	29.4	7.7	22.4	12.7	0.1	6.5	0.3
	% of Total	*8%*	*34%*	*9%*	*26%*	*15%*	*0%*	*8%*	*0%*
1996-2000	**MGD**	7.2	33.7	12.3	26.9	12.6	0.1	7.5	0.4
	% of Total	*7%*	*33%*	*12%*	*27%*	*13%*	*0%*	*7%*	*0%*

Historical and Projected Future Water Demand Summaries by Subbasin
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Period	Unit	Subbasins							
		1	2	3	4	5	6	7	8
2001-2005	**MGD**	8.1	32.3	42.2	31.0	13.3	0.2	9.2	0.3
	% of Total	*6%*	*24%*	*31%*	*23%*	*10%*	*0%*	*7%*	*0%*
2006-2010	**MGD**	8.0	30.7	42.0	29.9	18.1	0.2	9.2	0.3
	% of Total	*6%*	*22%*	*30%*	*22%*	*13%*	*0%*	*7%*	*0%*
2011-2015	**MGD**	10.0	34.4	44.9	35.7	21.4	0.2	10.3	0.5
	% of Total	*6%*	*22%*	*29%*	*23%*	*14%*	*0%*	*7%*	*0%*
2016-2020	**MGD**	8.1	41.9	34.7	38.5	22.6	0.2	9.7	0.3
	% of Total	*5%*	*27%*	*22%*	*25%*	*14%*	*0%*	*6%*	*0%*
2021-2025	**MGD**	8.0	50.4	29.7	39.9	24.5	0.2	9.8	0.4
	% of Total	*5%*	*31%*	*18%*	*24%*	*15%*	*0%*	*6%*	*0%*
2026-2030	**MGD**	9.9	58.8	32.4	40.0	23.0	0.3	10.8	0.6
	% of Total	*6%*	*33%*	*18%*	*23%*	*13%*	*0%*	*6%*	*0%*
2031-2035	**MGD**	10.0	63.8	32.6	40.9	23.6	0.3	11.0	0.6
	% of Total	*5%*	*35%*	*18%*	*22%*	*13%*	*0%*	*6%*	*0%*
2036-2040	**MGD**	10.1	67.1	33.9	41.5	23.9	0.3	11.4	0.8
	% of Total	*5%*	*35%*	*18%*	*22%*	*13%*	*0%*	*6%*	*0%*
2041-2045	**MGD**	10.7	72.1	36.6	43.8	25.5	0.3	12.2	1.0
	% of Total	*5%*	*36%*	*18%*	*22%*	*13%*	*0%*	*6%*	*0%*
2046-2050	**MGD**	10.2	74.4	36.8	42.4	24.7	0.3	12.3	1.1
	% of Total	*5%*	*37%*	*18%*	*21%*	*12%*	*0%*	*6%*	*1%*
2051-2055	**MGD**	10.2	76.6	38.0	43.1	25.2	0.3	12.7	1.3
	% of Total	*5%*	*37%*	*18%*	*21%*	*12%*	*0%*	*6%*	*1%*
2056-2060	**MGD**	10.4	77.7	39.7	44.1	25.6	0.3	13.0	1.4
	% of Total	*5%*	*37%*	*19%*	*21%*	*12%*	*0%*	*6%*	*1%*
2061-2065	**MGD**	10.4	78.5	40.6	44.9	26.0	0.3	13.4	1.6
	% of Total	*5%*	*36%*	*19%*	*21%*	*12%*	*0%*	*6%*	*1%*
2066-2070	**MGD**	10.4	79.1	41.9	45.4	26.2	0.3	13.8	1.7
	% of Total	*5%*	*36%*	*19%*	*21%*	*12%*	*0%*	*6%*	*1%*
2071-2075	**MGD**	11.3	82.3	44.9	49.3	28.9	0.4	14.8	1.9
	% of Total	*5%*	*35%*	*19%*	*21%*	*12%*	*0%*	*6%*	*1%*

Subbasin Key

ID	**Name**	**ID**	**Name**
1	Yellow Knox	5	Kankakee Momence
2	Kankakee Davis	6	Beaver
3	Kankakee Kouts	7	Iroquois
4	Kankakee Shelby	8	Sugar

D.2 Subbasin Specific Historical and Projected Water Withdrawals

The following presents detail of the historical and projected future water demand within each subbasin in Kankakee Basin. Each subbasin summary includes:

- Regional and subbasin map

- Monthly average water demand by 5-year period
- Annual average water demand by 5-year period by sector
- Annual average water demand by county
- Annual average water demand by source

See Appendix C for a detailed description of the methods used to estimate each of the water use sectors by county.

D.2.1 SUBBASIN 1, YELLOW KNOX

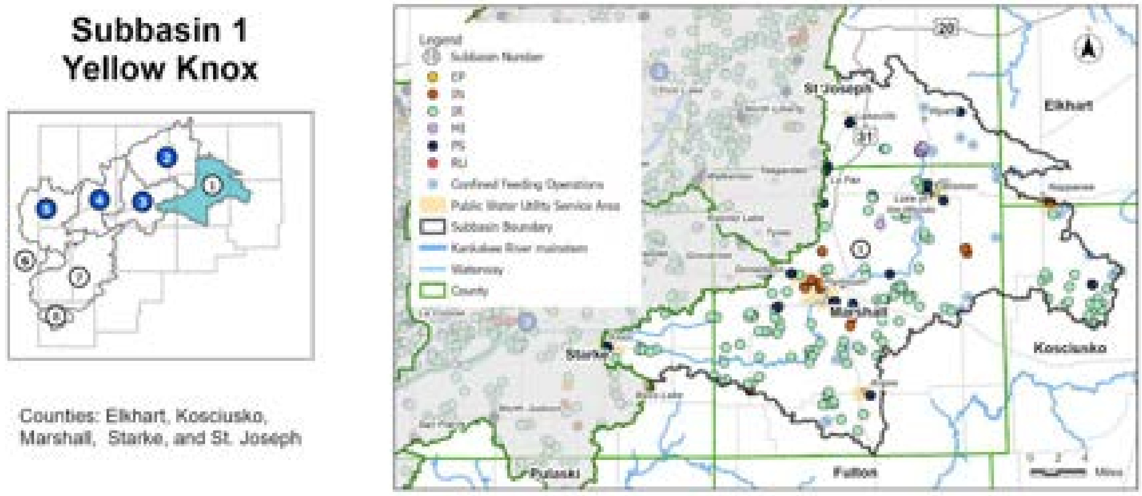

Figure D-3 Subbasin Key Map (left), Yellow Knox (Subbasin 1) Detail Map (right)

Table D-3. Yellow Knox (Subbasin 1) Annual Average Historical and Projected Future Monthly Water Demand by 5-Year Period, All Water Use Sectors, Millions of Gallons per Day

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	1.8	1.7	1.7	1.6	3.2	5.7	9.5	7.1	2.2	1.5	1.5	1.5
1986-1990	3.2	3.7	3.2	3.3	4.0	6.8	9.2	8.6	4.2	3.5	3.1	3.1
1991-1995	4.5	4.8	4.9	5.1	6.3	10.1	13.1	12.6	6.5	6.0	5.1	4.5
1996-2000	6.6	4.5	4.3	4.6	5.0	8.6	15.7	14.3	6.8	4.8	4.3	6.0
2001-2005	4.8	4.8	4.3	4.5	5.3	11.4	18.0	18.2	7.4	5.2	4.6	8.3
2006-2010	4.6	4.6	4.5	5.1	6.4	11.8	19.4	16.8	7.7	5.3	4.9	4.8
2011-2015	6.1	6.0	6.0	6.2	8.3	15.6	21.4	21.1	10.2	6.3	6.2	5.8
2016-2020	5.4	5.4	5.2	5.1	5.9	10.8	18.6	17.2	8.5	5.3	5.1	4.5
2021-2025	4.6	4.7	4.6	4.8	6.3	12.4	16.0	17.4	10.0	5.1	4.8	4.8
2026-2030	5.8	5.7	5.8	6.1	9.3	14.1	21.5	20.8	11.5	6.3	5.9	5.5
2031-2035	5.5	5.7	5.6	7.1	10.0	14.8	21.9	19.8	11.9	6.5	5.7	5.4
2036-2040	5.6	5.5	5.6	6.2	10.7	15.3	22.2	20.7	12.0	6.2	5.8	5.4
2041-2045	5.6	5.6	5.6	7.3	11.4	16.7	23.3	21.9	13.1	5.9	5.5	5.4
2046-2050	5.4	5.5	5.5	6.0	11.2	15.8	22.0	21.4	11.7	6.4	5.4	5.4
2051-2055	5.3	5.5	5.5	5.7	10.6	15.5	21.7	22.0	13.1	6.6	5.4	5.4
2056-2060	5.6	5.3	5.6	6.0	10.7	15.7	23.0	22.0	13.1	6.6	5.6	5.2
2061-2065	5.2	5.3	5.3	6.9	10.9	16.3	22.4	20.9	13.9	6.6	5.3	5.1
2066-2070	5.3	5.2	5.2	6.1	11.5	16.5	23.3	21.6	13.6	6.3	5.4	5.1
2071-2075	5.2	5.2	5.2	8.0	13.0	19.1	25.2	23.9	14.2	6.2	5.2	5.1

Note: Darker colored shading indicates the highest withdrawal rates and the lighter shading indicates the lowest.

Historical and Projected Future Water Demand Summaries by Subbasin
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Table D-4. Yellow Knox (Subbasin 1) Average-Day Historical and Projected Future Water Demand by 5-Year Period, by Sector, Millions of Gallons per Day and Percent of Total within the Subbasin

Period	Unit	Sector						
		CAFO	Energy Production	Industrial	Irrigation	Misc.	Public Supply	Self-Supplied
1985	MGD	NA	NA	0.2	1.6	0.0	1.5	NA
	% of Total	*NA*	*NA*	*7%*	*48%*	*0%*	*45%*	*NA*
1986-1990	MGD	NA	NA	0.3	1.1	0.0	3.3	NA
	% of Total	*NA*	*NA*	*6%*	*24%*	*0%*	*70%*	*NA*
1991-1995	MGD	NA	NA	0.6	1.7	1.7	3.0	NA
	% of Total	*NA*	*NA*	*8%*	*24%*	*24%*	*43%*	*NA*
1996-2000	MGD	0.1	NA	1.8	2.2	0.0	3.1	NA
	% of Total	*2%*	*NA*	*25%*	*30%*	*0%*	*43%*	*NA*
2001-2005	MGD	0.2	0.1	2.3	2.8	0.0	2.8	NA
	% of Total	*2%*	*1%*	*28%*	*34%*	*0%*	*35%*	*NA*
2006-2010	MGD	0.2	0.1	1.6	2.7	0.1	2.8	0.5
	% of Total	*2%*	*1%*	*20%*	*34%*	*1%*	*35%*	*6%*
2011-2015	MGD	0.2	0.1	2.1	3.4	0.0	2.9	1.2
	% of Total	*2%*	*1%*	*22%*	*34%*	*0%*	*29%*	*12%*
2016-2020	MGD	0.2	0.1	1.3	2.7	0.0	2.6	1.2
	% of Total	*3%*	*1%*	*16%*	*33%*	*0%*	*33%*	*15%*
2021-2025	MGD	0.2	0.1	0.8	2.9	0.0	2.7	1.2
	% of Total	*3%*	*1%*	*10%*	*37%*	*0%*	*35%*	*15%*
2026-2030	MGD	0.2	0.1	1.6	3.9	0.0	2.8	1.2
	% of Total	*2%*	*1%*	*17%*	*39%*	*0%*	*28%*	*12%*
2031-2035	MGD	0.3	0.1	1.6	4.1	0.0	2.8	1.2
	% of Total	*3%*	*1%*	*16%*	*40%*	*0%*	*28%*	*12%*
2036-2040	MGD	0.3	0.1	1.6	4.2	0.0	2.7	1.2
	% of Total	*3%*	*1%*	*16%*	*41%*	*0%*	*27%*	*12%*
2041-2045	MGD	0.3	0.1	1.6	4.7	0.0	2.7	1.2
	% of Total	*3%*	*1%*	*15%*	*44%*	*0%*	*26%*	*11%*
2046-2050	MGD	0.3	0.1	1.6	4.4	0.0	2.6	1.1
	% of Total	*3%*	*1%*	*16%*	*43%*	*0%*	*26%*	*11%*
2051-2055	MGD	0.3	0.1	1.6	4.5	0.0	2.6	1.1
	% of Total	*3%*	*1%*	*16%*	*44%*	*0%*	*25%*	*11%*
2056-2060	MGD	0.3	0.1	1.6	4.7	0.0	2.5	1.1
	% of Total	*3%*	*1%*	*16%*	*45%*	*0%*	*24%*	*10%*
2061-2065	MGD	0.3	0.1	1.6	4.7	0.0	2.4	1.1
	% of Total	*3%*	*1%*	*16%*	*46%*	*0%*	*23%*	*10%*
2066-2070	MGD	0.4	0.1	1.6	4.9	0.0	2.4	1.0
	% of Total	*3%*	*1%*	*16%*	*47%*	*0%*	*23%*	*10%*
2071-2075	MGD	0.4	0.2	1.6	5.7	0.0	2.4	1.0
	% of Total	*3%*	*1%*	*15%*	*51%*	*0%*	*21%*	*9%*

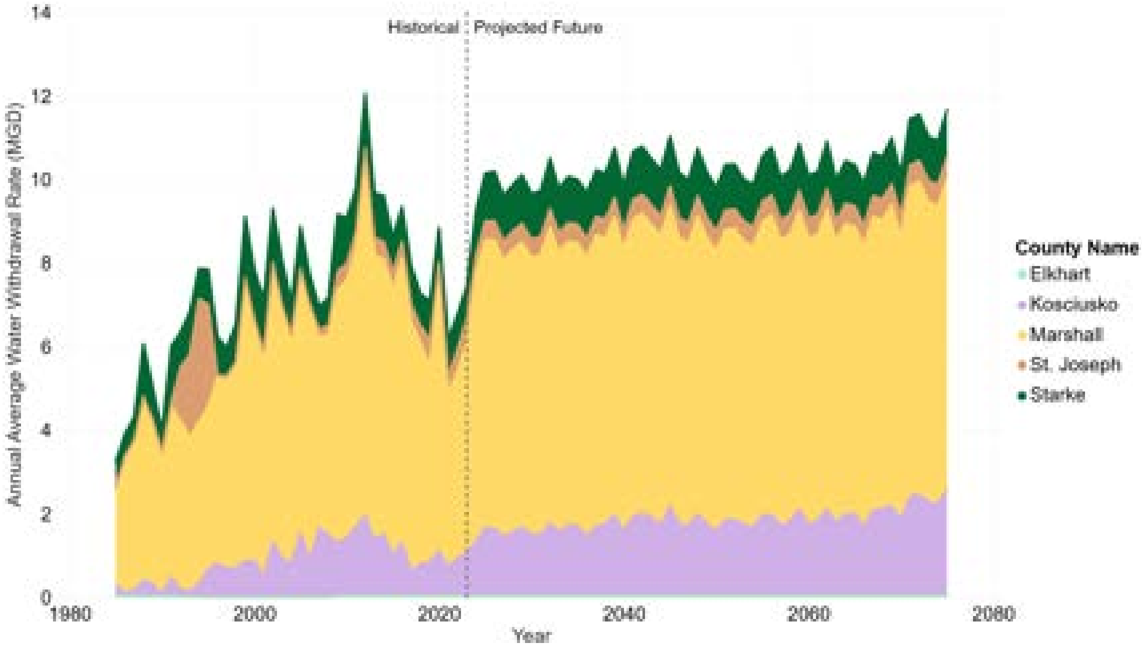
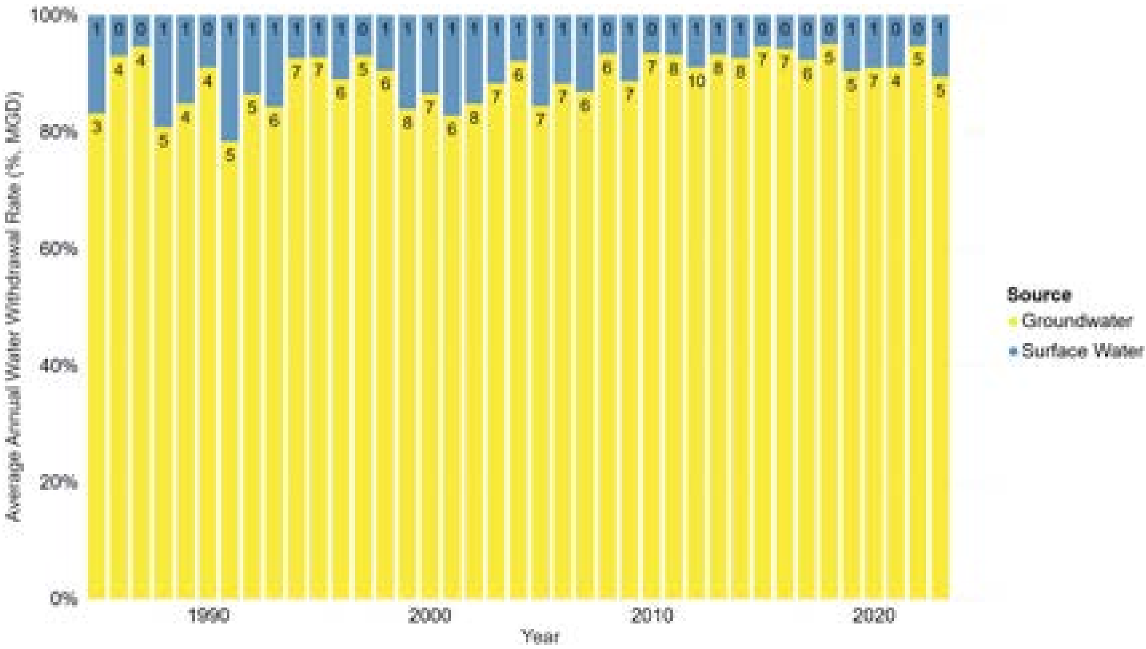


Figure D-4. Yellow Knox (Subbasin 1) Historical (1985 to 2023) and Projected Future (2024 to 2075) Annual Water Demand in Kankakee Basin, by County, Millions of Gallons per Day



Source: Significant Water Withdrawal Facility data 1985 to 2023 (IDNR 2025)
Note: SWWF database only includes sectors reporting to IDNR: energy production, industrial, irrigation, miscellaneous, public supply, and rural use.

Figure D-5. Yellow Knox (Subbasin 1) Significant Water Withdrawals Database by Source, All Subbasins, Millions of Gallons per Day, Percent of Total

Historical and Projected Future Water Demand Summaries by Subbasin
December 2025

D.2.2 SUBBASIN 2, KANKAKEE DAVIS

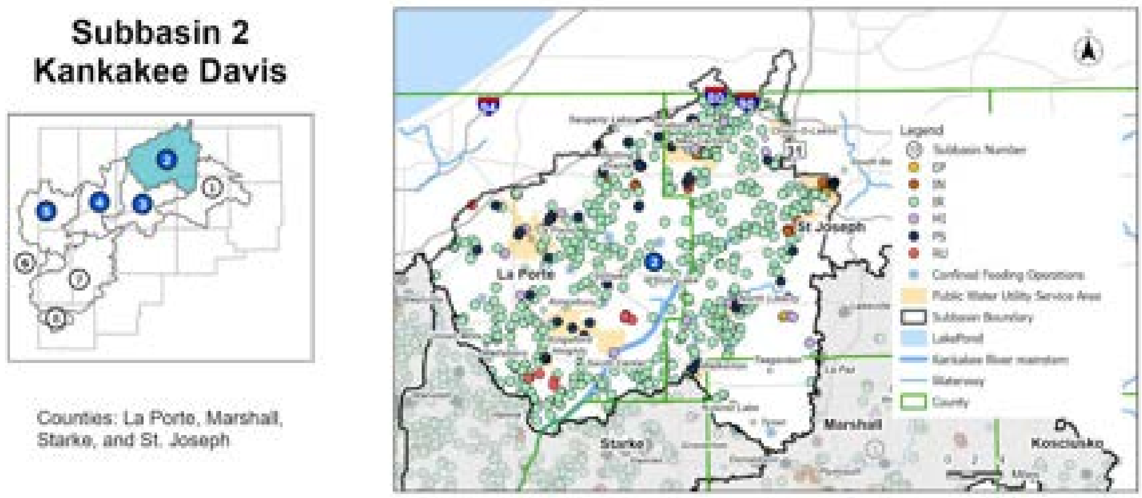


Figure D-6 Subbasin Key Map (left), Kankakee Davis (Subbasin 2) Detail Map (right)

Table D-5. Kankakee Davis (Subbasin 2) Annual Average Historical and Projected Future Monthly Water Demand by 5-Year Period, All Water Use Sectors, Millions of Gallons per Day

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	10.1	10.8	10.4	19.9	32.9	41.9	56.2	41.7	18.6	16.3	15.4	12.8
1986-1990	11.0	12.5	11.6	15.6	25.0	36.3	44.0	35.5	22.6	19.9	13.7	12.4
1991-1995	13.7	14.2	15.5	21.8	33.4	50.7	58.3	53.6	29.7	23.0	20.4	17.0
1996-2000	16.9	18.0	22.6	23.6	28.7	48.7	74.0	67.1	34.7	25.5	23.2	19.7
2001-2005	16.1	16.7	16.3	17.5	22.1	50.7	83.8	74.5	36.6	18.5	16.6	16.6
2006-2010	15.7	15.7	17.0	16.7	23.2	54.8	78.0	67.7	29.9	17.2	16.2	15.3
2011-2015	16.0	18.2	16.3	16.5	24.7	57.4	90.5	85.2	38.6	16.8	15.2	15.8
2016-2020	24.6	27.0	25.8	22.5	31.2	58.4	94.4	95.6	44.6	26.5	24.4	26.1
2021-2025	34.1	33.5	30.0	28.0	42.2	74.3	99.9	102.1	59.5	34.1	31.1	34.1
2026-2030	42.8	42.6	37.7	35.4	57.9	82.0	108.8	105.6	66.9	43.2	39.3	42.4
2031-2035	46.5	47.1	41.5	42.0	64.8	88.7	114.7	108.8	71.8	48.2	43.3	46.2
2036-2040	50.3	49.7	45.1	42.7	69.2	92.0	119.0	113.6	75.3	50.0	46.6	49.6
2041-2045	53.9	53.3	48.3	48.4	74.9	101.0	124.9	120.8	82.5	53.5	49.3	53.1
2046-2050	56.8	56.4	51.1	48.4	77.5	101.4	127.2	123.4	82.3	58.1	52.2	56.3
2051-2055	58.5	58.5	52.9	49.5	79.2	103.6	128.6	126.9	87.7	60.0	54.0	58.2
2056-2060	59.5	59.3	53.7	50.6	79.3	104.5	131.4	128.0	89.9	61.1	54.9	58.5
2061-2065	59.6	60.0	53.7	53.3	80.8	107.0	131.3	126.8	91.6	62.0	55.1	58.8
2066-2070	60.6	60.1	54.6	51.6	83.1	107.1	134.2	128.2	91.4	60.8	55.8	59.7
2071-2075	61.5	61.1	54.8	56.8	87.4	116.5	139.7	134.4	95.0	62.1	56.0	60.5

Note: Darker colored shading indicates the highest withdrawal rates and the lighter shading indicates the lowest.

Historical and Projected Future Water Demand Summaries by Subbasin
December 2025

Table D-6. Kankakee Davis (Subbasin 2) Average Historical and Projected Future Water Demand by 5-Year Period, by Sector, Millions of Gallons per Day and Percent of Total within the Subbasin

Period	Unit	Sector							
		CAFO	Energy Production	Industrial	Irrigation	Misc.	Public Supply	Rural	Self-Supplied
1985	MGD	NA	NA	9.0	8.3	0.4	5.6	0.9	NA
	% of Total	NA	NA	37%	34%	2%	23%	4%	NA
1986-1990	MGD	NA	NA	7.7	7.0	0.3	5.9	0.8	NA
	% of Total	NA	NA	36%	32%	1%	27%	4%	NA
1991-1995	MGD	NA	NA	12.2	9.7	1.3	5.3	0.9	NA
	% of Total	NA	NA	41%	33%	4%	18%	3%	NA
1996-2000	MGD	0.1	NA	14.9	10.7	0.7	6.4	0.9	NA
	% of Total	0%	NA	44%	32%	2%	19%	3%	NA
2001-2005	MGD	0.2	0.0	9.9	14.0	0.1	7.2	0.8	NA
	% of Total	1%	0%	31%	43%	0%	22%	3%	NA
2006-2010	MGD	0.2	0.0	9.1	13.1	1.1	5.3	0.8	1.1
	% of Total	1%	0%	30%	43%	4%	17%	3%	4%
2011-2015	MGD	0.2	0.0	7.0	17.0	0.9	5.6	0.8	2.8
	% of Total	1%	0%	20%	49%	3%	16%	2%	8%
2016-2020	MGD	0.2	7.1	8.4	15.7	1.9	5.0	0.8	2.8
	% of Total	0%	17%	20%	38%	4%	12%	2%	7%
2021-2025	MGD	0.1	12.9	10.2	16.7	1.0	5.8	0.7	2.9
	% of Total	0%	26%	20%	33%	2%	12%	1%	6%
2026-2030	MGD	0.1	13.7	16.3	18.0	1.9	5.2	0.8	2.9
	% of Total	0%	23%	28%	31%	3%	9%	1%	5%
2031-2035	MGD	0.1	13.6	20.8	18.6	1.9	5.2	0.8	2.9
	% of Total	0%	21%	33%	29%	3%	8%	1%	5%
2036-2040	MGD	0.1	14.2	23.3	18.8	1.9	5.2	0.8	2.8
	% of Total	0%	21%	35%	28%	3%	8%	1%	4%
2041-2045	MGD	0.1	15.1	25.8	20.3	1.9	5.4	0.8	2.8
	% of Total	0%	21%	36%	28%	3%	7%	1%	4%
2046-2050	MGD	0.1	15.8	28.3	19.6	1.9	5.2	0.8	2.8
	% of Total	0%	21%	38%	26%	2%	7%	1%	4%
2051-2055	MGD	0.1	16.5	29.3	20.2	1.9	5.2	0.8	2.7
	% of Total	0%	21%	38%	26%	2%	7%	1%	4%
2056-2060	MGD	0.1	17.1	29.3	20.7	1.9	5.2	0.8	2.7
	% of Total	0%	22%	38%	27%	2%	7%	1%	3%
2061-2065	MGD	0.1	17.8	29.3	20.9	1.9	5.1	0.8	2.6
	% of Total	0%	23%	37%	27%	2%	7%	1%	3%
2066-2070	MGD	0.1	18.5	29.3	21.0	1.9	5.1	0.8	2.6
	% of Total	0%	23%	37%	27%	2%	6%	1%	3%
2071-2075	MGD	0.0	19.1	29.3	23.3	1.9	5.4	0.8	2.6
	% of Total	0%	23%	36%	28%	2%	7%	1%	3%

Key:
CAFO = concentrated animal feeding operation
MGD = million gallons per day
NA = not applicable

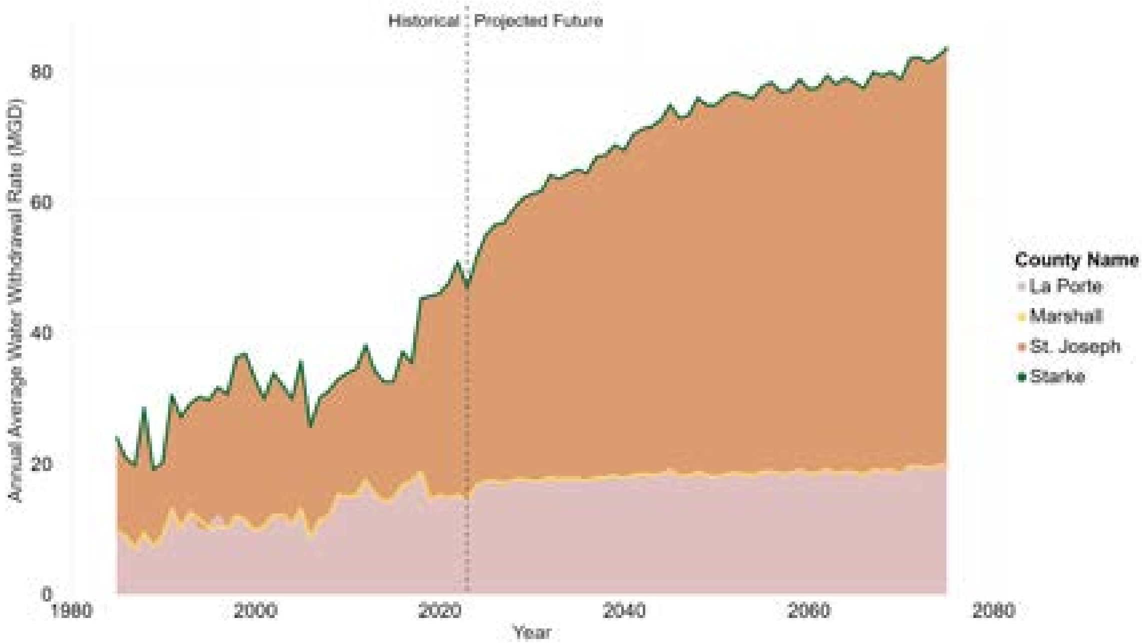
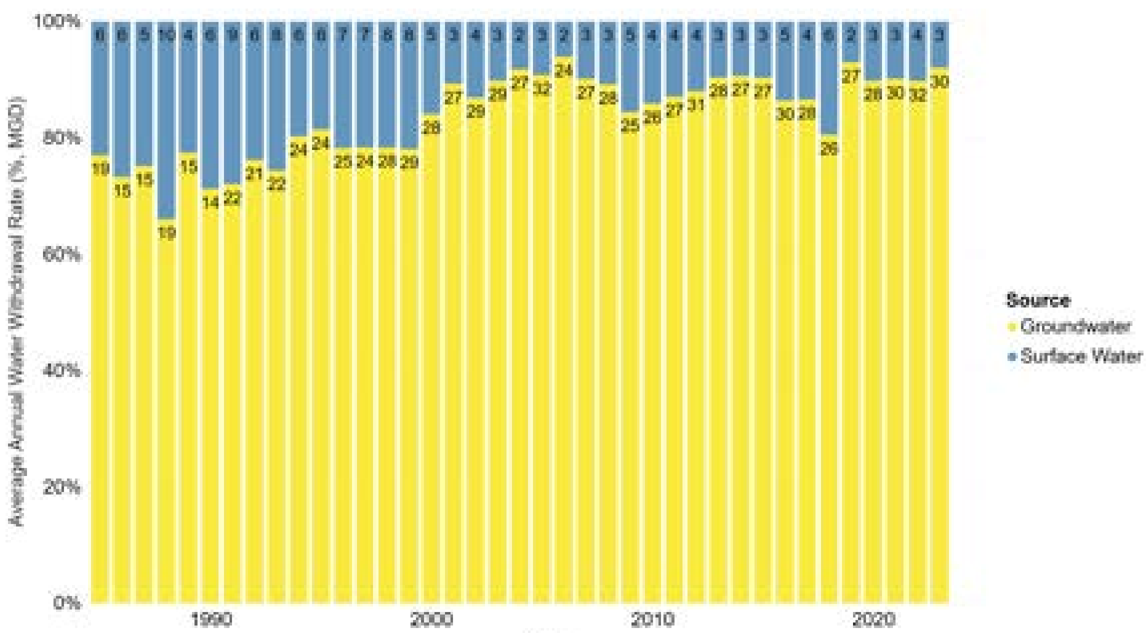


Figure D-7. Kankakee Davis (Subbasin 2) Historical (1985 to 2023) and Projected Future (2024 to 2075) Annual Water Demand in Kankakee Basin, by County, Millions of Gallons per Day



Source: Significant Water Withdrawal Facility data 1985 to 2023 (IDNR 2025)

Note: SWWF database only includes sectors reporting to IDNR: energy production, industrial, irrigation, miscellaneous, public supply, and rural use.

Figure D-8. Kankakee Davis (Subbasin 2) Significant Water Withdrawals Database by Source, All Subbasins, Millions of Gallons per Day, Percent of Total

D.2.3 SUBBASIN 3, KANKAKEE KOUTS

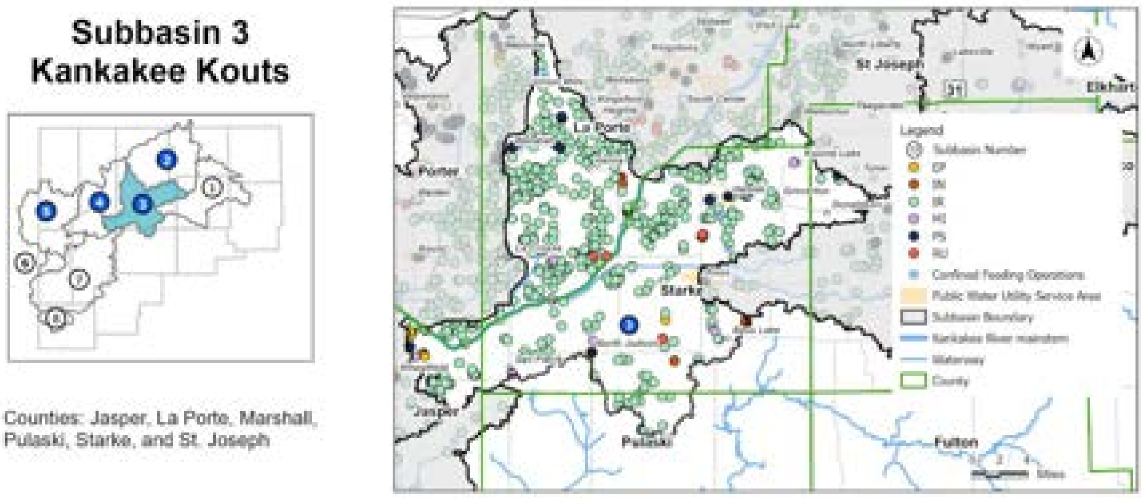


Figure D-9 Subbasin Key Map (left), Kankakee Kouts (Subbasin 3) Detail Map (right)

Table D-7. Kankakee Kouts (Subbasin 3) Annual Average Historical and Projected Future Monthly Water Demand by 5-Year Period, All Water Use Sectors, Millions of Gallons per Day

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	0.3	0.3	0.3	0.3	17.7	14.6	22.6	15.1	3.2	1.8	0.3	0.2
1986-1990	0.5	0.5	0.6	1.2	5.4	9.7	15.4	12.3	2.5	1.9	0.4	0.4
1991-1995	0.5	0.6	0.5	1.1	9.5	19.1	27.5	20.7	6.0	4.5	0.9	0.7
1996-2000	0.5	0.6	0.6	2.0	17.0	29.6	44.0	29.2	11.0	8.2	2.3	1.2
2001-2005	29.7	29.7	29.6	32.1	46.2	56.2	75.5	72.8	41.4	34.2	29.8	28.2
2006-2010	30.7	30.6	30.2	31.1	44.7	54.8	73.8	68.1	46.9	34.6	29.4	28.0
2011-2015	24.0	23.6	24.8	26.3	51.4	86.0	94.4	85.6	45.5	29.9	23.4	21.8
2016-2020	16.9	17.0	18.4	18.9	36.4	52.1	81.4	78.8	41.0	20.9	17.1	16.0
2021-2025	12.5	12.9	12.8	13.2	29.3	50.7	70.4	71.5	40.0	16.5	12.7	12.3
2026-2030	15.2	16.2	13.8	11.0	31.1	52.7	79.9	79.6	40.9	18.0	14.0	14.8
2031-2035	15.1	16.5	13.1	12.0	33.7	55.0	81.6	75.3	40.7	18.2	13.3	14.7
2036-2040	16.3	17.1	13.9	11.2	35.0	55.5	83.7	81.4	43.2	18.3	14.6	15.7
2041-2045	17.9	18.8	15.2	13.2	38.2	63.0	87.8	85.0	48.0	18.8	14.9	17.1
2046-2050	18.7	20.0	15.7	11.8	38.5	61.1	87.7	85.8	45.7	21.5	15.6	18.2
2051-2055	19.7	20.9	16.8	11.8	39.3	61.1	87.2	88.9	50.4	22.9	16.6	19.1
2056-2060	21.2	21.8	18.0	12.9	40.2	64.2	91.0	90.9	52.6	24.3	18.0	19.9
2061-2065	21.8	23.3	18.2	15.3	43.2	67.2	92.3	86.5	54.1	25.0	18.4	20.9
2066-2070	22.9	23.9	19.0	14.4	44.3	67.0	95.0	92.5	55.4	25.2	19.5	21.9
2071-2075	24.0	25.2	19.8	18.2	49.1	76.1	100.2	97.3	58.7	25.9	19.8	23.1

Note: Darker colored shading indicates the highest withdrawal rates and the lighter shading indicates the lowest.

Table D-8. Kankakee Kouts (Subbasin 3) Average-Day Historical and Projected Future Water Demand by 5-Year Period, by Sector, Millions of Gallons per Day and Percent of Total within the Subbasin

Period	Unit	Sector							
		CAFO	Energy Production	Industrial	Irrigation	Misc.	Public Supply	Rural	Self-Supplied
1985	MGD	NA	NA	1.2	4.9	0.0	0.3	0.0	NA
	% of Total	NA	NA	19%	76%	0%	4%	0%	NA
1986-1990	MGD	NA	NA	0.5	3.4	0.1	0.3	0.0	NA
	% of Total	NA	NA	12%	79%	2%	7%	0%	NA
1991-1995	MGD	NA	NA	0.4	6.5	0.5	0.3	0.0	NA
	% of Total	NA	NA	5%	85%	6%	4%	0%	NA
1996-2000	MGD	0.2	NA	1.0	10.4	0.3	0.3	0.0	NA
	% of Total	2%	NA	8%	85%	3%	3%	0%	NA
2001-2005	MGD	0.3	30.1	1.1	9.6	0.7	0.4	0.0	NA
	% of Total	1%	71%	3%	23%	2%	1%	0%	NA
2006-2010	MGD	0.6	30.2	0.0	9.4	0.6	0.4	0.1	0.7
	% of Total	1%	72%	0%	22%	1%	1%	0%	2%
2011-2015	MGD	0.8	21.5	0.0	18.4	0.6	0.4	1.6	1.6
	% of Total	2%	48%	0%	41%	1%	1%	4%	4%
2016-2020	MGD	0.2	15.4	0.0	15.5	0.5	0.4	1.1	1.6
	% of Total	1%	44%	0%	45%	1%	1%	3%	5%
2021-2025	MGD	0.1	9.8	0.1	16.0	0.9	0.4	0.6	1.7
	% of Total	0%	33%	0%	54%	3%	1%	2%	6%
2026-2030	MGD	0.1	9.8	0.3	18.1	1.0	0.4	1.0	1.6
	% of Total	0%	30%	1%	56%	3%	1%	3%	5%
2031-2035	MGD	0.1	9.6	0.3	18.5	1.0	0.5	1.0	1.6
	% of Total	0%	30%	1%	57%	3%	1%	3%	5%
2036-2040	MGD	0.1	10.6	0.3	19.0	1.0	0.5	1.0	1.6
	% of Total	0%	31%	1%	56%	3%	1%	3%	5%
2041-2045	MGD	0.1	11.8	0.3	20.4	1.0	0.5	1.0	1.5
	% of Total	0%	32%	1%	56%	3%	1%	3%	4%
2046-2050	MGD	0.1	12.7	0.3	19.8	1.0	0.5	1.0	1.5
	% of Total	0%	35%	1%	54%	3%	1%	3%	4%
2051-2055	MGD	0.1	13.7	0.3	20.1	1.0	0.5	1.0	1.4
	% of Total	0%	36%	1%	53%	3%	1%	3%	4%
2056-2060	MGD	0.1	14.6	0.3	20.9	1.0	0.5	1.0	1.4
	% of Total	0%	37%	1%	53%	2%	1%	3%	3%
2061-2065	MGD	0.1	15.5	0.3	20.9	1.0	0.5	1.0	1.3
	% of Total	0%	38%	1%	52%	2%	1%	3%	3%
2066-2070	MGD	0.1	16.5	0.3	21.3	1.0	0.5	1.0	1.2
	% of Total	0%	39%	1%	51%	2%	1%	2%	3%
2071-2075	MGD	0.1	17.4	0.3	23.4	1.0	0.5	1.0	1.2
	% of Total	0%	39%	1%	52%	2%	1%	2%	3%

Key:
CAFO = concentrated animal feeding operation
MGD = million gallons per day
NA = not applicable

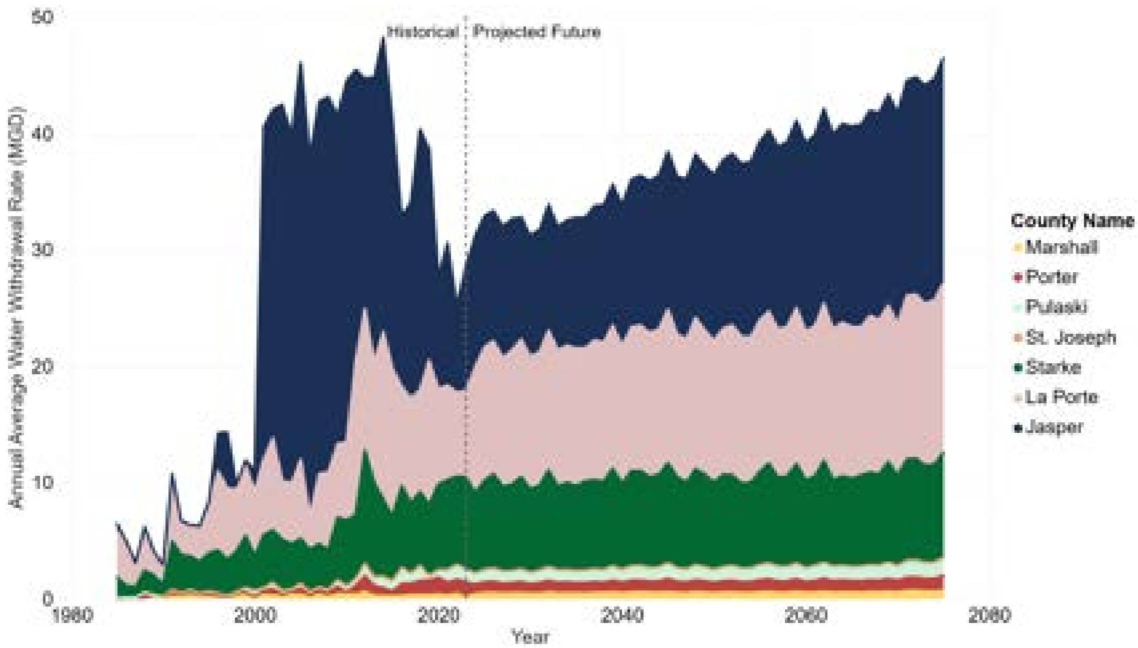
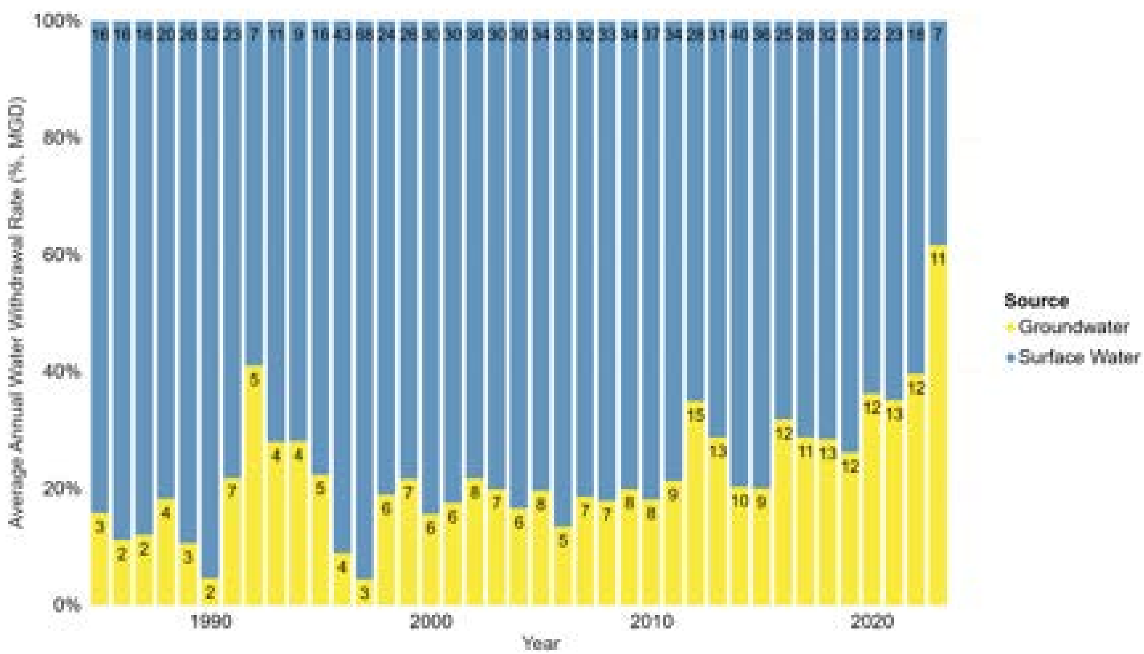


Figure D-10. Kankakee Kouts (Subbasin 3) Historical (1985 to 2023) and Projected Future (2024 to 2075) Annual Water Demand in Kankakee Basin, by County, Millions of Gallons per Day



Source: Significant Water Withdrawal Facility data 1985 to 2023 (IDNR 2025)

Note: SWWF database only includes sectors reporting to IDNR: energy production, industrial, irrigation, miscellaneous, public supply, and rural.

Figure D-11. Kankakee Kouts (Subbasin 3) Significant Water Withdrawals Database by Source, All Subbasins, Millions of Gallons per Day, Percent of Total

D.2.4 SUBBASIN 4, KANKAKEE SHELBY

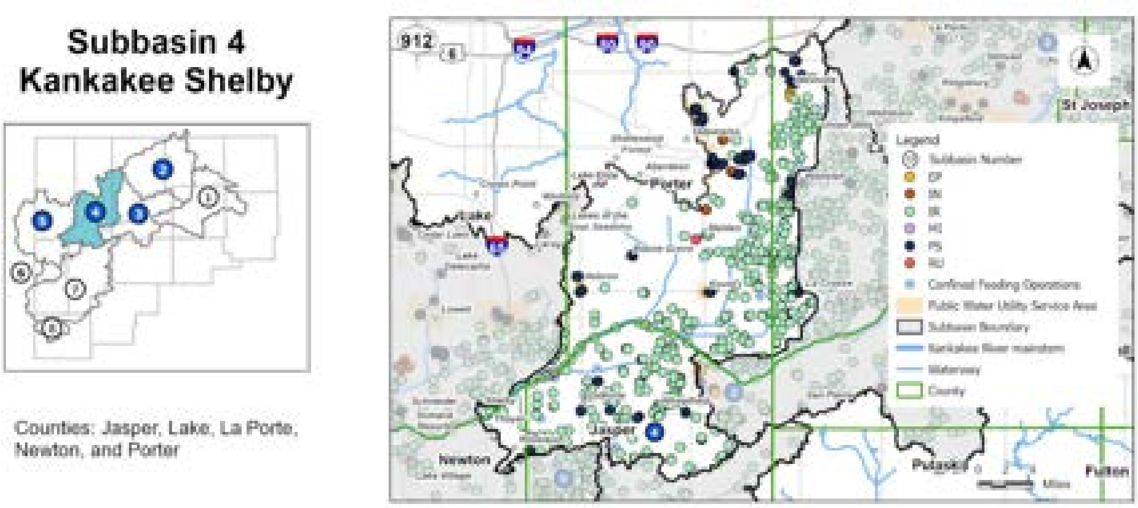


Figure D-12 Subbasin Key Map (left), Kankakee Shelby (Subbasin 4) Detail Map (right)

Table D-9. Kankakee Shelby (Subbasin 4) Average Historical and Projected Future Monthly Water Demand by 5-Year Period, All Water Use Sectors, Millions of Gallons per Day

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	3.9	5.8	5.6	19.9	9.8	18.1	59.1	35.3	13.2	11.6	6.8	4.8
1986-1990	5.0	5.4	5.3	6.1	7.2	28.9	50.2	42.4	15.3	8.6	6.6	5.3
1991-1995	6.2	6.8	7.3	9.9	17.0	45.9	63.6	61.8	15.1	14.1	11.3	7.9
1996-2000	5.8	7.3	13.0	12.2	13.5	34.7	72.5	75.4	30.3	22.5	20.3	13.3
2001-2005	6.1	6.0	10.3	12.2	11.0	48.0	91.7	93.3	38.1	21.6	21.4	9.3
2006-2010	6.8	7.0	7.8	9.7	12.9	51.1	98.3	74.5	24.9	26.6	27.0	9.6
2011-2015	9.2	9.4	11.1	16.9	15.8	41.1	94.6	98.7	36.0	40.7	34.7	17.7
2016-2020	10.9	11.1	11.3	15.5	22.1	50.6	103.9	107.9	45.0	34.1	30.3	15.5
2021-2025	10.5	11.1	11.1	14.4	21.1	57.6	109.8	114.3	45.1	31.6	29.6	19.3
2026-2030	11.0	11.5	13.6	15.2	25.0	54.6	101.6	109.1	45.4	37.7	32.4	19.5
2031-2035	10.9	12.9	12.7	19.4	30.5	56.3	107.8	102.6	46.0	38.2	31.7	18.9
2036-2040	12.1	12.3	13.0	17.2	27.3	56.4	109.8	109.3	47.0	37.4	33.0	19.6
2041-2045	12.1	12.5	13.7	19.9	31.0	67.6	113.0	113.2	52.1	36.1	31.1	19.6
2046-2050	12.1	12.9	13.3	16.7	31.2	60.4	109.4	113.1	45.4	39.0	31.3	20.8
2051-2055	11.8	13.8	14.4	16.0	28.9	58.3	108.5	114.9	52.1	41.2	32.3	21.1
2056-2060	13.0	12.6	15.8	16.7	31.5	63.2	107.1	116.8	53.3	42.3	33.7	20.5
2061-2065	12.5	14.0	14.6	20.9	36.1	64.3	113.0	108.6	54.7	42.7	33.1	20.6
2066-2070	13.8	13.5	14.8	19.1	33.6	62.5	116.7	115.2	55.0	41.9	34.1	21.1
2071-2075	13.8	14.0	14.9	25.0	40.3	80.1	123.5	122.2	58.3	41.0	33.0	21.3

Note: Darker colored shading indicates the highest withdrawal rates and the lighter shading indicates the lowest.

Table D-10. Kankakee Shelby (Subbasin 4) Average Historical and Projected Future Water Demand by 5-Year Period, by Sector, Millions of Gallons per Day and Percent of Total within the Subbasin

Period	Unit	Sector						
		CAFO	Industrial	Irrigation	Misc.	Public Supply	Rural	Self-Supplied
1985	MGD	NA	1.5	9.4	1.7	3.7	0.0	NA
	% of Total	*NA*	*9%*	*58%*	*11%*	*23%*	*0.0%*	*NA*
1986-1990	MGD	NA	1.2	9.1	1.4	4.0	0.0	NA
	% of Total	*NA*	*8%*	*58%*	*9%*	*25%*	*0.0%*	*NA*
1991-1995	MGD	NA	2.4	13.1	2.5	4.3	0.0	NA
	% of Total	*NA*	*11%*	*59%*	*11%*	*19%*	*0.0%*	*NA*
1996-2000	MGD	0.2	1.3	14.5	6.1	4.7	0.0	NA
	% of Total	*1%*	*5%*	*54%*	*23%*	*17%*	*0.0%*	*NA*
2001-2005	MGD	0.3	0.9	18.3	6.7	4.8	0.0	NA
	% of Total	*1%*	*3%*	*59%*	*22%*	*15%*	*0.0%*	*NA*
2006-2010	MGD	0.3	0.3	17.5	6.3	4.3	0.0	1.2
	% of Total	*1%*	*1%*	*58%*	*21%*	*14%*	*0.1%*	*4%*
2011-2015	MGD	0.3	1.5	18.0	8.0	4.8	0.0	3.2
	% of Total	*1%*	*4%*	*50%*	*22%*	*13%*	*0.0%*	*9%*
2016-2020	MGD	0.2	2.3	21.3	5.5	5.9	0.0	3.2
	% of Total	*0%*	*6%*	*55%*	*14%*	*15%*	*0.1%*	*8%*
2021-2025	MGD	0.1	1.4	23.6	5.3	6.1	0.0	3.3
	% of Total	*0%*	*4%*	*59%*	*13%*	*15%*	*0.0%*	*8%*
2026-2030	MGD	0.1	1.2	22.3	6.4	6.4	0.0	3.4
	% of Total	*0%*	*3%*	*56%*	*16%*	*16%*	*0.1%*	*9%*
2031-2035	MGD	0.1	1.2	22.9	6.4	6.8	0.0	3.5
	% of Total	0%	3%	56%	16%	17%	0.1%	9%
2036-2040	MGD	0.1	1.2	23.2	6.4	7.0	0.0	3.5
	% of Total	*0%*	*3%*	*56%*	*15%*	*17%*	*0.1%*	*9%*
2041-2045	MGD	0.1	1.2	24.9	6.4	7.5	0.0	3.6
	% of Total	*0%*	*3%*	*57%*	*15%*	*17%*	*0.1%*	*8%*
2046-2050	MGD	0.1	1.2	23.3	6.4	7.7	0.0	3.6
	% of Total	*0%*	*3%*	*55%*	*15%*	*18%*	*0.1%*	*9%*
2051-2055	MGD	0.1	1.2	23.6	6.4	8.0	0.0	3.7
	% of Total	*0%*	*3%*	*55%*	*15%*	*19%*	*0.1%*	*9%*
2056-2060	MGD	0.2	1.2	24.4	6.4	8.2	0.0	3.7
	% of Total	*0%*	*3%*	*55%*	*14%*	*19%*	*0.1%*	*8%*
2061-2065	MGD	0.2	1.2	24.8	6.4	8.5	0.0	3.8
	% of Total	*0%*	*3%*	*55%*	*14%*	*19%*	*0.1%*	*8%*
2066-2070	MGD	0.2	1.2	25.0	6.4	8.8	0.0	3.8
	% of Total	*0%*	*3%*	*55%*	*14%*	*19%*	*0.1%*	*8%*
2071-2075	MGD	0.2	1.2	28.0	6.4	9.5	0.0	3.9
	% of Total	*0%*	*3%*	*57%*	*13%*	*19%*	*0.1%*	*8%*

Key:
CAFO = concentrated animal feeding operation
MGD = million gallons per day
NA = not applicable

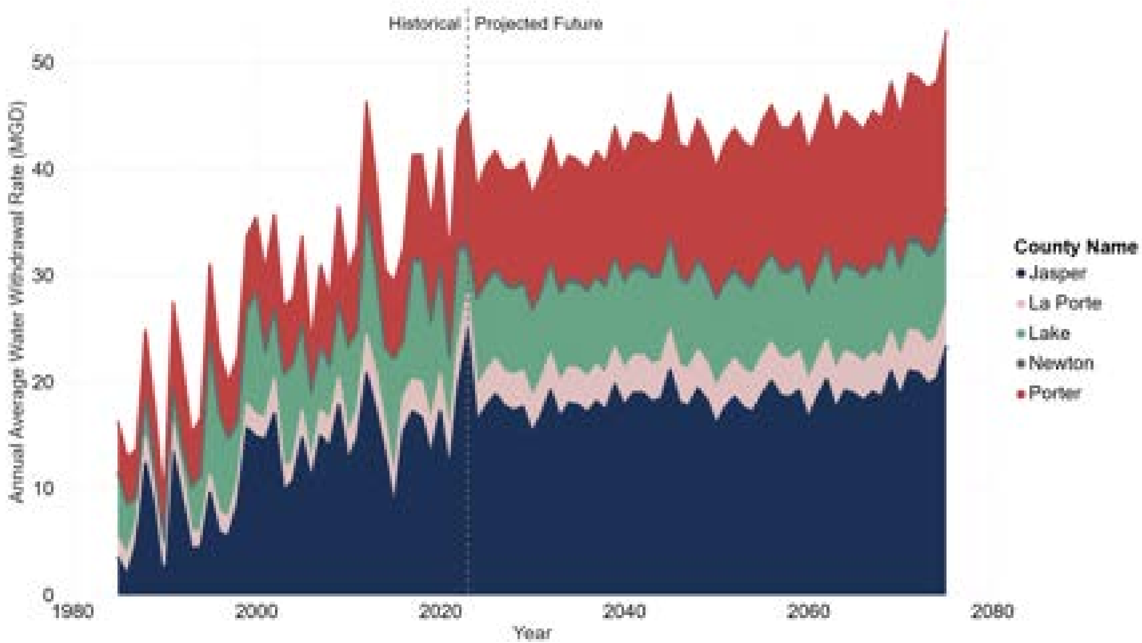
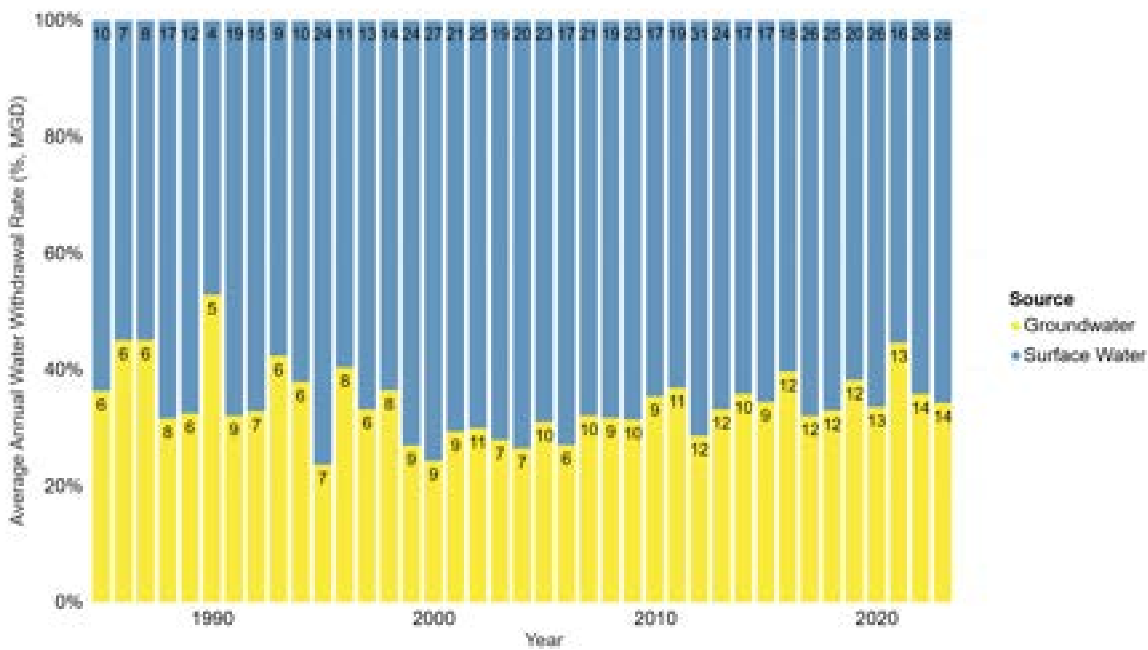


Figure D-13. Kankakee Shelby (Subbasin 4) Historical (1985 to 2023) and Projected Future (2024 to 2075) Annual Water Demand in Kankakee Basin, by County, Millions of Gallons per Day



Source: Significant Water Withdrawal Facility data 1985 to 2023 (IDNR 2025)

Note: SWWF database only includes sectors reporting to IDNR: energy production, industrial, irrigation, miscellaneous, public supply, and rural use.

Figure D-14. Kankakee Shelby (Subbasin 4) Significant Water Withdrawals Database by Source, All Subbasins, Millions of Gallons per Day, Percent of Total

D.2.5 SUBBASIN 5, KANKAKEE MOMENCE

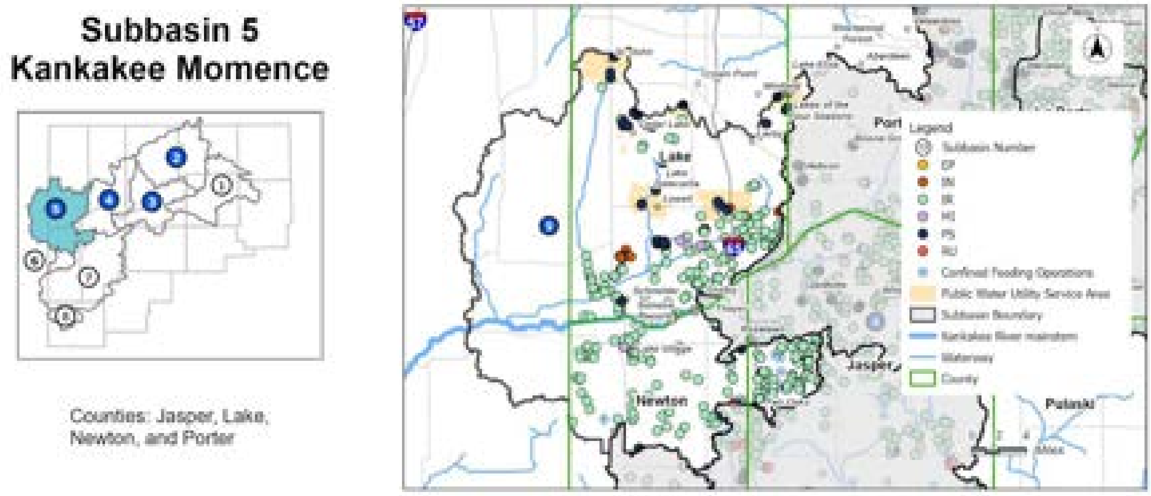


Figure D-15 Subbasin Key Map (left), Kankakee Momence (Subbasin 5) Detail Map (right)

Table D-11. Kankakee Momence (Subbasin 5) Average Historical and Projected Future Monthly Water Demand by 5-Year Period, All Water Use Sectors, Millions of Gallons per Day

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	1.8	1.7	1.5	3.7	5.5	19.3	61.1	26.4	6.4	1.8	1.8	1.9
1986-1990	2.1	2.1	1.8	2.2	4.3	18.6	41.4	33.8	4.4	2.1	1.8	2.0
1991-1995	3.3	3.8	3.5	4.8	12.0	31.2	39.1	33.7	8.5	4.1	3.7	4.1
1996-2000	5.7	5.7	5.1	5.2	7.8	17.3	36.7	36.2	11.0	7.9	6.4	5.4
2001-2005	4.3	4.9	4.5	5.2	7.1	22.4	41.2	42.5	11.1	5.8	4.4	4.7
2006-2010	11.3	11.0	10.7	10.2	12.8	25.9	48.4	40.4	15.7	10.5	9.9	9.7
2011-2015	11.6	12.0	11.3	12.2	15.9	30.6	52.1	48.9	20.8	14.1	13.0	12.7
2016-2020	13.4	11.9	13.2	14.3	17.2	34.8	47.6	48.0	22.0	16.5	15.3	15.0
2021-2025	12.7	13.9	14.0	15.8	20.1	39.3	50.6	50.6	28.7	19.1	14.4	14.6
2026-2030	12.2	13.1	12.9	14.4	19.6	34.2	49.5	52.4	23.6	16.1	13.9	13.3
2031-2035	12.0	13.6	12.6	16.7	22.7	35.4	52.1	49.4	23.2	17.1	14.2	13.0
2036-2040	12.9	13.6	12.9	15.8	21.8	35.4	52.1	52.1	24.0	16.8	14.7	13.5
2041-2045	13.3	13.9	13.3	17.9	23.1	42.6	54.1	55.5	27.2	16.5	13.7	13.6
2046-2050	13.1	14.1	13.2	15.6	23.3	38.6	53.0	55.0	22.8	18.5	13.8	14.4
2051-2055	12.6	14.5	13.9	14.8	22.6	37.5	51.9	56.1	27.1	19.9	14.5	15.0
2056-2060	13.9	13.8	14.6	16.0	22.8	38.5	51.4	56.9	28.0	20.0	15.4	14.7
2061-2065	13.3	14.5	14.2	18.4	25.3	39.4	54.3	52.9	27.6	20.6	15.6	14.4
2066-2070	14.1	14.2	14.3	17.6	24.5	38.9	55.2	55.3	28.2	20.2	15.8	14.8
2071-2075	14.2	14.8	14.3	21.7	28.4	49.8	60.9	60.8	31.0	19.8	15.2	14.9

Note: Darker colored shading indicates the highest withdrawal rates and the lighter shading indicates the lowest.

Table D-12. Kankakee Momence (Subbasin 5) Average Historical and Projected Future Water Demand by 5-Year Period, by Sector, Millions of Gallons per Day and Percent of Total within the Subbasin

Period	Unit	Sector						
		CAFO	Energy Production	Industrial	Irrigation	Misc.	Public Supply	Self-Supplied
1985	MGD	NA	0.0	0.0	9.3	0.1	1.8	0.0
	% of Total	NA	NA	0%	84%	1%	16%	0%
1986-1990	MGD	NA	0.0	0.0	7.8	0.1	1.9	0.0
	% of Total	NA	NA	0%	80%	1%	20%	0%
1991-1995	MGD	NA	0.0	1.6	8.2	0.7	2.2	0.0
	% of Total	NA	NA	13%	64%	5%	17%	0%
1996-2000	MGD	0.0	0.0	3.0	6.8	0.5	2.3	0.0
	% of Total	0%	NA	24%	54%	4%	18%	0%
2001-2005	MGD	0.1	0.0	1.9	8.6	0.1	2.6	0.0
	% of Total	1%	0%	14%	65%	1%	19%	0%
2006-2010	MGD	0.2	0.0	5.6	7.6	0.2	2.9	1.7
	% of Total	1%	0%	31%	42%	1%	16%	9%
2011-2015	MGD	0.4	0.0	5.4	8.2	0.1	2.9	4.2
	% of Total	2%	0%	25%	38%	1%	14%	20%
2016-2020	MGD	0.5	0.0	7.0	7.6	0.2	3.1	4.2
	% of Total	2%	0%	31%	34%	1%	14%	18%
2021-2025	MGD	0.5	0.0	7.0	8.9	0.8	3.1	4.3
	% of Total	2%	0%	29%	36%	3%	13%	17%
2026-2030	MGD	0.5	0.0	5.3	9.1	0.1	3.5	4.5
	% of Total	2%	0%	23%	40%	0%	15%	20%
2031-2035	MGD	0.5	0.0	5.3	9.2	0.1	3.8	4.8
	% of Total	2%	0%	22%	39%	0%	16%	20%
2036-2040	MGD	0.5	0.0	5.3	9.1	0.1	3.9	4.9
	% of Total	2%	0%	22%	38%	0%	16%	21%
2041-2045	MGD	0.5	0.0	5.3	10.3	0.1	4.1	5.1
	% of Total	2%	0%	21%	41%	0%	16%	20%
2046-2050	MGD	0.5	0.0	5.3	9.4	0.1	4.2	5.2
	% of Total	2%	0%	21%	38%	0%	17%	21%
2051-2055	MGD	0.6	0.0	5.3	9.6	0.1	4.3	5.3
	% of Total	2%	0%	21%	38%	0%	17%	21%
2056-2060	MGD	0.6	0.0	5.3	9.7	0.1	4.5	5.4
	% of Total	2%	0%	21%	38%	0%	18%	21%
2061-2065	MGD	0.6	0.0	5.3	9.7	0.1	4.7	5.5
	% of Total	2%	0%	20%	38%	0%	18%	21%
2066-2070	MGD	0.6	0.0	5.3	9.8	0.1	4.8	5.7
	% of Total	2%	0%	20%	37%	0%	18%	22%
2071-2075	MGD	0.6	0.0	5.3	12.0	0.1	5.1	5.8
	% of Total	2%	0%	18%	42%	0%	18%	20%

Key:
CAFO = concentrated animal feeding operation
MGD = million gallons per day
NA = not applicable

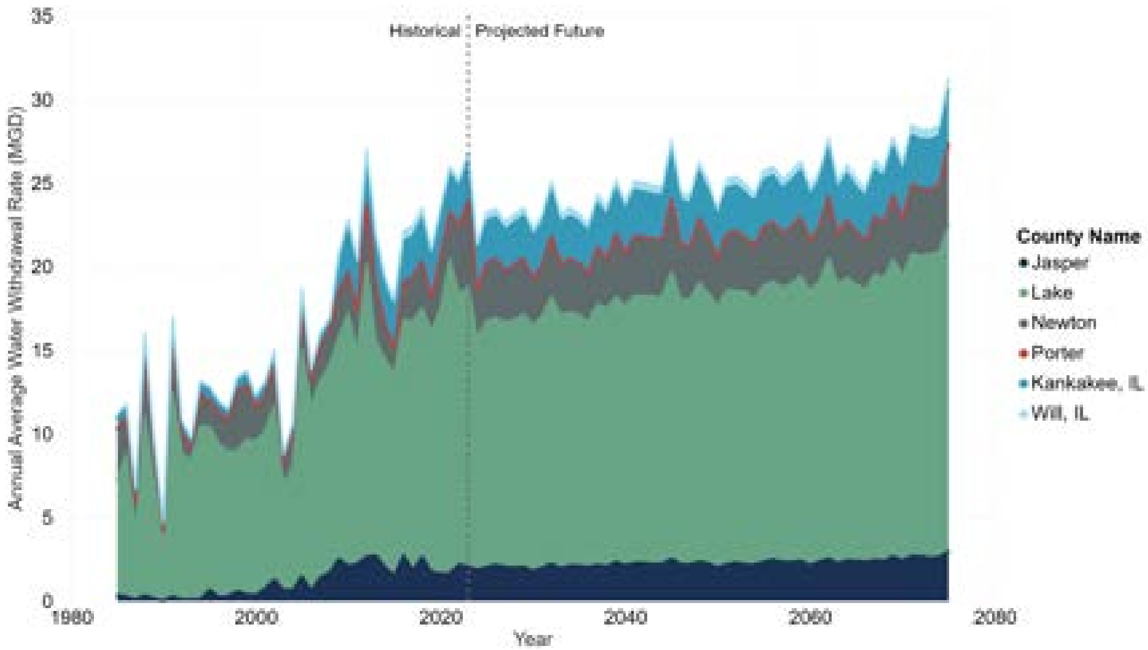
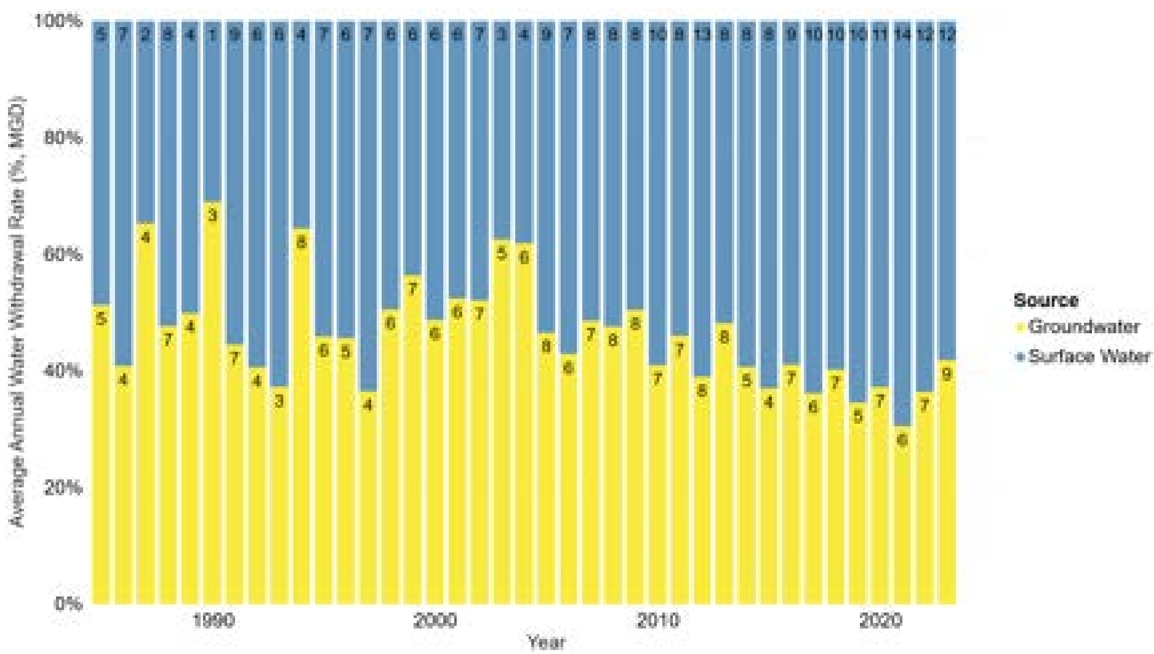


Figure D-16. Kankakee Momence (Subbasin 5) Historical (1985 to 2023) and Projected Future (2024 to 2075) Annual Water Demand in Kankakee Basin, by County, Millions of Gallons per Day



Source: Significant Water Withdrawal Facility data 1985 to 2023 (IDNR 2025)

Note: SWWF database only includes sectors reporting to IDNR: energy production, industrial, irrigation, miscellaneous, public supply, and rural use.

Figure D-17. Kankakee Momence (Subbasin 5) Significant Water Withdrawals Database by Source, All Subbasins, Millions of Gallons per Day, Percent of Total

D.2.6 SUBBASIN 6, BEAVER

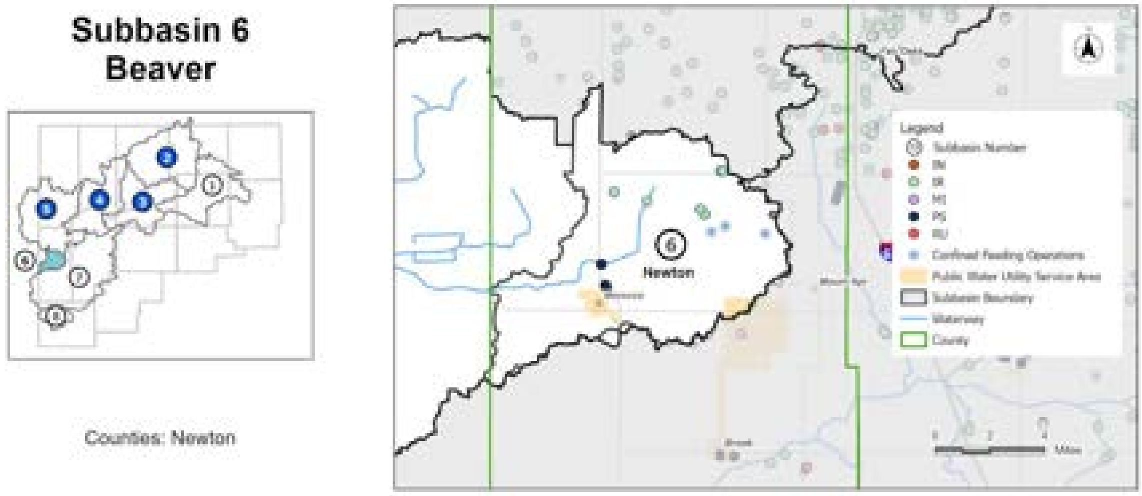


Figure D-18 Subbasin Key Map (left), Beaver (Subbasin 6) Detail Map (right)

Table D-13. Beaver (Subbasin 6) Average Historical and Projected Future Monthly Water Demand by 5-Year Period, All Water Use Sectors, Millions of Gallons per Day

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
1986-1990	0.1	0.1	0.1	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
1991-1995	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1996-2000	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2001-2005	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.3	0.1	0.1	0.1	0.1
2006-2010	0.1	0.1	0.1	0.1	0.1	0.2	0.4	0.3	0.1	0.1	0.1	0.1
2011-2015	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.5	0.2	0.1	0.1	0.1
2016-2020	0.2	0.2	0.2	0.2	0.2	0.3	0.6	0.4	0.2	0.2	0.2	0.2
2021-2025	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.5	0.3	0.2	0.2	0.2
2026-2030	0.2	0.2	0.2	0.2	0.3	0.4	0.5	0.5	0.3	0.2	0.2	0.2
2031-2035	0.2	0.2	0.2	0.2	0.3	0.4	0.5	0.5	0.3	0.2	0.2	0.2
2036-2040	0.2	0.2	0.2	0.2	0.3	0.4	0.6	0.5	0.3	0.2	0.2	0.2
2041-2045	0.2	0.2	0.2	0.3	0.3	0.5	0.6	0.5	0.3	0.2	0.2	0.2
2046-2050	0.2	0.2	0.2	0.3	0.3	0.4	0.6	0.5	0.3	0.2	0.2	0.2
2051-2055	0.2	0.2	0.2	0.2	0.3	0.4	0.6	0.6	0.3	0.3	0.2	0.2
2056-2060	0.2	0.2	0.2	0.2	0.3	0.4	0.6	0.6	0.3	0.2	0.2	0.2
2061-2065	0.2	0.2	0.2	0.3	0.3	0.4	0.6	0.5	0.3	0.3	0.2	0.2
2066-2070	0.2	0.2	0.2	0.3	0.3	0.4	0.6	0.6	0.4	0.3	0.2	0.2
2071-2075	0.2	0.3	0.2	0.3	0.4	0.6	0.7	0.6	0.4	0.3	0.2	0.2

Note: Darker colored shading indicates the highest withdrawal rates and the lighter shading indicates the lowest.

Table D-14. Beaver (Subbasin 6) Average Historical and Projected Future Water Demand by 5-Year Period, by Sector, Millions of Gallons per Day and Percent of Total within the Subbasin

Period	Unit	Sector			
		CAFO	Irrigation	Public Supply	Self-Supplied
1985	MGD	NA	0.00	0.11	NA
	% of Total	NA	0%	100%	NA
1986-1990	MGD	NA	0.00	0.11	NA
	% of Total	NA	13%	87%	NA
1991-1995	MGD	NA	0.00	0.11	NA
	% of Total	NA	0%	100%	NA
1996-2000	MGD	0.00	0.00	0.10	NA
	% of Total	0%	0%	100%	NA
2001-2005	MGD	0.00	0.04	0.11	NA
	% of Total	0%	29%	71%	NA
2006-2010	MGD	0.01	0.04	0.10	0.02
	% of Total	8%	24%	58%	10%
2011-2015	MGD	0.04	0.04	0.08	0.04
	% of Total	21%	21%	37%	20%
2016-2020	MGD	0.04	0.05	0.08	0.04
	% of Total	20%	25%	37%	19%
2021-2025	MGD	0.04	0.07	0.10	0.04
	% of Total	18%	27%	40%	16%
2026-2030	MGD	0.07	0.06	0.09	0.04
	% of Total	27%	23%	35%	15%
2031-2035	MGD	0.07	0.07	0.10	0.04
	% of Total	26%	24%	35%	14%
2036-2040	MGD	0.08	0.07	0.09	0.04
	% of Total	30%	24%	33%	14%
2041-2045	MGD	0.09	0.08	0.10	0.04
	% of Total	28%	26%	34%	12%
2046-2050	MGD	0.11	0.07	0.10	0.04
	% of Total	35%	21%	32%	12%
2051-2055	MGD	0.12	0.07	0.09	0.04
	% of Total	37%	23%	30%	11%
2056-2060	MGD	0.12	0.07	0.08	0.04
	% of Total	41%	22%	26%	12%
2061-2065	MGD	0.13	0.07	0.08	0.04
	% of Total	41%	23%	25%	11%
2066-2070	MGD	0.15	0.07	0.08	0.03
	% of Total	45%	21%	24%	10%
2071-2075	MGD	0.15	0.10	0.08	0.03
	% of Total	42%	27%	22%	9%

Key:
CAFO = concentrated animal feeding operation
MGD = million gallons per day
NA = not applicable

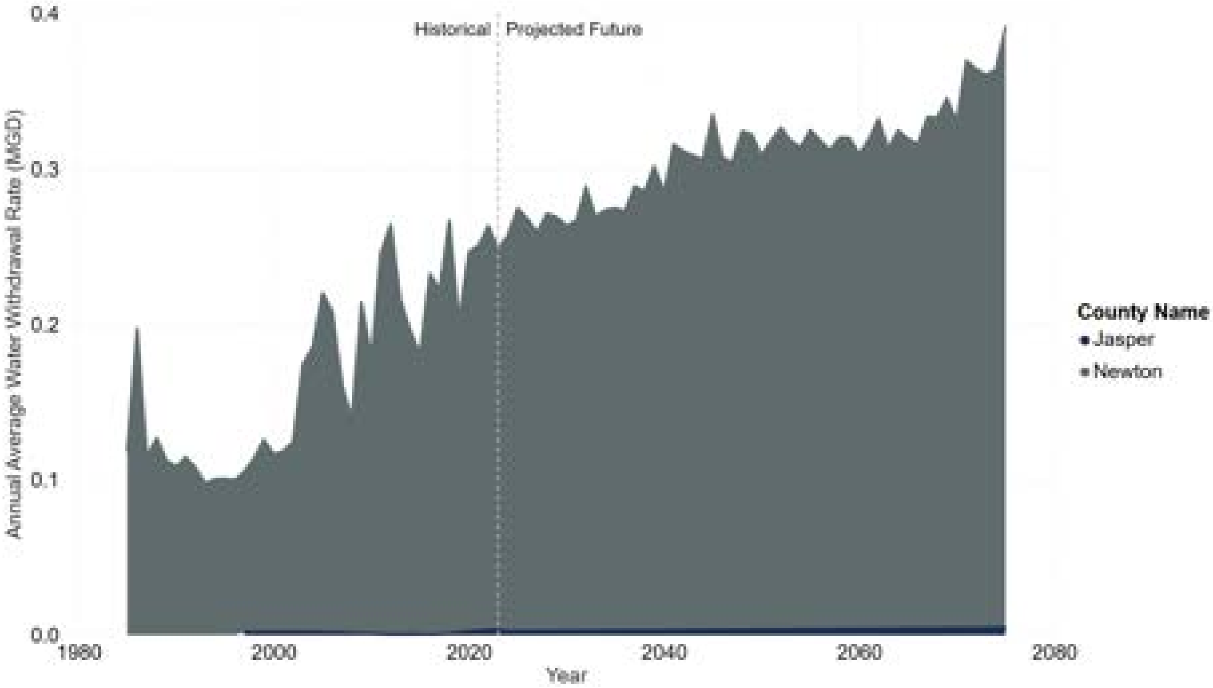
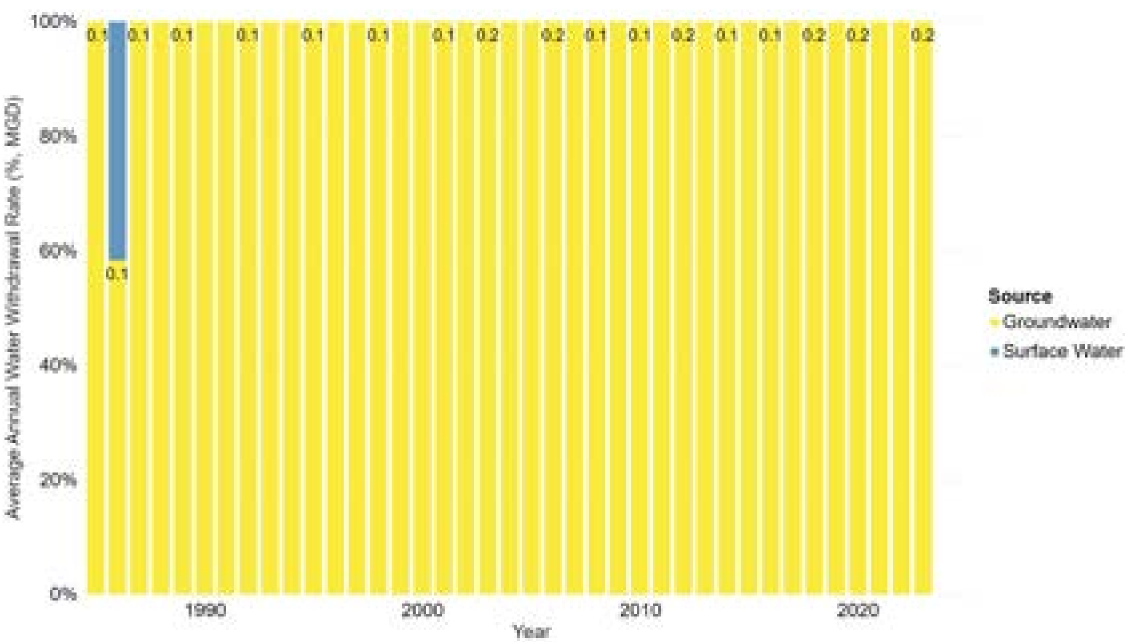


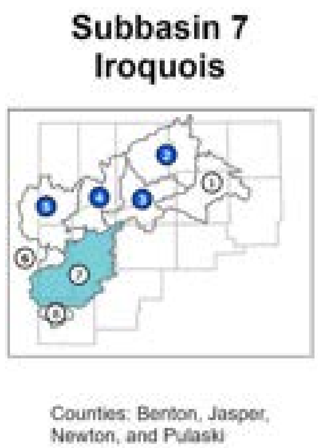
Figure D-19. Beaver (Subbasin 6) Historical (1985 to 2023) and Projected Future (2024 to 2075) Annual Water Demand in Kankakee Basin, by County, Millions of Gallons per Day



Source: Significant Water Withdrawal Facility data 1985 to 2023 (IDNR 2025)
Note: SWWF database only includes sectors reporting to IDNR: energy production, industrial, irrigation, miscellaneous, public supply, and rural use.

Figure D-20. Beaver (Subbasin 6) Significant Water Withdrawals Database by Source, All Subbasins, Percent of Total, Millions of Gallons per Day

D.2.7 SUBBASIN 7, IROQUOIS



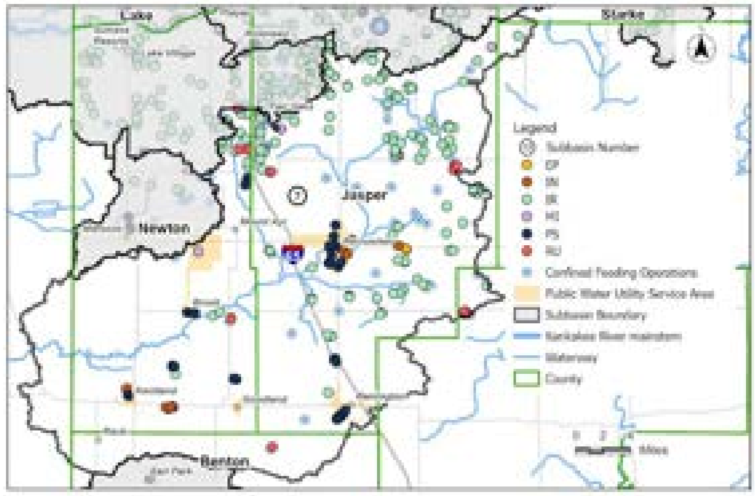


Figure D-21 Subbasin Key Map (left), Iroquois (Subbasin 7) Detail Map (right)

Table D-15. Iroquois (Subbasin 7) Average Historical and Projected Future Monthly Water Demand by 5-Year Period, All Water Use Sectors, Millions of Gallons per Day

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	3.0	3.0	3.0	3.1	4.9	12.7	25.0	9.2	4.1	2.9	2.8	3.0
1986-1990	3.5	3.5	3.7	4.1	5.5	11.6	19.4	16.1	5.4	4.0	3.9	3.6
1991-1995	3.6	3.7	3.6	3.7	4.6	10.8	17.1	14.9	5.0	4.0	3.6	3.5
1996-2000	5.1	5.2	5.3	5.4	5.9	8.2	16.2	14.6	7.5	5.6	5.2	5.0
2001-2005	6.8	6.6	7.4	7.3	8.4	12.7	16.4	14.6	9.9	7.1	6.6	6.0
2006-2010	6.2	7.2	7.0	7.7	7.9	12.1	18.4	15.4	8.8	6.8	6.7	6.6
2011-2015	6.6	6.7	7.1	8.6	9.4	14.1	20.4	18.1	10.7	7.6	7.1	6.7
2016-2020	7.0	6.8	6.8	7.8	8.3	12.1	18.5	17.0	9.6	7.7	7.3	6.8
2021-2025	6.4	6.8	6.4	6.5	7.9	14.3	20.0	18.3	9.6	7.2	6.8	6.4
2026-2030	7.6	8.0	7.8	7.8	9.3	13.7	20.7	20.7	10.6	8.2	7.9	7.8
2031-2035	7.6	8.3	7.7	8.6	10.1	13.8	21.9	19.7	10.8	8.4	7.9	7.7
2036-2040	8.1	8.6	7.9	8.6	9.6	14.3	22.8	21.1	11.3	8.6	8.4	8.1
2041-2045	8.5	9.0	8.4	9.2	10.5	16.8	23.6	22.3	12.6	8.7	8.4	8.5
2046-2050	8.8	9.4	8.6	8.8	10.9	15.8	23.3	22.7	11.6	9.4	8.7	9.0
2051-2055	9.0	9.8	9.0	8.7	10.7	15.5	23.6	23.5	13.2	10.1	9.0	9.4
2056-2060	9.6	9.7	9.5	9.1	11.4	16.5	23.5	24.0	13.6	10.4	9.5	9.5
2061-2065	9.7	10.4	9.5	9.8	12.4	16.8	25.0	23.0	14.0	10.9	9.7	9.8
2066-2070	10.2	10.6	9.8	9.9	11.9	17.1	26.1	24.3	14.5	11.1	10.0	10.1
2071-2075	10.5	11.0	10.1	11.1	13.4	20.6	27.7	26.2	15.5	11.1	10.2	10.4

Note: Darker colored shading indicates the highest withdrawal rates and the lighter shading indicates the lowest.

Table D-16. Iroquois (Subbasin 7) Average Historical and Projected Future Water Demand by 5-Year Period, by Sector, Millions of Gallons per Day and Percent of Total within the Subbasin

Period	Unit	Sector							
		CAFO	Energy Production	Industrial	Irrigation	Misc.	Public Supply	Rural	Self-Supplied
1985	MGD	NA	0.0	1.4	3.4	0.0	1.6	0.0	NA
	% of Total	*NA*	*NA*	*22%*	*53%*	*0%*	*25%*	*0%*	*NA*
1986-1990	MGD	NA	0.0	2.2	3.2	0.0	1.7	0.0	NA
	% of Total	*NA*	*NA*	*31%*	*46%*	*0%*	*23%*	*0%*	*NA*
1991-1995	MGD	NA	0.0	1.9	2.8	0.0	1.7	0.0	NA
	% of Total	*NA*	*NA*	*30%*	*44%*	*0%*	*26%*	*0%*	*NA*
1996-2000	MGD	0.2	0.0	3.3	2.0	0.0	1.8	0.2	NA
	% of Total	*2%*	*NA*	*44%*	*27%*	*0%*	*24%*	*2%*	*NA*
2001-2005	MGD	0.4	0.0	3.8	2.1	0.0	1.7	1.2	NA
	% of Total	*5%*	*0%*	*41%*	*23%*	*0%*	*18%*	*13%*	*NA*
2006-2010	MGD	0.6	0.0	3.4	2.5	0.0	1.6	0.9	0.3
	% of Total	*6%*	*0%*	*37%*	*27%*	*0%*	*17%*	*9%*	*3%*
2011-2015	MGD	0.8	0.0	3.3	3.0	0.0	1.6	0.7	0.8
	% of Total	*8%*	*0%*	*32%*	*29%*	*0%*	*15%*	*7%*	*8%*
2016-2020	MGD	1.1	0.0	3.0	2.4	0.0	1.5	0.9	0.8
	% of Total	*11%*	*0%*	*31%*	*25%*	*0%*	*16%*	*10%*	*8%*
2021-2025	MGD	1.2	0.0	2.0	3.1	0.1	1.6	1.0	0.8
	% of Total	*13%*	*0%*	*21%*	*31%*	*1%*	*16%*	*10%*	*8%*
2026-2030	MGD	1.5	0.0	3.1	3.0	0.0	1.5	0.9	0.8
	% of Total	*13%*	*0%*	*29%*	*28%*	*0%*	*14%*	*8%*	*7%*
2031-2035	MGD	1.7	0.1	3.1	3.0	0.0	1.5	0.9	0.8
	% of Total	*15%*	*1%*	*28%*	*28%*	*0%*	*13%*	*8%*	*7%*
2036-2040	MGD	1.9	0.3	3.1	3.1	0.0	1.4	0.9	0.8
	% of Total	*16%*	*2%*	*27%*	*27%*	*0%*	*12%*	*8%*	*7%*
2041-2045	MGD	2.1	0.5	3.1	3.5	0.0	1.4	0.9	0.8
	% of Total	*17%*	*4%*	*25%*	*28%*	*0%*	*11%*	*8%*	*6%*
2046-2050	MGD	2.3	0.7	3.1	3.2	0.0	1.3	0.9	0.7
	% of Total	*19%*	*6%*	*25%*	*26%*	*0%*	*11%*	*8%*	*6%*
2051-2055	MGD	2.5	0.9	3.1	3.2	0.0	1.2	0.9	0.7
	% of Total	*20%*	*7%*	*25%*	*26%*	*0%*	*10%*	*7%*	*6%*
2056-2060	MGD	2.7	1.1	3.1	3.3	0.0	1.2	0.9	0.7
	% of Total	*21%*	*9%*	*24%*	*25%*	*0%*	*9%*	*7%*	*5%*
2061-2065	MGD	2.9	1.3	3.1	3.3	0.0	1.1	0.9	0.7
	% of Total	*22%*	*10%*	*23%*	*25%*	*0%*	*8%*	*7%*	*5%*
2066-2070	MGD	3.1	1.5	3.1	3.4	0.0	1.1	0.9	0.7
	% of Total	*23%*	*11%*	*23%*	*25%*	*0%*	*8%*	*7%*	*5%*
2071-2075	MGD	3.3	1.8	3.1	4.0	0.0	1.0	0.9	0.7
	% of Total	*22%*	*12%*	*21%*	*27%*	*0%*	*7%*	*6%*	*5%*

Key:
CAFO = concentrated animal feeding operation
MGD = million gallons per day
NA = not applicable

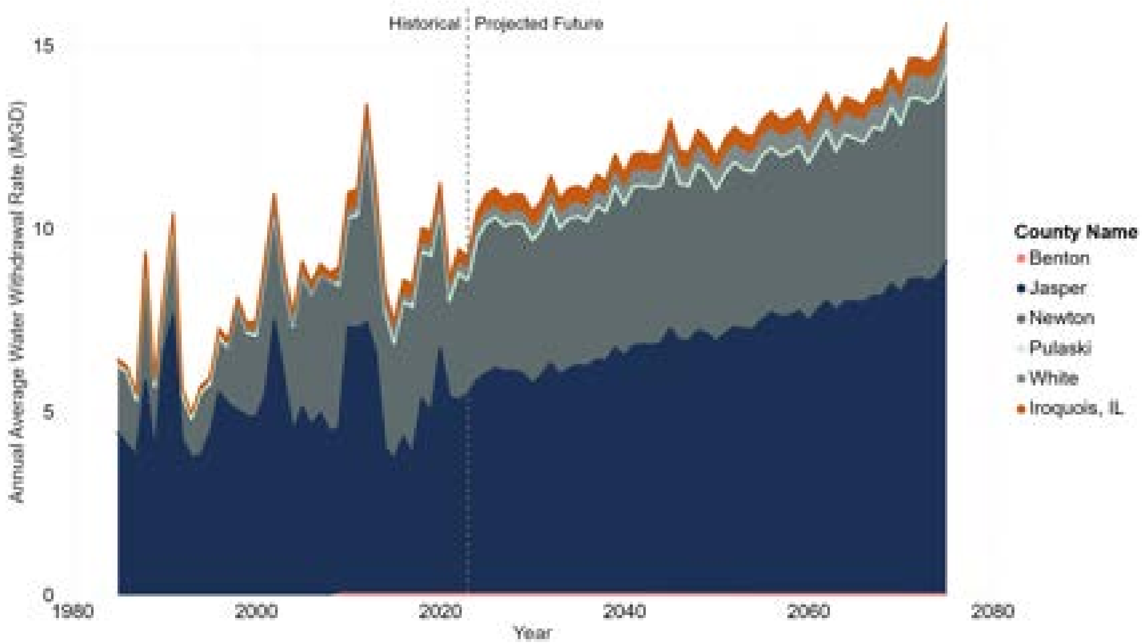
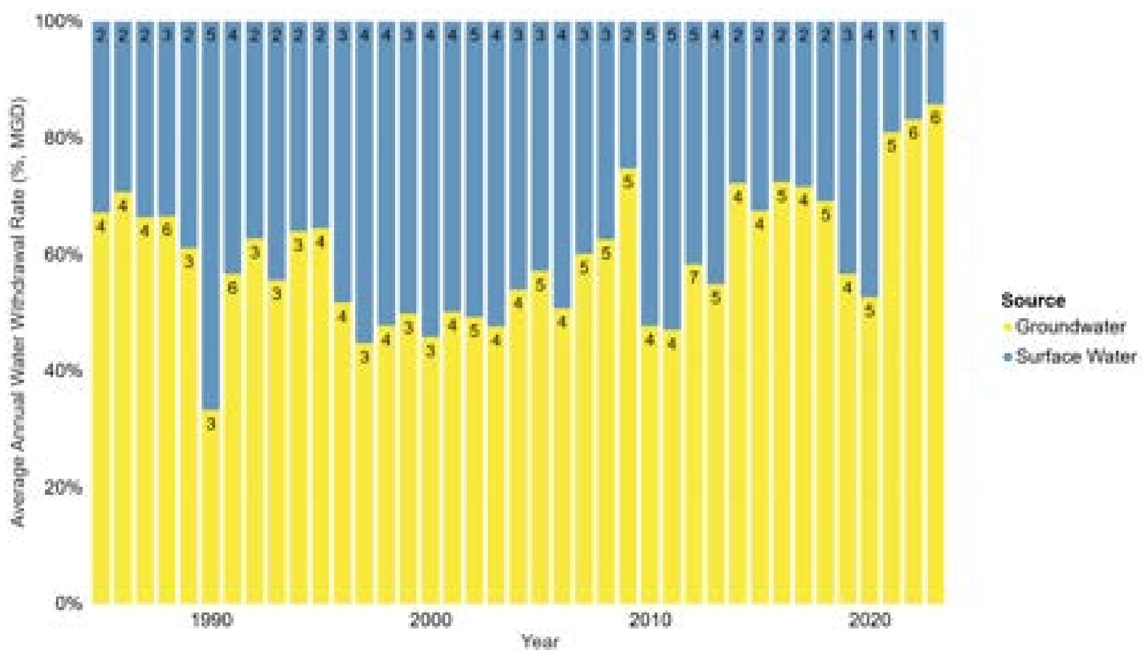


Figure D-22. Iroquois (Subbasin 7) Historical (1985 to 2023) and Projected Future (2024 to 2075) Annual Water Demand in Kankakee Basin, by County, Millions of Gallons per Day



Source: Significant Water Withdrawal Facility data 1985 to 2023 (IDNR 2025)

Note: SWWF database only includes sectors reporting to IDNR: energy production, industrial, irrigation, miscellaneous, public supply, and rural use.

Figure D-23. Iroquois (Subbasin 7) Significant Water Withdrawals Database by Source, All Subbasins, Percent of Total, Millions of Gallons per Day

D.2.8 SUBBASIN 8, SUGAR

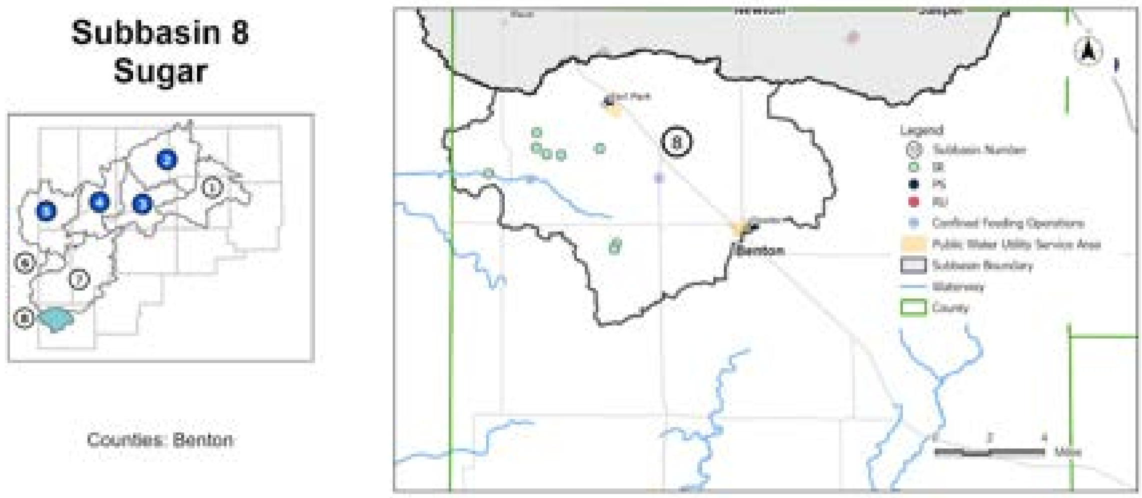


Figure D-24 Subbasin Key Map (left), Sugar (Subbasin 8) Detail Map (right)

Table D-17. Sugar (Subbasin 8) Average Historical and Projected Future Monthly Water Demand by 5-Year Period, All Water Use Sectors, Millions of Gallons per Day

Period	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
1986-1990	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
1991-1995	0.2	0.2	0.2	0.2	0.3	0.6	0.5	0.7	0.3	0.2	0.2	0.2
1996-2000	0.2	0.2	0.2	0.2	0.3	0.3	0.7	1.3	0.3	0.2	0.2	0.2
2001-2005	0.3	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.2
2006-2010	0.2	0.2	0.2	0.2	0.2	0.4	0.5	0.6	0.2	0.2	0.2	0.2
2011-2015	0.2	0.2	0.2	0.2	0.2	0.9	1.7	1.9	0.2	0.2	0.2	0.2
2016-2020	0.2	0.2	0.2	0.2	0.2	0.4	0.7	0.5	0.2	0.2	0.2	0.2
2021-2025	0.3	0.3	0.3	0.4	0.3	0.5	0.7	0.7	0.4	0.3	0.3	0.3
2026-2030	0.3	0.3	0.3	0.3	0.5	0.9	1.1	1.4	0.5	0.3	0.3	0.3
2031-2035	0.3	0.3	0.3	0.4	0.6	0.9	1.3	1.4	0.6	0.4	0.3	0.3
2036-2040	0.5	0.5	0.4	0.5	0.7	1.1	1.5	1.7	0.8	0.5	0.4	0.5
2041-2045	0.7	0.7	0.6	0.6	0.9	1.5	1.8	1.9	1.1	0.6	0.6	0.7
2046-2050	0.8	0.9	0.7	0.6	1.1	1.6	1.9	2.1	1.2	0.8	0.7	0.8
2051-2055	1.0	1.0	0.9	0.7	1.1	1.7	2.1	2.3	1.4	1.0	0.8	1.0
2056-2060	1.2	1.2	1.0	0.7	1.3	1.9	2.2	2.5	1.6	1.1	1.0	1.1
2061-2065	1.3	1.4	1.1	0.9	1.5	2.0	2.4	2.6	1.7	1.2	1.1	1.2
2066-2070	1.5	1.5	1.2	0.9	1.6	2.2	2.7	2.9	1.9	1.4	1.2	1.4
2071-2075	1.6	1.7	1.3	1.1	1.8	2.6	3.0	3.1	2.2	1.5	1.3	1.5

Note: Darker colored shading indicates the highest withdrawal rates and the lighter shading indicates the lowest.

Table D-18. Sugar (Subbasin 8) Average Historical and Projected Future Water Demand by 5-Year Period, by Sector, Millions of Gallons per Day and Percent of Total within the Subbasin

Period	Unit	Sector				
		CAFO	Energy Production	Irrigation	Public Supply	Self-Supplied
1985	MGD	NA	NA	0.00	0.3	NA
	% of Total	*NA*	*NA*	*0%*	*100%*	*NA*
1986-1990	MGD	NA	NA	0.00	0.23	NA
	% of Total	*NA*	*NA*	*0%*	*100%*	*NA*
1991-1995	MGD	NA	NA	0.08	0.2	NA
	% of Total	*NA*	*NA*	*24%*	*76%*	*NA*
1996-2000	MGD	0.01	NA	0.12	0.24	NA
	% of Total	*2%*	*NA*	*33%*	*65%*	*NA*
2001-2005	MGD	0.01	0.00	0.02	0.24	NA
	% of Total	*2%*	*0%*	*9%*	*89%*	*NA*
2006-2010	MGD	0.01	0.00	0.07	0.19	0.0
	% of Total	*2%*	*0%*	*26%*	*72%*	*0%*
2011-2015	MGD	0.01	0.00	0.31	0.18	0.0
	% of Total	*1%*	*0%*	*59%*	*34%*	*6%*
2016-2020	MGD	0.04	0.00	0.06	0.17	0.0
	% of Total	*13%*	*0%*	*20%*	*56%*	*11%*
2021-2025	MGD	0.08	0.00	0.09	0.17	0.0
	% of Total	*22%*	*0%*	*24%*	*45%*	*9%*
2026-2030	MGD	0.08	0.03	0.24	0.17	0.0
	% of Total	*15%*	*5%*	*43%*	*30%*	*6%*
2031-2035	MGD	0.11	0.03	0.25	0.16	0.0
	% of Total	*19%*	*6%*	*42%*	*28%*	*6%*
2036-2040	MGD	0.12	0.16	0.28	0.16	0.0
	% of Total	*16%*	*21%*	*37%*	*21%*	*4%*
2041-2045	MGD	0.15	0.33	0.32	0.16	0.0
	% of Total	*15%*	*33%*	*32%*	*16%*	*3%*
2046-2050	MGD	0.15	0.45	0.30	0.16	0.0
	% of Total	*14%*	*41%*	*28%*	*14%*	*3%*
2051-2055	MGD	0.17	0.58	0.32	0.15	0.0
	% of Total	*14%*	*46%*	*25%*	*12%*	*3%*
2056-2060	MGD	0.18	0.71	0.33	0.15	0.0
	% of Total	*13%*	*51%*	*24%*	*10%*	*2%*
2061-2065	MGD	0.20	0.83	0.34	0.15	0.0
	% of Total	*13%*	*54%*	*22%*	*9%*	*2%*
2066-2070	MGD	0.22	0.97	0.36	0.14	0.0
	% of Total	*13%*	*56%*	*21%*	*8%*	*2%*
2071-2075	MGD	0.24	1.10	0.42	0.13	0.0
	% of Total	*12%*	*57%*	*22%*	*7%*	*2%*

Key:
CAFO = concentrated animal feeding operation
MGD = million gallons per day
NA = not applicable

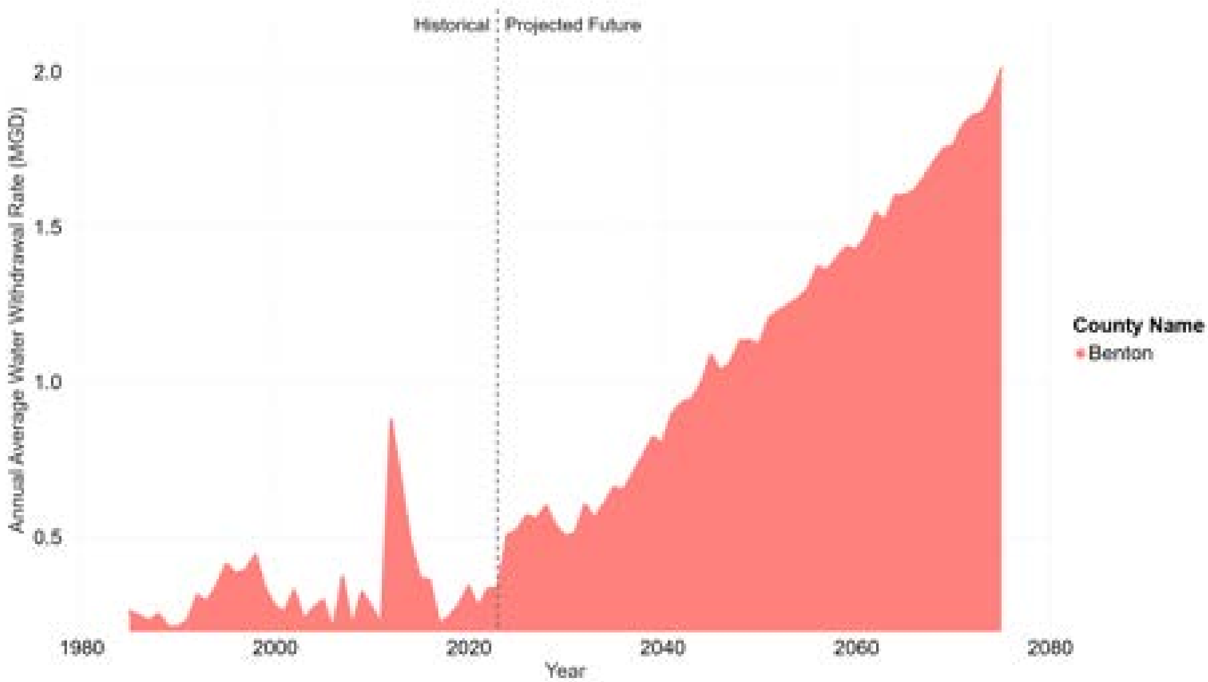
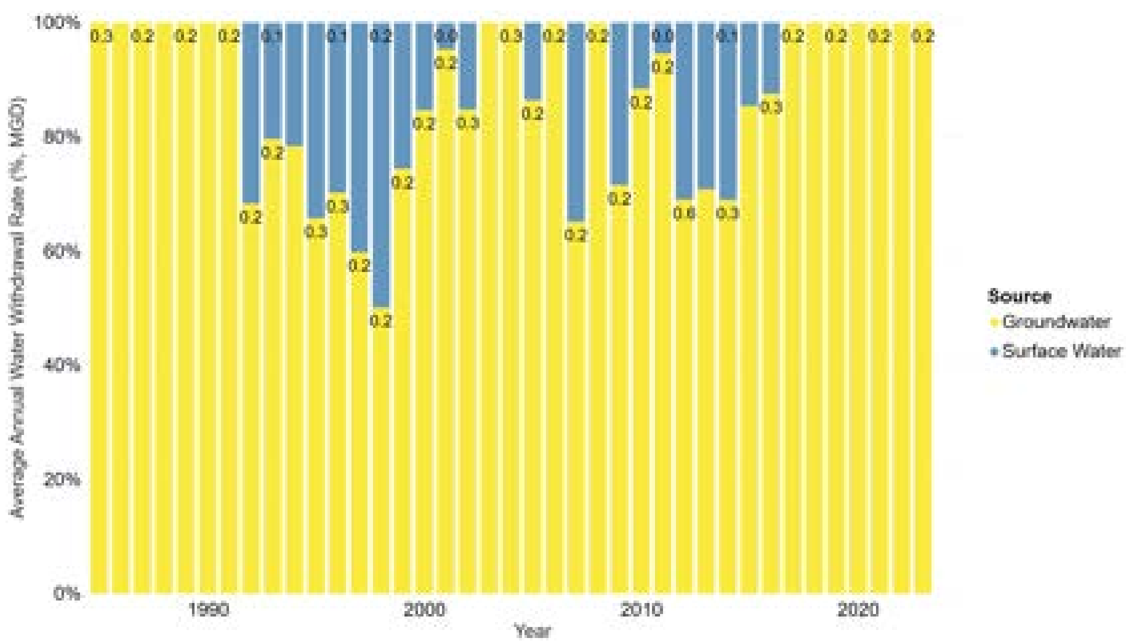


Figure D-25. Sugar (Subbasin 8) Historical (1985 to 2023) and Projected Future (2024 to 2075) Annual Water Demand in Kankakee Basin, by County, Millions of Gallons per Day



Source: Significant Water Withdrawal Facility data 1985 to 2023 (IDNR 2025)
Note: SWWF database only includes sectors reporting to IDNR: energy production, industrial, irrigation, miscellaneous, public supply, and rural use.

Figure D-26. Sugar (Subbasin 8) Significant Water Withdrawals Database by Source, All Subbasins, Percent of Total, Millions of Gallons per Day

D.3 References

National Weather Service. (n.d.). *The Drought of 2012*. NOAA Weather.gov. https://www.weather.gov/iwx/2012_Drought

Indiana Department of Natural Resources (IDNR). 2025. Significant Water Withdrawal Facility data 1985 to 2023. https://www.in.gov/dnr/water/water-availability-use-rights/significant-water-withdrawal-facility-data/

APPENDIX E

Development of Future Baseline Data

Stantec

Kankakee Basin Regional Water Study

Appendix E – Development of Future Baseline Data

December 2025

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LIST OF FIGURES

ABBREVIATIONS

BCSD	Bias Correction and Spatial Disaggregation
CD	Classic Delta
EP	energy production
GCM	global climate model

HD	Hybrid Delta
IN	industry
INCCIA	Indiana Climate Change Impacts Assessment
NPDES	National Pollutant Discharge Elimination System
PS	public supply
RCP	Representative Concentration Pathway
SWWF	Significant Water Withdrawal Facility
USGS	U.S. Geological Survey
VIC	Variable Infiltration Capacity

Appendix E Development of Future Baseline Data

The methodology for developing future baseline water demand projections is described in Appendix D, and results are summarized by subbasin in Appendix E. To develop the water budget analysis, future baseline projections were required for natural streamflow, natural baseflow, instream flow, and return flow. This appendix describes methods used to develop a future baseline time series for these components.

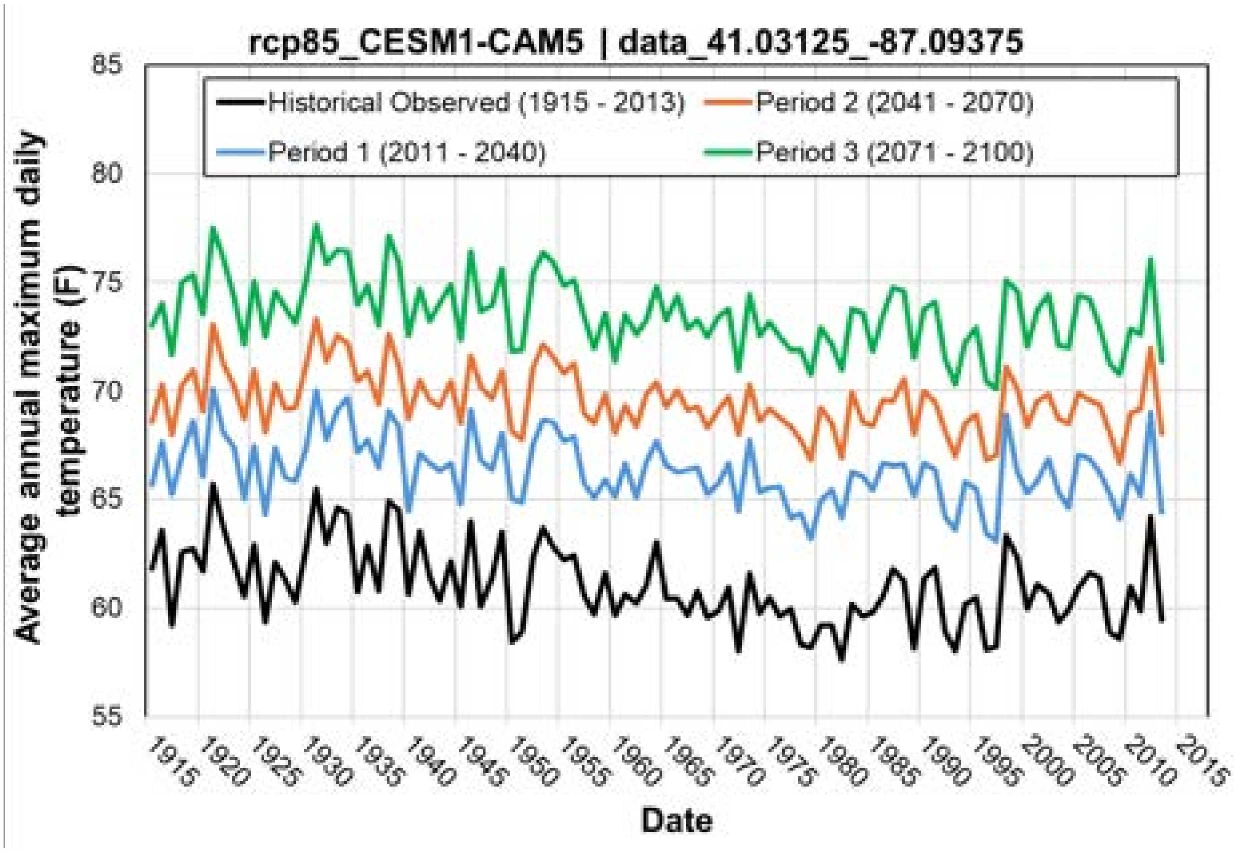
E.1 Future Natural Streamflow

Future baseline daily natural streamflow was calculated to remain consistent with the methodology developed for the Indiana Climate Change Impacts Assessment (INCCIA) (Cherkauer et al. 2021). The methodology is summarized below, and additional information can be found in the INCCIA document.

The INCCIA assessed changes to water resources in Indiana using statistically downscaled climate projections generated for the midwestern United States by Byun and Hamlet (2018) and Byun et al. (2019). Downscaling was guided by an observed 1915-2013 meteorological dataset with 1/16° spatial resolution, developed to drive historical hydrologic simulations over the Midwest and Great Lakes region. The meteorological dataset was derived by combining data from the Daily Global Historical Climatology Network, the U.S. Historical Climatology Network, the Adjusted and Homogenized Canadian Climate Data, and regridded National Center for Atmospheric Research Reanalysis wind speed data. The resulting data products included daily gridded historical maximum and minimum air temperature and precipitation.

Future meteorological data were developed using a climate-period analysis. This approach applies a statistical method to increase or decrease the magnitude of a climate variable in the historical time series based on projected changes in precipitation and air temperature centered around a future 30-year period of a global climate model (GCM). For example, to represent projected air temperatures during the future 30-year period of 2041-2070, the historical maximum daily air temperatures from 1915- 2013 are increased or decreased based on the modeled future maximum daily air temperature from a GCM for 2041-2070. The specific method used by Byun and Hamlet (2018) is a Hybrid Delta (HD) downscaling method, which combines the Classic Delta (CD) method and the Bias Correction and Spatial Disaggregation (BCSD) method, and is designed to represent future conditions in Indiana. Conceptually, whereas the CD method reflects change in a monthly mean climate variable, the HD method reflects change in monthly variability by preserving climate-model changes across the distribution of that variable (not just the mean). Instead of imposing a single mean monthly change across all quantiles (as in CD), the HD method applies projected changes at each quantile of the distribution.

The INCCIA developed three future time series of meteorological variables representing three future periods: Period 1 (2011-2040), Period 2 (2041-2070), and Period 3 (2071-2100). Each period includes a time series of daily meteorological data from 1915-2013 that has been adjusted to represent future meteorological projections centered around the defined period. An example time series of maximum daily air temperature for historical and future periods at a grid cell in central Jasper County is shown in Figure E-1 for the CESM1-CAM5 Global Climate Model and an 8.5 Representative Concentration Pathways (RCP) greenhouse-gas emissions scenario. The time series shows that for each future period, maximum daily air temperatures are increased by approximately 3 to 5 degrees Fahrenheit relative to the previous period.



Source: Cherkauer et al., 2021.

Figure E-1. Time Series of Daily Maximum Air Temperature Centered around Jasper County for Historical and Future Periods

To develop future streamflow projections, the INCCIA study used future projected air temperature, precipitation, wind speed, and other variables as inputs to drive a calibrated variable infiltration capacity (VIC) large-scale hydrologic model, which was used for statewide simulations of hydrologic fluxes and storage. These simulations used the final 30 years (1984-2013) of each meteorological time series (historical, Period 1, Period 2, and Period 3) to drive the VIC model and produce estimates of future daily runoff and baseflow for each corresponding future period. Simulated runoff and baseflow were routed to the locations of the corresponding U.S. Geological Survey (USGS) gaging stations. To help illustrate these time period connections, Table E-1 shows the historical time period and the future climate periods associated with that historical period.

Table E-1. Future Streamflow Hydrologic Sequence

Historical Years	Period 1 Years	Period 2 Years	Period 3 Years
1984	2011	2041	2071
1985	2012	2042	2072
1986	2013	2043	2073
1987	2014	2044	2074
1988	2015	2045	2075
1989	2016	2046	2076
1990	2017	2047	2077
1991	2018	2048	2078
1992	2019	2049	2079
1993	2020	2050	2080
1994	2021	2051	2081
1995	2022	2052	2082
1996	2023	2053	2083
1997	2024	2054	2084
1998	2025	2055	2085
1999	2026	2056	2086
2000	2027	2057	2087
2001	2028	2058	2088
2002	2029	2059	2089
2003	2030	2060	2060
2004	2031	2061	2091
2005	2032	2062	2092
2006	2033	2063	2093
2007	2034	2064	2094
2008	2035	2065	2095
2009	2036	2066	2096
2010	2037	2067	2097
2011	2038	2068	2098
2012	2039	2069	2099
2013	2040	2070	2100

The INCCIA future projected streamflow data were not used directly in the Kankakee Basin study due to methodological differences between the INCCIA study and this water availability study. The INCCIA study captured the relative effects of climate change on streamflow by comparing future simulated streamflow to historical **simulated streamflow**. The relative difference between these two monthly values reflected the predicted effects of future climate change for a given GCM, representing the general trend in streamflow (up or down) in each month over a broad future climate period (e.g., 30 years centered around the 2050s). While this approach is consistent with a typical climate period analysis, this water availability study uses **measured historical daily streamflow** as the basis for historical streamflow. An analysis of measured streamflow and simulated historical streamflow from the INCCIA showed notable differences in average flow values for several months. If the INCCIA future streamflow values were used directly in this water availability study, these streamflow differences would have introduced a notable shift in future streamflow timing and magnitude that was only the result of a methodological difference, and not of future projected climate change. To ensure that the statistical difference in projected future streamflow relative to historical simulated streamflow from the INCCIA study were preserved, a change factor (or delta approach) was used to perturb (scale) values of natural streamflow and develop a future baseline natural streamflow time series, similar to methods used in large scale water planning studies in the western United States (CA DWR 2018). This method was applied to develop future streamflow for 2024–2075 in two steps: 1) hydrologic sequencing and 2) hydrologic change factor application.

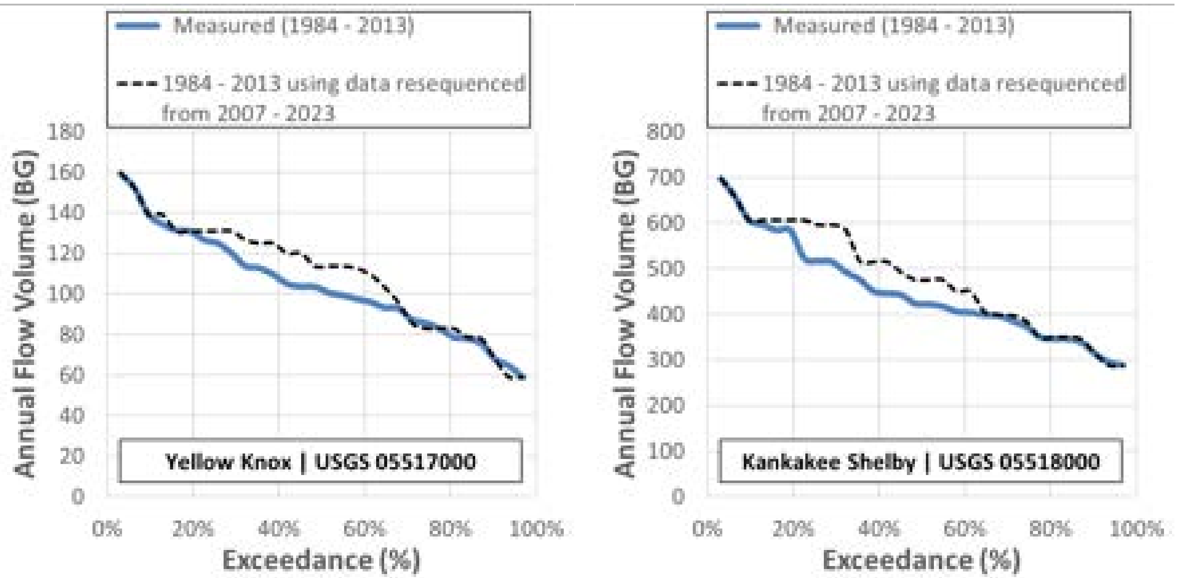
Hydrologic sequencing: The historical period of 2007-2023 was used in the Kankakee Basin study to calculate natural streamflow, as this period contained the most recent publicly available data to calculate all water budget components (the limiting component being water returns). Unfortunately, this time period does not align with the INCCIA historical or future time periods, and only contains 17 years of data, half of the needed 30-year climate period data.

A method was developed to map (cross-reference) the Study's shorter historical period to the 1984-2013 historical period of the INCCIA study. A hydrologic analysis was conducted to select years from 2007-2023 that best matched the seasonal streamflow volume of the years 1984-2006. Winter/Spring and Summer/Fall flow volumes were totaled, and the years that most closely matched both seasons were identified for each gage. This method allowed the distinct seasons observed in the Study Area hydrology to be represented into the future. The years that most frequently matched across all 12 USGS gages located in the Kankakee Basin (six were included in and six were excluded from the study) Study Area were selected as representative. The actual years of 2007-2013 were used to represent streamflow in those years. The daily natural streamflow from these 30 years was matched to the historical years from the INCCIA study for all future periods. The final hydrologic sequence is shown in Table E-2.

To ensure the 30-year period developed from 17 years of hydrologic data is representative of the actual historical 30-year period, two 30-year exceedance curves were developed: one for measured flow from 1984-2013 at each USGS gage analyzed in the study area, and one using flow from 2007-2023, resequenced as shown in Table E-2. The results (Figure E-2 shows two representative USGS gages) indicate that the range of wet and dry years from 1984-2013 is generally well represented using flows resequenced from 2007-2023.

Table E-2. Future Streamflow Hydrologic Sequence

Historical Year (INCCIA)	Representative Historical Year (this study)	Future Year (this study)
1984	2018,2010	2041, 2071
1985	2017	2042, 2072
1986	2011	2043, 2073
1987	2023	2044, 2074
1988	2023	2045, 2075
1989	2013	2046
1990	2016	2047
1991	2009	2048
1992	2013	2049
1993	2019	2050
1994	2011	2051
1995	2011	2052
1996	2015	2053
1997	2019, 2014	2024, 2054
1998	2020	2025, 2055
1999	2022	2026, 2056
2000	2021	2027, 2057
2001	2013	2028, 2058
2002	2020	2029, 2059
2003	2021	2030, 2060
2004	2013	2031, 2061
2005	2020	2032, 2062
2006	2013	2033, 2063
2007	2007	2034, 2064
2008	2008	2035, 2065
2009	2009	2036, 2066
2010	2010	2037, 2067
2011	2011	2038, 2068
2012	2012	2039, 2069
2013	2013	2040, 2070



Key:
BG = billion gallons

Figure E-2. Representative Exceedance Curves of Measured Historical Streamflow and Resequenced Data

Monthly hydrologic change factor application: An adjustment process was used to 'scale' the future natural streamflow time series to reflect the projected effects of climate change. The adjustment process is similar to the delta method, a climate change analysis technique where change factors (or scaling coefficients), which are calculated based on the difference between simulated future and historical climate data, are applied to actual historical climate data to create a bias-corrected model (Navarro-Racines et al. 2020). The change factor represents the change in future streamflow predicted by a hydrologic model, relative to the historical streamflow predicted by the hydrologic model. A monthly change factor typically ranges between 0.5 and 1.5 and is multiplied by the historical measured streamflow to produce an estimate of future streamflow under climate change. Change factors less than one reduce the streamflow estimate, while change factors greater than one reflect an increase in the estimated streamflow. The hydrologic change factor approach has been applied widely in other regions, including to estimate future changes in streamflow and groundwater interactions under different climate conditions (CA DWR 2018).

To develop a monthly change factor for each USGS gage in the Kankakee Basin study area, monthly average future simulated flow was calculated for each INCCIA period and divided by the monthly average INCCIA predicted historical flow. A set of twelve-monthly change factors was calculated for each period and each gage. Daily natural streamflow in each future year was multiplied by the monthly change factor for the relevant period, with change factors switching to Period 2 for all years after 2040. A list of monthly change factors is shown in Table E-3 and Table E-4, and the values are shown graphically in Figure E-3 and Figure E-4. The process of monthly change factor application for one year at a specific USGS gage is illustrated in Figure E-5.

Table E-3. Future Streamflow Change Factors for Period 1 (2011–2040)

Subbasin	01	02	03	04[a]	05	06[b]	07	08[b]
Jan	0.95	1.16	1.10	1.09	1.09	0.96	0.96	0.96
Feb	0.92	1.09	1.02	0.99	0.97	0.88	0.88	0.88
Mar	0.81	0.96	0.92	0.92	0.93	0.94	0.94	0.94
Apr	1.12	1.22	1.20	1.20	1.21	1.33	1.33	1.33
May	0.98	1.02	1.01	1.02	1.03	1.13	1.13	1.13
Jun	1.05	1.07	1.06	1.05	1.04	1.13	1.13	1.13
Jul	1.09	1.18	1.15	1.15	1.14	0.99	0.99	0.99
Aug	0.82	0.91	0.88	0.87	0.87	0.75	0.75	0.75
Sep	0.80	0.84	0.82	0.81	0.80	0.64	0.64	0.64
Oct	0.96	0.98	0.96	0.96	0.95	0.84	0.84	0.84
Nov	1.04	1.04	1.02	1.01	0.99	0.92	0.92	0.92
Dec	1.05	1.18	1.13	1.11	1.10	0.83	0.83	0.83

Notes:
Subbasin names and USGS gage assignment: 01 = Yellow Knox = USGS 05517000, 02 = Kankakee Davis = USGS 05515500, 03 = Kankakee Kouts = USGS 05517530, 04 = Kankakee Shelby = USGS 055180000, 05 = Kankakee Momence = USGS 05520500, 06 = Beaver, 07 = Iroquois = USGS 05525000, 08 = Sugar

a. Future streamflow data from the INCCIA study was not accurate for this USGS gage. For Subbasin 04, the average of change factors from upstream subbasin (Subbasin 03) and the downstream subbasin (Subbasin 05) were applied.

b. Change factors from Iroquois (Subbasin 07) were applied to Subbasin 06 and 08 since these locations contained synthetic hydrology.

Table E-4. Future Streamflow Change Factors for Period 2 (2041–2070)

Subbasin	01	02	03	04[a]	05	06[b]	07	08[b]
Jan	1.17	1.48	1.38	1.38	1.37	1.16	1.16	1.16
Feb	1.13	1.36	1.28	1.26	1.24	1.16	1.16	1.16
Mar	0.82	0.91	0.90	0.92	0.93	1.01	1.01	1.01
Apr	1.39	1.42	1.44	1.45	1.46	1.66	1.66	1.66
May	1.20	1.18	1.20	1.21	1.22	1.32	1.32	1.32
Jun	1.06	1.05	1.06	1.05	1.04	1.17	1.17	1.17
Jul	1.08	1.20	1.16	1.16	1.17	1.11	1.11	1.11
Aug	0.93	1.02	0.98	0.98	0.97	0.86	0.86	0.86
Sep	0.81	0.85	0.83	0.82	0.81	0.61	0.61	0.61
Oct	0.88	0.90	0.88	0.88	0.88	0.78	0.78	0.78
Nov	1.00	1.01	0.99	0.98	0.96	0.92	0.92	0.92
Dec	1.11	1.28	1.23	1.22	1.22	0.91	0.91	0.91

Notes:
Subbasin names and USGS gage assignment: 01 = Yellow Knox = USGS 05517000, 02 = Kankakee Davis = USGS 05515500, 03 = Kankakee Kouts = USGS 05517530, 04 = Kankakee Shelby = USGS 055180000, 05 = Kankakee Momence = USGS 05520500, 06 = Beaver, 07 = Iroquois = USGS 05525000, 08 = Sugar
a. Future streamflow data from the INCCIA study was not accurate for this USGS gage. For Subbasin 04, the average of change factors from upstream subbasin (Subbasin 03) and the downstream subbasin (Subbasin 05) were applied.
b. Change factors from Iroquois (Subbasin 07) were applied to Subbasin 06 and 08 since these locations contained synthetic hydrology.

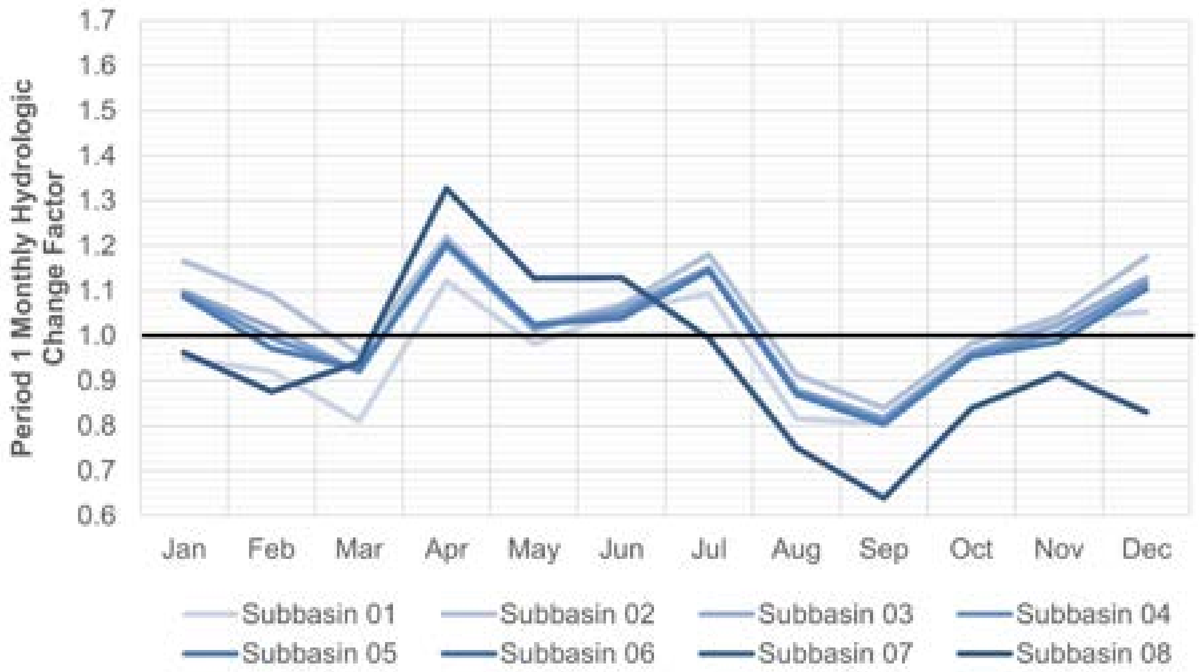


Figure E-3. Period 1 (2011–2040) Climate Change Factors by Subbasin

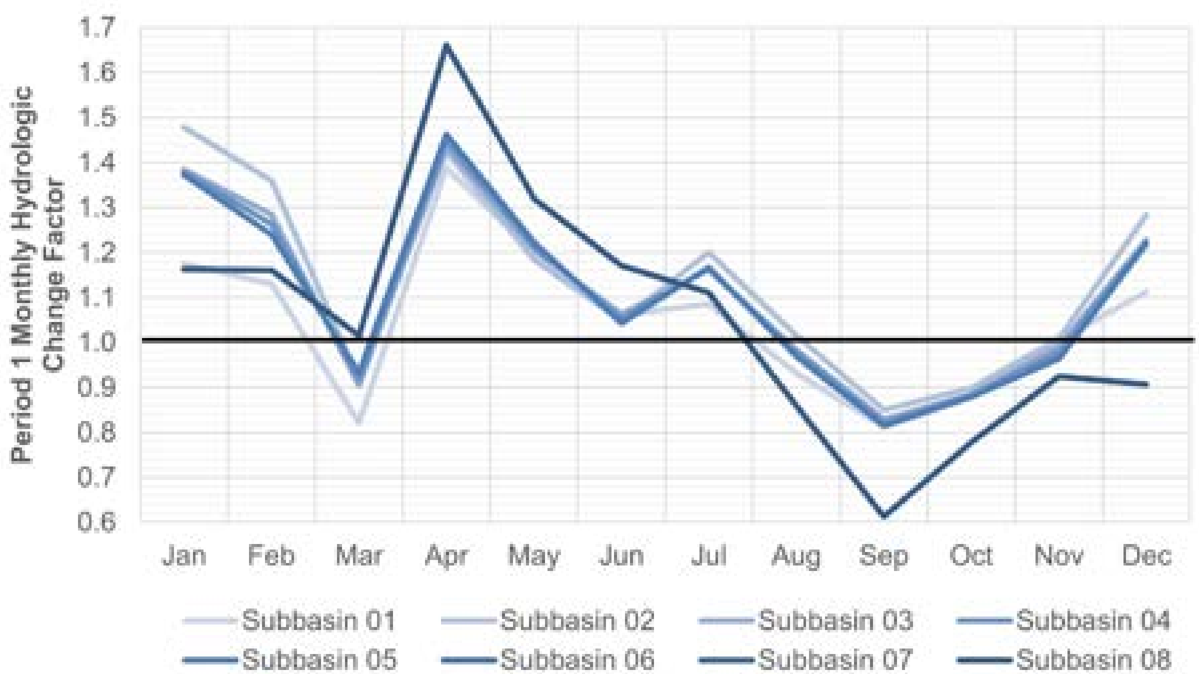
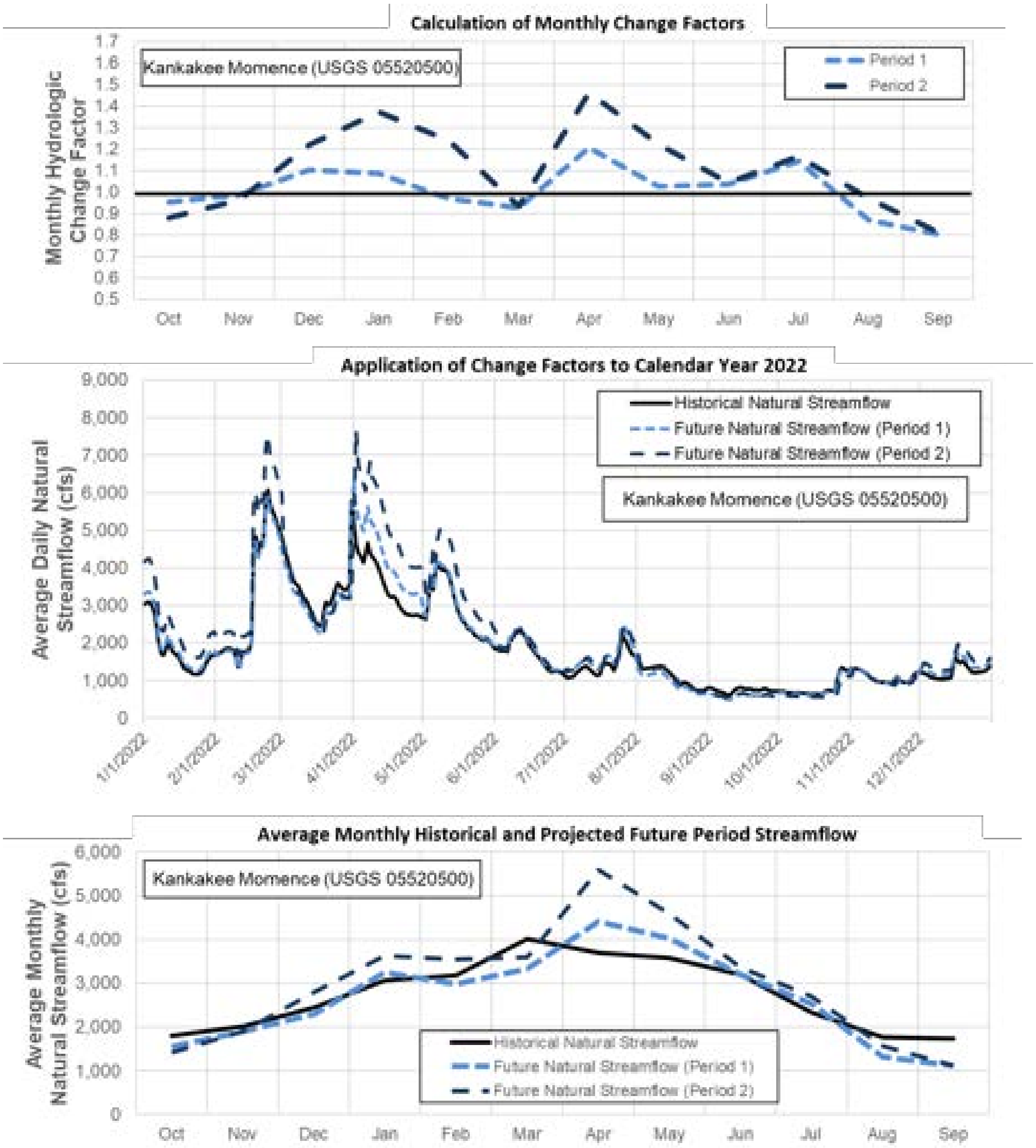


Figure E-4. Period 2 (2014–2070) Climate Change Factors by Subbasin



Note: Generation of Change Factor (top), Application of Change Factor to Specific Year (middle), and Average for Future Periods Compared to Historical (bottom).

Figure F-5. Climate Change Factor Example for USGS 05520500 (Kankakee Momence)

E.2 Future Natural Baseflow

The same method for baseflow separation was applied to future natural streamflow as was used to develop historical natural baseflow. The time series of future natural streamflow was input to the USGS Groundwater Toolbox, and the HYSEP Sliding Interval baseflow separation method was used to develop a future baseflow time series for each subbasin.

E.3 Future Instream Flow

As described in the main body of the report, historical instream flow metrics were repeated into the future. The daily time series for each variable from the period 2007-2023 was repeated into the future based on the sequence identified in Table E-2.

E.4 Future Return Flow Estimates

The same Significant Water Withdrawal Facility (SWWF) withdrawals and adjusted[1] reported National Pollutant Discharge Elimination System (NPDES) return inputs prepared for historical water availability analysis were used to identify the relationship between return and withdrawal. These data are discussed in detail in Appendix B. Future return flows were then estimated based on future withdrawal estimates (Appendix D) and preserving the historical relationship between withdrawals and returns.

E.4.1 HISTORICAL RELATIONSHIP: PUBLIC SUPPLY, ENERGY PRODUCTION, INDUSTRY

Historical SWWF withdrawals and adjusted NPDES return flow data were evaluated on a monthly time scale. For each subbasin, relationships between withdrawal and return were assessed for individual sectors (mainly energy production (EP), public supply (PS), industry (IN)) to establish estimates of future adjusted return flows as a function of withdrawals unique to each subbasin and sector.

Initially, the relationship between SWWF and adjusted NPDES return flow data was examined for each subbasin and sector using scatterplots that plotted monthly SWWF withdrawal rates and monthly adjusted NPDES return flow rates. The initial findings did not indicate a strong statistical relationship between monthly withdrawals and adjusted return flows, indicating a need for an alternative approach. To estimate return flows, average monthly factors were calculated by dividing the average monthly adjusted NPDES return flow by the average monthly SWWF withdrawal for each sector for each subbasin. These monthly factors were then multiplied by the SWWF withdrawals to produce a synthetic monthly time series of modeled adjusted return flows (or modeled returns). This approach generated a linear relationship between return flows and withdrawals that could be used to estimate future return flows as a function of future withdrawals. Figure E-6 presents scatterplots for the PS sector for Yellow Knox (Subbasin 01). It

[1] As described in the main body of the report, reported NPDES return flows were adjusted to remove irregularities in the data and for PS sectors only were adjusted to remove the influence of combined sewer overflow reported discharge from wastewater treatment plant discharge.

can be observed that the modeled return flow exhibited a better relationship with withdrawal compared to adjusted return flow.

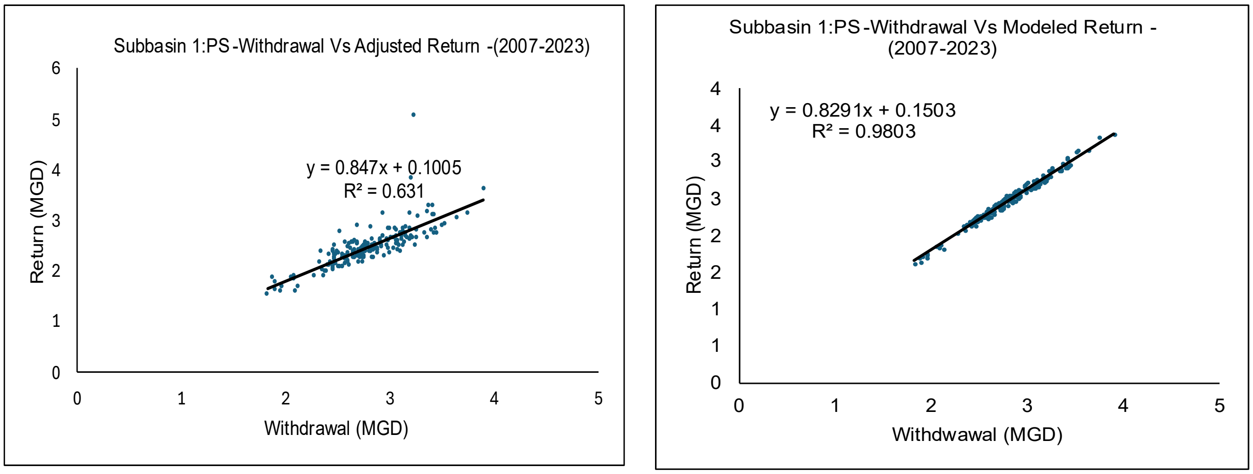


Figure E-6. Monthly Withdrawal vs Adjusted Reported Return (left) and Monthly Withdrawal vs Modeled Return (right) for Study Period (2007-2023) for Public Supply Sector in Subbasin 01

E.4.2 REGRESSION EQUATION DEVELOPMENT (PS, EP, IN)

This section describes the development of regression equations to estimate PS, EP, and IN return flows based on corresponding withdrawal data. The equations were calibrated using historical withdrawal and return flow records to define relationships that describe the proportion of withdrawn water returned to water resources. Scatterplots and a linear regression approach were used to develop regression equations unique to each sector and subbasin. Equations were developed based on regression over the full year or on a seasonal basis for the study period, as described below.

E.4.2.1 Full Year

For a given sector, when withdrawal and modeled return flow exhibited similar trends throughout the year, linear regression was applied to the entire study period, and a single regression equation was developed for that sector in that subbasin. Years with adjusted reported return flow that did not align with the majority of the data from the study period were considered outlier years. Examples of outlier years include those with significantly higher or lower flows not in line with the broader study period. Outlier years were excluded from computing monthly average return factors used to generate modeled return flows. However, the regression was applied to the full study period of withdrawal and modeled return data.

E.4.2.2 Seasonal

For a given sector, when withdrawal and modeled return flow did not exhibit similar trends throughout the year, linear regression was applied on a seasonal basis. Seasonal periods were divided into two periods: the wet period from November to May, and the dry period from June to October. The wet and dry periods are generally correlated with increasing and decreasing streamflow trends, respectively. Outlier years were investigated closely on a seasonal basis. Any year with adjusted reported return flow not in agreement with most of the data and not exhibiting similar trends with withdrawal data in a given seasonal period was considered an outlier year for that seasonal period. Outlier years were excluded from computing monthly average return factors used to generate modeled return flow as well as from regression equation development. Seasonal analyses yielded two sets of regression equations for the wet and dry periods for a given sector in a subbasin.

Regression equations developed for PS, EP, and IN are summarized in Table E-5 below.

Table E-5. Regression Equation Summary for PS, EP, and in Sectors in Individual Subbasins (y = monthly return flow in MGD, and X = monthly withdrawal in MGD)

Sector	PS			IN			EP[2]
Analysis Type	Full Year	Seasonal		Full Year	Seasonal		Full Year pre-Coal Phase Out
Subbasin		Wet	Dry		Wet	Dry	
01	y=0.78X+0.27	-	-	y=0.1X+0	-	-	-
02	y=0.55X+0.65	-	-	y=0.31X+0.18	-	-	y=0.08X+0
03	-	y=2.99X-0.22	y=2.52X-0.26	[1]y=0.098+0.8(X-0.005)	-	-	y=0.44X+0
04	-	y=0.26X+0	y=0.19X+0.1	[1]y=0.004+0.8(X-1.469)	-	-	-
05	-	y=1.33X+0.43	y=0.96X+0.85	y=1.28X-0.17	-	-	-
06	y=1.34X+0	-	-	-	-	-	-
07	-	y=0.43X+0.58	y=0.66X+0.02	y=0.49X+0.06	-	-	-
08	-	-	-	-	-	-	-

Notes:
[1] For subbasins with no IN withdrawal or IN return, it is assumed that future return will be sum of average historical return and 80% of difference between future withdrawal and average historical withdrawal.
[2] For EP, additional modifications were made as described in the next Section.
Key:
EP = energy production
IN = industry
MGD = million gallons per day
PS = public supply

For the energy production sectors, the near-term energy source in the study area is coal. Based on data from the U.S. Department of Energy, Energy Information Administration, the major regional coal plants have a consumptive use factor of 56%, meaning 44% of water withdrawals are returned to a waterway. This 56% consumptive use factor was used in the calculations until coal was projected to be phased out under the future baseline scenario in the late 2020s. Future withdrawals for energy production after the coal phase-out were estimated using energy generation growth by energy-generation technology (additional information is provided in Appendix D.2). Future water withdrawal volumes were estimated based on future energy demand, generation mix, and withdrawal intensity by energy generation source.

For each energy generation technology, a consumptive use factor was defined, and the remaining portion of withdrawals was assumed to be return flows (Table E-6). Future EP withdrawals for Subbasins 01, 04, 05, 06, 07, and 08 were zero, so return flows were also zero. For Subbasins 02 and 03, although EP withdrawals were greater than zero, future energy generation mix data were unavailable, so average historical return flows were used as future return flows.

Table E-6. Future Return Flow Estimates by Energy Generation Technology

Generation Type	Withdrawal Intensity (gallon/kWh)	Return Flows (% of withdrawals)	Source
Close Loop Cooling (Recirculating, coal)	1.15	44%	Harris and Diehl (2019)
Flat Panel Photovoltaic (PV)	0.00	0%	Meldrum et al. (2013)
Onshore Wind	0.00	0%	Meldrum et al. (2013)
Combined Cycle Cooling Tower	0.90	31%	EIA data average for Indiana

Key:
EIA = U.S. Department of Energy, Energy Information Administration
kWh = kilowatt-hour

E.4.3 OTHER SECTORS

For the large-scale livestock operations (Concentrated Animal Feeding Operation), Self-Supplied Residential, and Irrigation, future return flows were estimated using the same method as historical return flows, summarized in Table E-7.

Table E-7. Historical Return Flow Estimates for Irrigation, CAFOs, and Self-Supplied Residential

Sector	Return Flow Assumption
Irrigation	80% of irrigation withdrawals are considered consumptive, either taken up by crops and livestock or lost through evapotranspiration. The remaining 20% is assumed to be return flow that first infiltrates into the earth and eventually returns to the stream as baseflow.
CAFOs	80% of CAFO withdrawals are considered consumptive for animal related operations. The remaining 20% is assumed to be return flow that first infiltrates into the earth and eventually returns to the stream as baseflow.
Self-Supplied Residential Domestic	Seasonal return flow estimates as percentage of withdrawal: 100% in Winter, 98% in Spring, 81% in Summer, and 93% in the Fall.

Key:
CAFO = concentrated animal feeding operation

E.5 References

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APPENDIX F

Historical Water Availability by Subbasin

Stantec

Kankakee Basin Regional Water Study

Appendix F – Historical Water Availability by Subbasin

December 2025

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Appendix F Historical Water Availability by Subbasin

Results from the historical water availability model are summarized by subbasin for the historical analysis period of 2007–2023. Excess water availability (local, subbasin) by season is summarized in Table F-1 through Table F-4. Cumulative excess water availability (regional) by season is summarized in Tables Table F-5 through Table F-8. Timeseries of daily net natural baseflow, subbasin withdrawals, subbasin return flows, subbasin net returns, and seasonal average subbasin excess water availability (local) are shown in Figure F-1 through Figure F-11. For each subbasin that receives flow from upstream subbasins, an additional figure is included that shows daily cumulative natural baseflow, cumulative withdrawals, cumulative return flows, cumulative net returns, and seasonal average cumulative excess water availability (regional). Box and whisker plots for historical cumulative excess water availability by season and subbasin are shown in Figure F-12 through Figure F-19.

F.1 Summary Tables of Excess and Cumulative Excess Water Availability

Historical Water Availability by Subbasin
December 2025

Table F-1. Winter Average Excess Water Availability by Subbasin (MGD)

Subbasin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Yellow Knox (01)	208	371	190	92	3	284	60	69	113	123	226	232	207	177	-6	177	78
Kankakee Davis (02)	250	387	308	172	88	259	63	127	143	189	316	231	225	272	61	136	60
Kankakee Kouts (03)	423	594	247	155	38	205	53	163	319	303	268	152	266	272	53	188	70
Kankakee Shelby (04)	469	412	322	199	80	400	106	118	98	200	242	220	361	368	96	262	82
Kankakee Momence (05)	436	550	419	125	72	282	160	111	185	238	214	112	427	279	-36	80	53
Beaver (06)	53	76	35	26	12	24	12	14	23	44	37	42	45	35	1	34	23
Iroquois (07)	670	730	355	227	91	367	114	136	244	392	414	388	449	404	12	343	241
Sugar (08)	51	50	34	24	18	19	13	7	24	46	33	38	41	27	3	28	34

Notes:
Winter values for the indicated year are calculated as the average excess water availability (local) from December (previous year) through February (indicated year).
Key:
MGD = million gallons per day

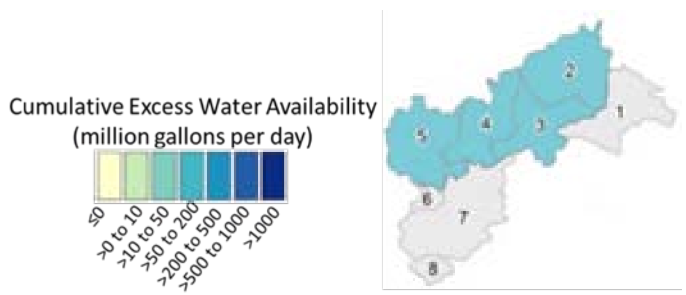
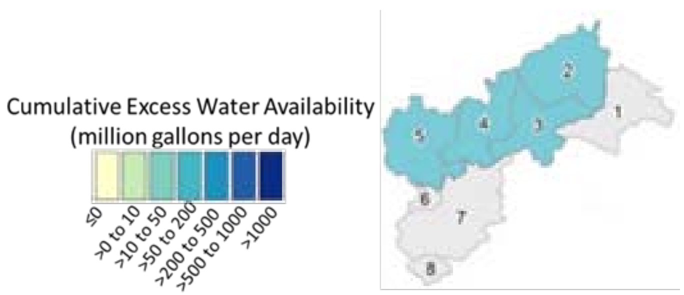


Table F-2. Spring Average Excess Water Availability by Subbasin (MGD)

Subbasin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Yellow Knox (01)	198	294	319	188	323	94	214	215	125	213	238	288	321	212	72	241	233
Kankakee Davis (02)	225	326	491	230	289	160	188	276	184	274	345	448	328	286	107	210	233
Kankakee Kouts (03)	295	443	577	197	391	99	214	289	230	395	318	525	356	318	114	276	258
Kankakee Shelby (04)	387	414	601	284	456	192	249	300	137	237	388	482	445	425	208	349	225
Kankakee Momence (05)	280	413	649	338	476	168	367	415	221	385	312	241	485	407	72	205	311
Beaver (06)	53	35	74	44	64	18	48	41	28	36	53	32	59	43	29	38	44
Iroquois (07)	588	364	724	426	687	150	486	386	277	482	569	375	575	415	240	358	618
Sugar (08)	47	39	70	47	76	20	56	38	31	40	63	35	52	47	35	38	50

Notes:
Spring values are calculated as the average excess water availability (local) from March through May.
Key:
MGD = million gallons per day

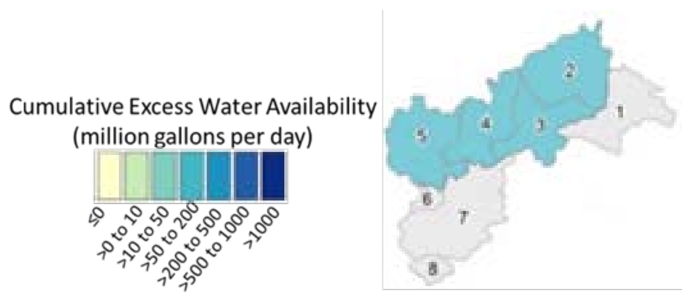


Historical Water Availability by Subbasin
December 2025

Table F-3. Summer Average Excess Water Availability by Subbasin (MGD)

Subbasin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Yellow Knox (01)	102	110	74	133	156	20	179	95	325	108	146	121	143	69	170	71	48
Kankakee Davis (02)	110	84	191	185	218	34	144	195	265	181	179	179	294	146	138	61	77
Kankakee Kouts (03)	98	115	113	136	277	-15	146	154	518	151	171	79	210	110	182	82	59
Kankakee Shelby (04)	91	149	159	186	306	-1	161	175	486	109	163	115	294	156	232	66	7
Kankakee Momence (05)	62	92	134	308	293	90	110	343	724	194	79	-40	317	80	102	-4	10
Beaver (06)	6	23	13	36	22	2	28	31	113	30	25	11	26	12	29	9	8
Iroquois (07)	72	198	126	234	362	16	347	329	1,305	240	192	97	260	119	252	125	44
Sugar (08)	6	33	15	51	14	3	20	25	88	19	26	20	18	11	30	5	13

Notes:
Summer values are calculated as the average excess water availability (local) from June through August.
Key:
MGD = million gallons per day

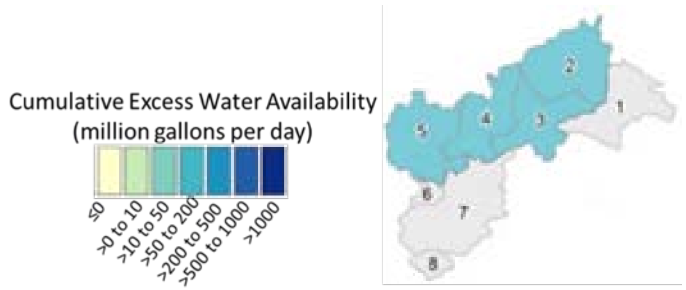


Historical Water Availability by Subbasin
December 2025

Table F-4. Fall Average Excess Water Availability by Subbasin (MGD)

Subbasin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Yellow Knox (01)	98	79	84	48	134	21	61	116	71	198	117	120	73	23	149	40	25
Kankakee Davis (02)	176	299	182	66	146	45	106	228	119	303	164	173	205	67	112	38	88
Kankakee Kouts (03)	122	271	91	-22	62	-10	86	291	89	336	139	79	101	24	143	39	69
Kankakee Shelby (04)	169	337	152	61	150	65	111	304	118	165	199	195	236	64	245	19	80
Kankakee Momence (05)	139	434	164	18	73	35	-4	342	23	336	86	-14	190	-23	237	-9	20
Beaver (06)	3	19	12	1	2	2	1	28	11	19	14	7	11	1	24	2	3
Iroquois (07)	37	185	60	13	46	22	26	285	57	224	159	83	127	14	205	46	29
Sugar (08)	2	12	11	1	0	3	0	26	13	12	16	9	3	1	22	2	2

Notes:
Fall values are calculated as the average excess water availability (local) from September through November.
Key:
MGD = million gallons per day



Historical Water Availability by Subbasin
December 2025

Table F-5. Winter Average Cumulative Excess Water Availability by Subbasin (MGD)

Subbasin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Yellow Knox (01)	208	371	190	92	3	284	60	69	113	123	226	232	207	177	-6	177	78
Kankakee Davis (02)	250	387	308	172	88	259	63	127	143	189	316	231	225	272	61	136	60
Kankakee Kouts (03)	881	1,337	741	420	125	746	173	356	575	615	811	593	697	721	108	487	201
Kankakee Shelby (04)	1,350	1,750	1,063	619	205	1,146	279	473	673	815	1,053	813	1,058	1,089	204	750	283
Kankakee Momence (05)	1,786	2,299	1,482	744	277	1,427	440	549	857	1,053	1,247	854	1,485	1,368	91	759	336
Beaver (06)	53	76	35	26	12	24	12	14	23	44	37	42	45	35	1	34	23
Iroquois (07)	670	730	355	227	91	367	114	136	244	392	414	388	449	404	12	343	241
Sugar (08)	51	50	34	24	18	19	13	7	24	46	33	38	41	27	3	28	34

Notes:
Winter values for the indicated year are calculated as the average cumulative excess water availability (regional) from December (previous year) through February (indicated year).
Key:
MGD = million gallons per day

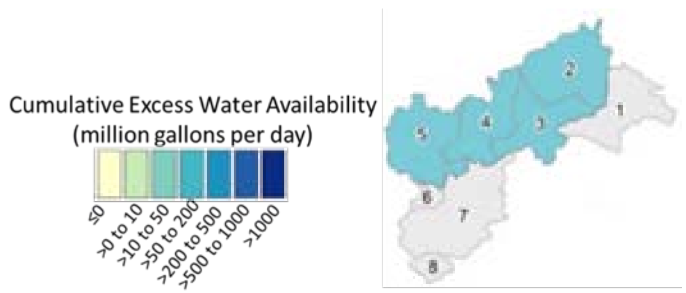


Table F-6. Spring Average Cumulative Excess Water Availability by Subbasin (MGD)

Subbasin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Yellow Knox (01)	198	294	319	188	323	94	214	215	125	213	238	288	321	212	72	241	233
Kankakee Davis (02)	225	326	491	230	289	160	188	276	184	274	345	448	328	286	107	210	233
Kankakee Kouts (03)	717	1,063	1,387	615	1,001	353	613	779	537	882	901	1,261	1,001	817	292	726	723
Kankakee Shelby (04)	1,104	1,477	1,988	899	1,456	545	862	1,079	675	1,119	1,289	1,743	1,446	1,242	500	1,075	948
Kankakee Momence (05)	1,384	1,890	2,637	1,237	1,933	713	1,229	1,494	895	1,504	1,601	1,982	1,931	1,649	563	1,280	1,259
Beaver (06)	53	35	74	44	64	18	48	41	28	36	53	32	59	43	29	38	44
Iroquois (07)	588	364	724	426	687	150	486	386	277	482	569	375	575	415	240	358	618
Sugar (08)	47	39	70	47	76	20	56	38	31	40	63	35	52	47	35	38	50

Notes:
Spring values are calculated as the average cumulative excess water availability (regional) from March through May.
Key:
MGD = million gallons per day

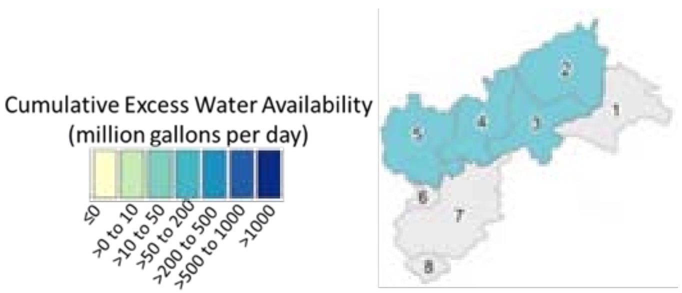
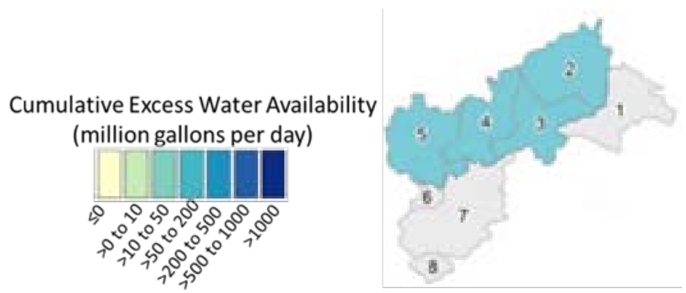


Table F-7. Summer Average Cumulative Excess Water Availability by Subbasin (MGD)

Subbasin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Yellow Knox (01)	102	110	74	133	156	20	179	95	325	108	146	121	143	69	170	71	48
Kankakee Davis (02)	110	84	191	185	218	34	144	195	265	181	179	179	294	146	138	61	77
Kankakee Kouts (03)	299	309	377	454	650	38	467	444	1,109	430	495	379	647	324	482	215	184
Kankakee Shelby (04)	390	459	536	640	957	37	628	619	1,594	539	658	494	941	481	715	281	192
Kankakee Momence (05)	448	550	670	948	1,250	127	735	957	2,317	732	735	446	1,258	561	812	277	201
Beaver (06)	6	23	13	36	22	2	28	31	113	30	25	11	26	12	29	9	8
Iroquois (07)	72	198	126	234	362	16	347	329	1,305	240	192	97	260	119	252	125	44
Sugar (08)	6	33	15	51	14	3	20	25	88	19	26	20	18	11	30	5	13

Notes:
Summer values are calculated as the average cumulative excess water availability (regional) from June through August.
Key:
MGD = million gallons per day

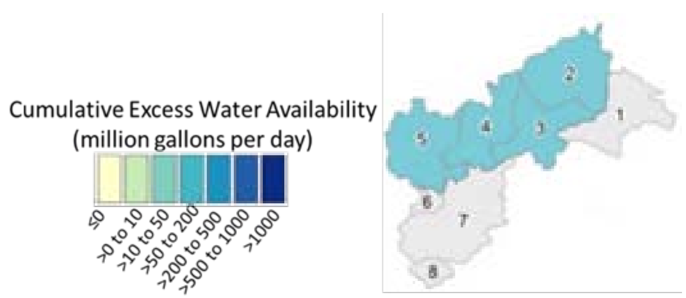


Historical Water Availability by Subbasin
December 2025

Table F-8. Fall Average Cumulative Excess Water Availability by Subbasin (MGD)

Subbasin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Yellow Knox (01)	98	79	84	48	134	21	61	116	71	198	117	120	73	23	149	40	25
Kankakee Davis (02)	176	299	182	66	146	45	106	228	119	303	164	173	205	67	112	38	88
Kankakee Kouts (03)	395	643	356	92	334	56	253	636	279	837	419	369	375	113	396	117	183
Kankakee Shelby (04)	564	980	508	153	485	121	364	940	397	1,002	619	564	611	177	641	136	262
Kankakee Momence (05)	703	1,414	672	171	556	155	357	1,281	420	1,338	704	545	801	154	877	126	282
Beaver (06)	3	19	12	1	2	2	1	28	11	19	14	7	11	1	24	2	3
Iroquois (07)	37	185	60	13	46	22	26	285	57	224	159	83	127	14	205	46	29
Sugar (08)	2	12	11	1	0	3	0	26	13	12	16	9	3	1	22	2	2

Notes:
Fall values are calculated as the average cumulative excess water availability (regional) from September through November.
Key:
MGD = million gallons per day



F.2 Timeseries of Subbasin and Cumulative Water Budget Components and Subbasin and Cumulative Excess Water Availability

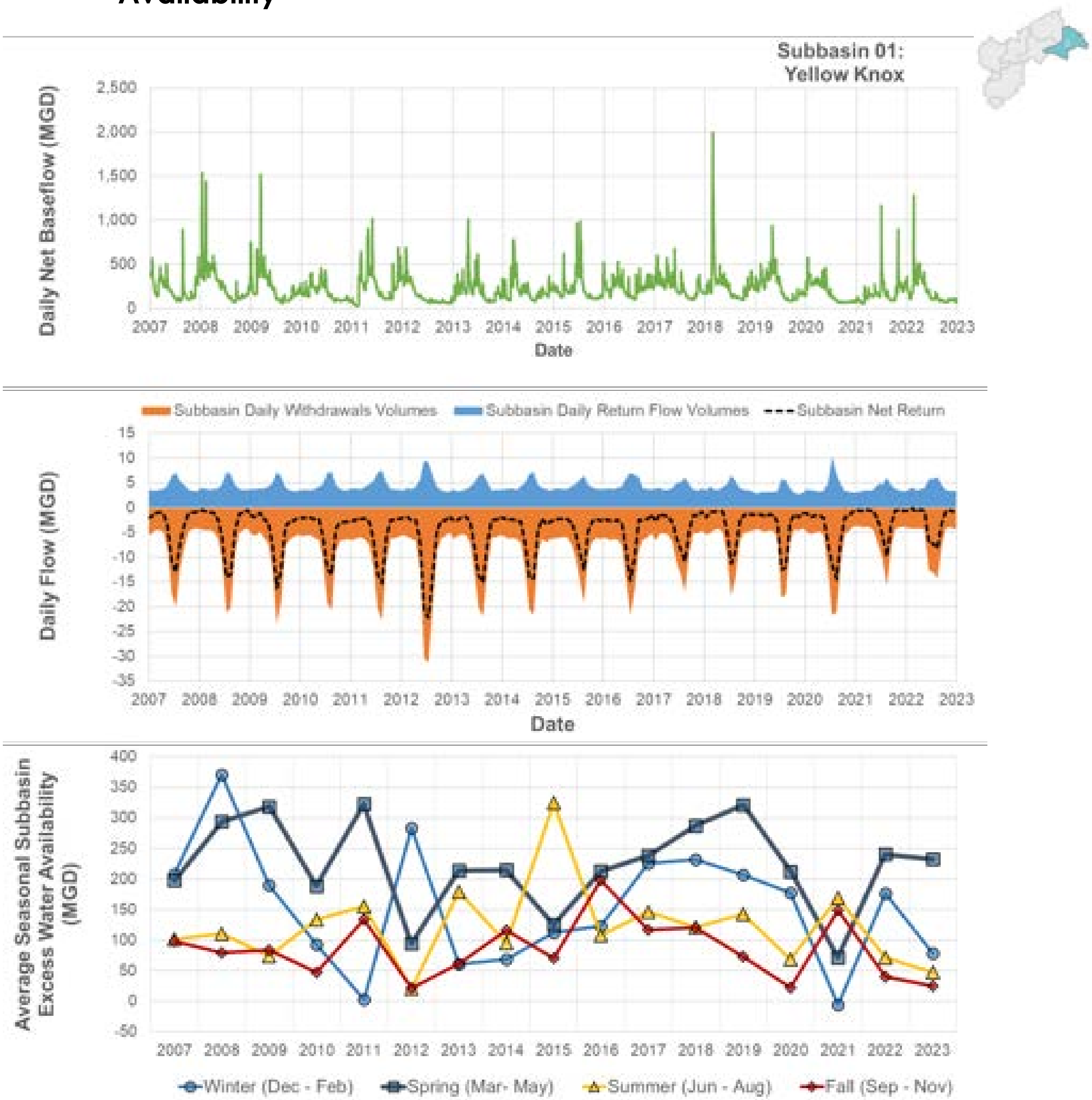


Figure F-1. Historical Daily Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Yellow Knox (Subbasin 01)

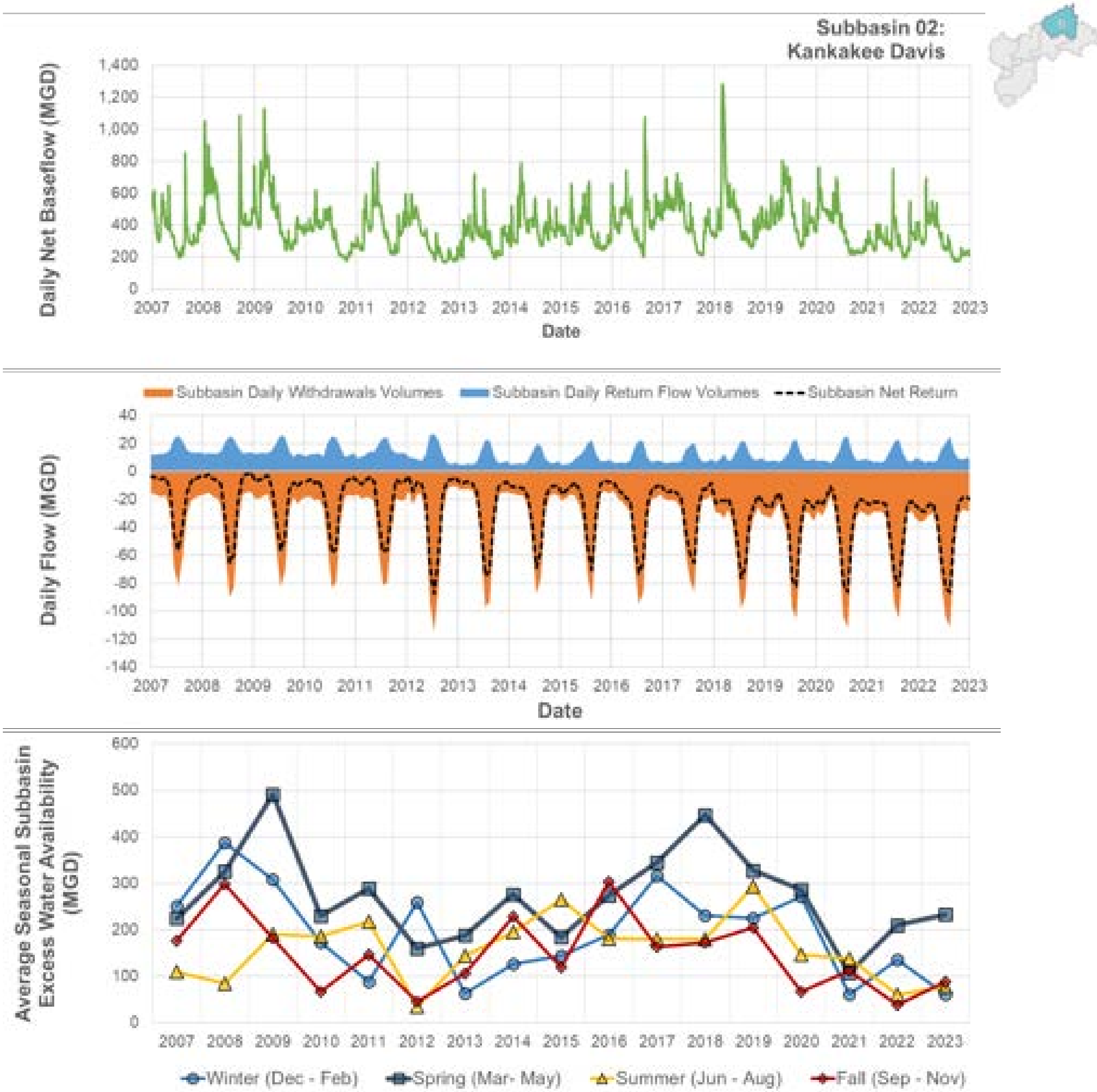


Figure F-2. Historical Daily Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Kankakee Davis (Subbasin 02)

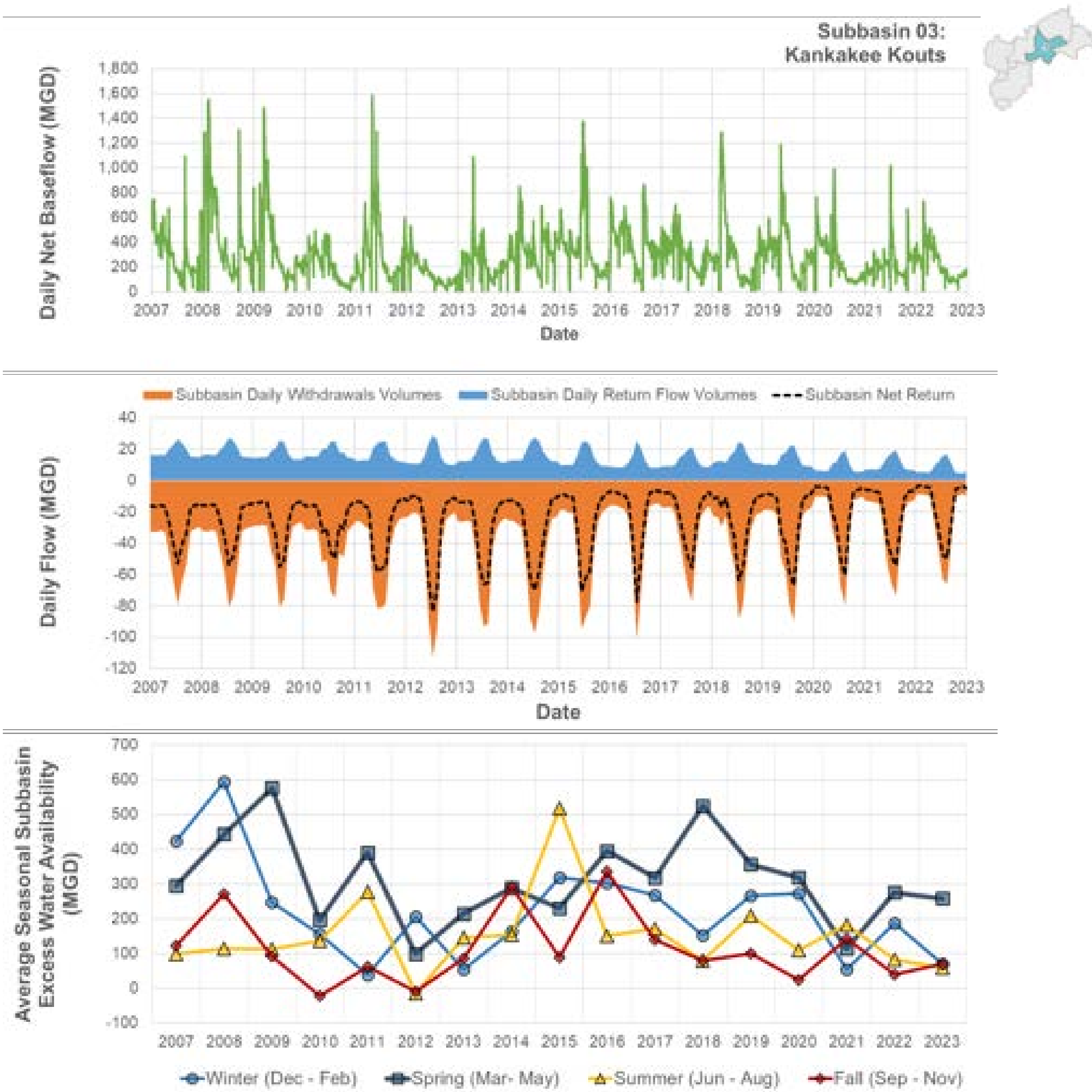


Figure F-3. Historical Daily Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Kankakee Kouts (Subbasin 03)

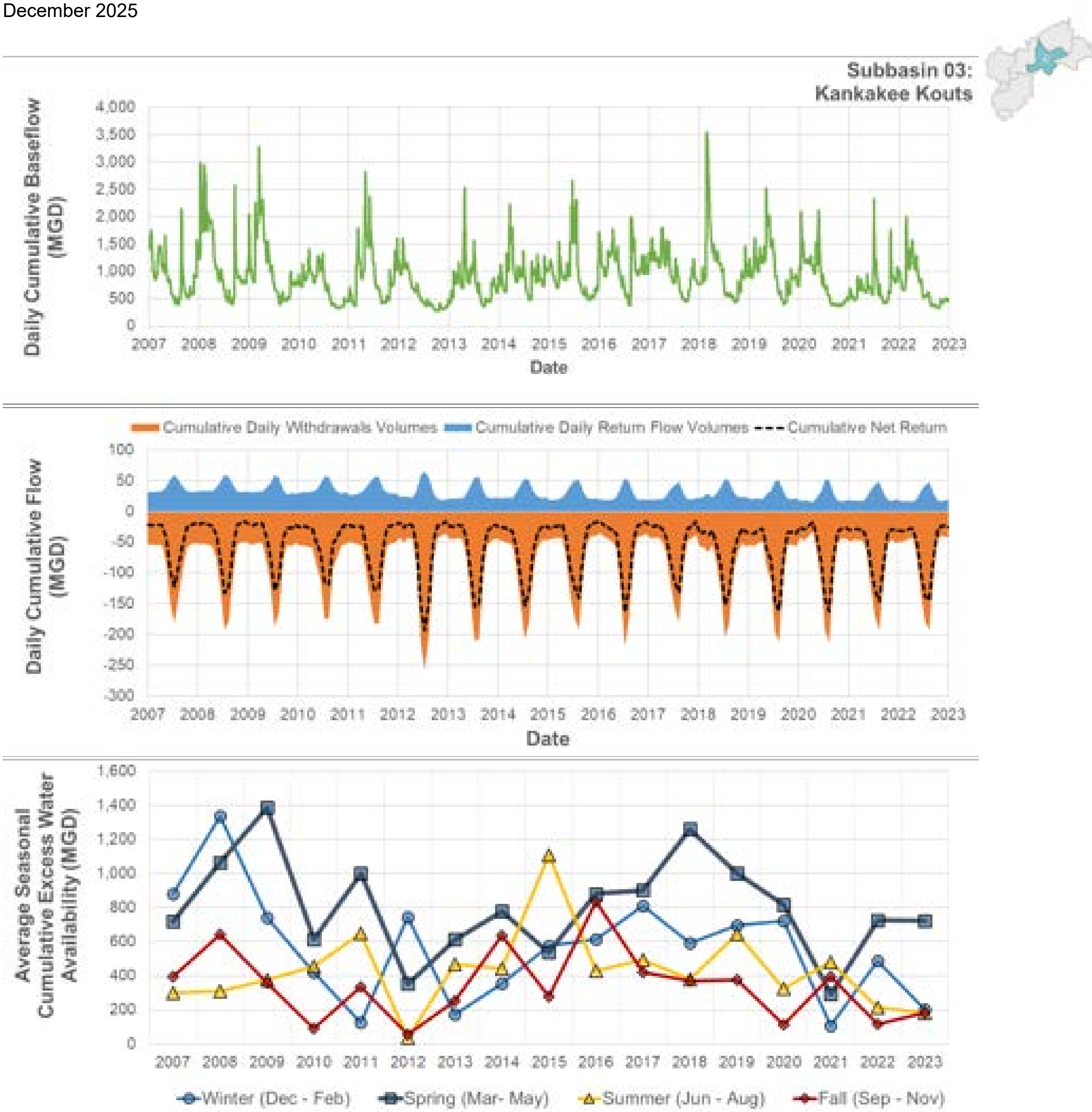


Figure F-4. Historical Cumulative Natural Baseflow, Cumulative Net Returns, and Average Seasonal Cumulative Excess Water Availability (local) for Kankakee Kouts (Subbasin 03)

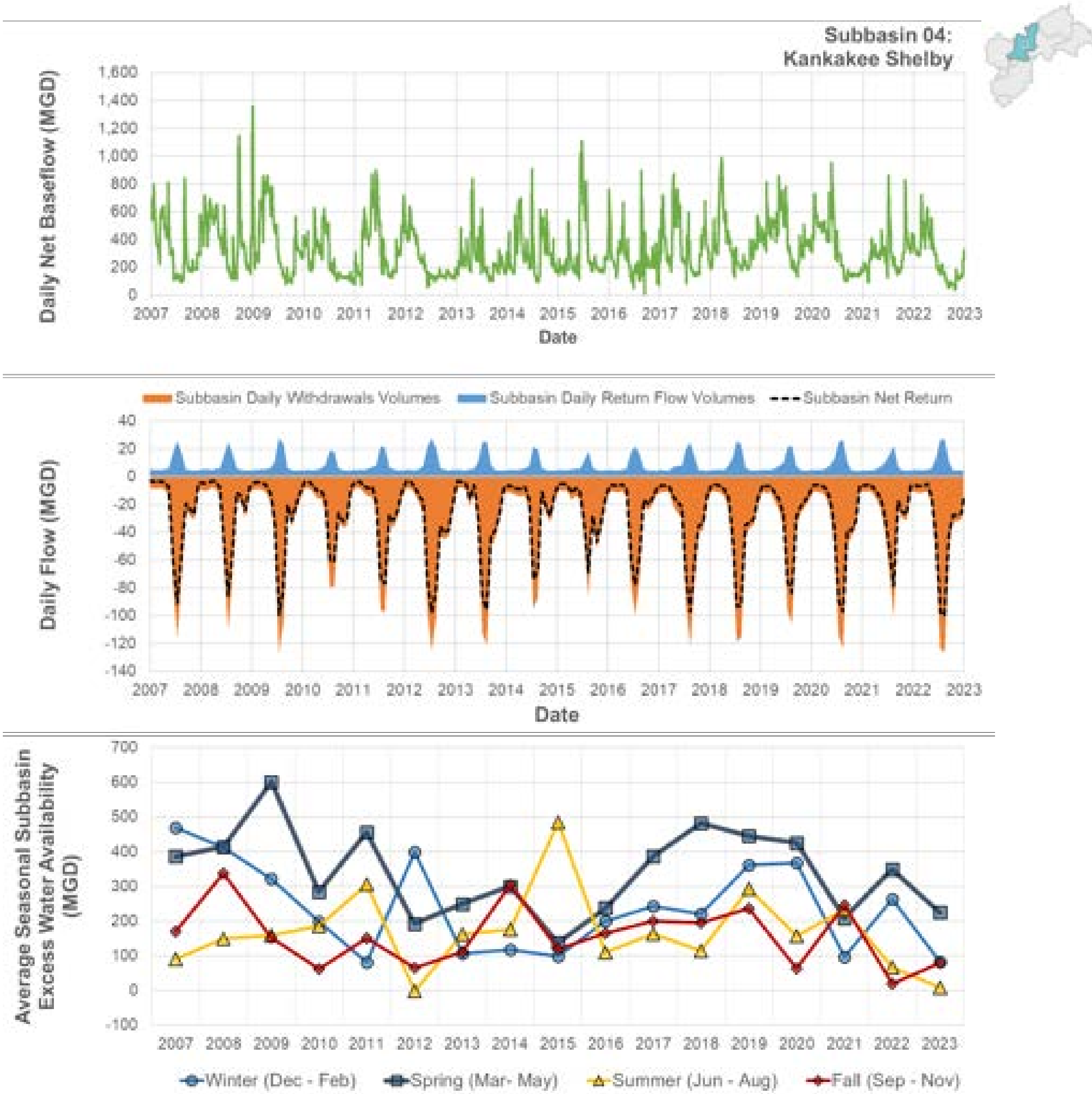


Figure F-5. Historical Daily Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Kankakee Shelby (Subbasin 04)

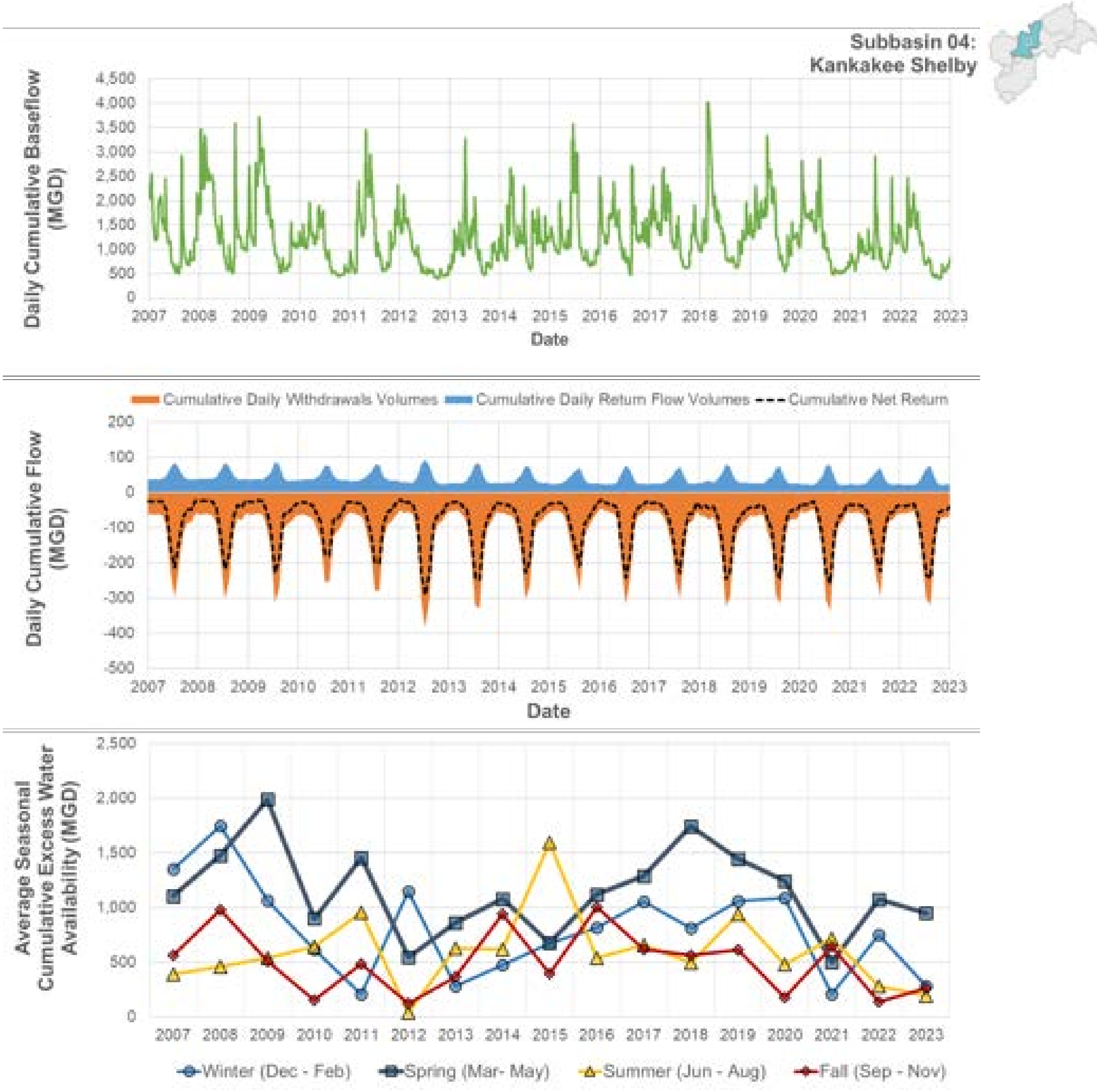


Figure F-6. Historical Cumulative Natural Baseflow, Cumulative Net Returns, and Average Seasonal Cumulative Excess Water Availability (regional) for Kankakee Shelby (Subbasin 04)

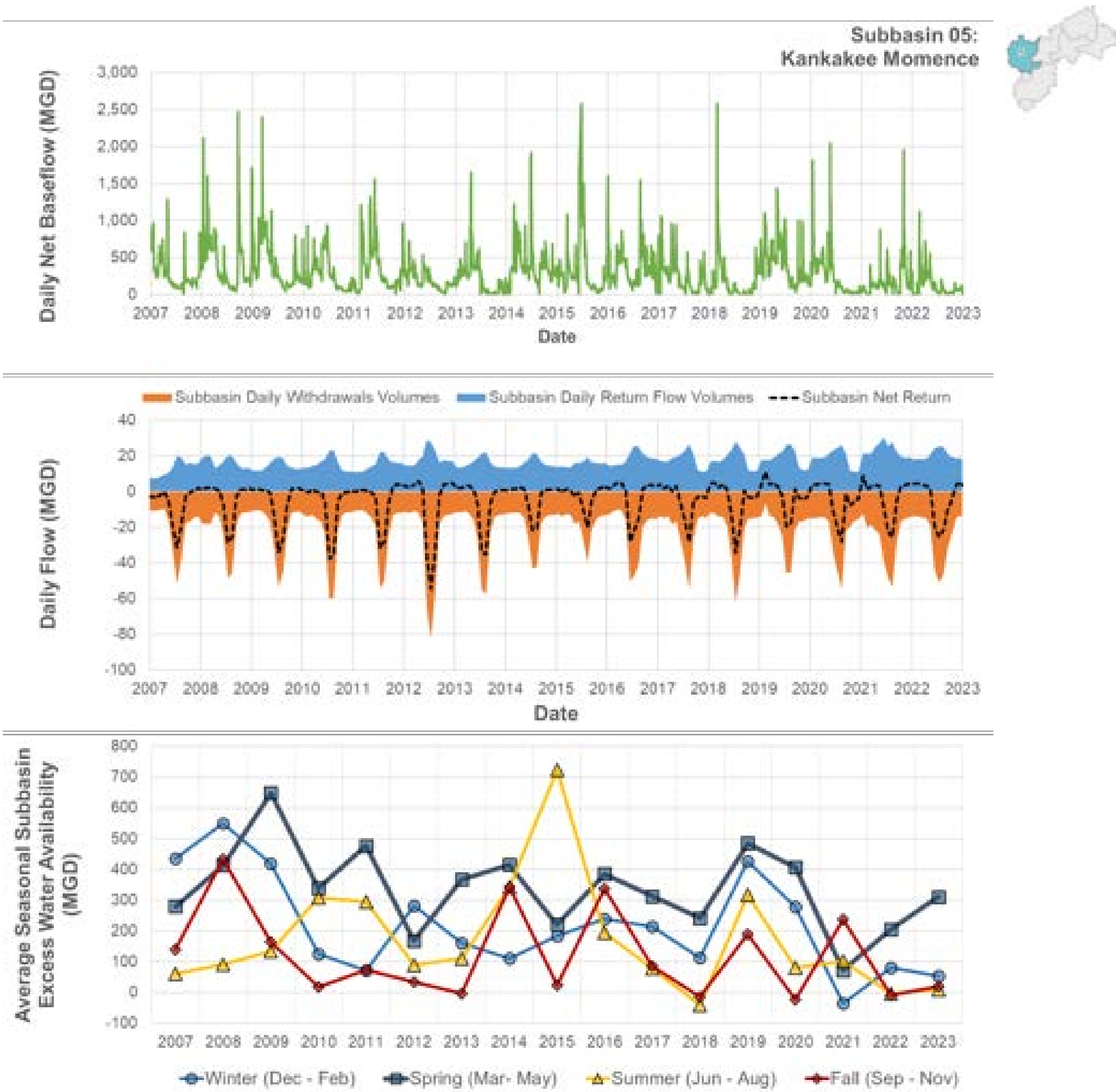


Figure F-7. Historical Daily Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Kankakee Momence (Subbasin 05)

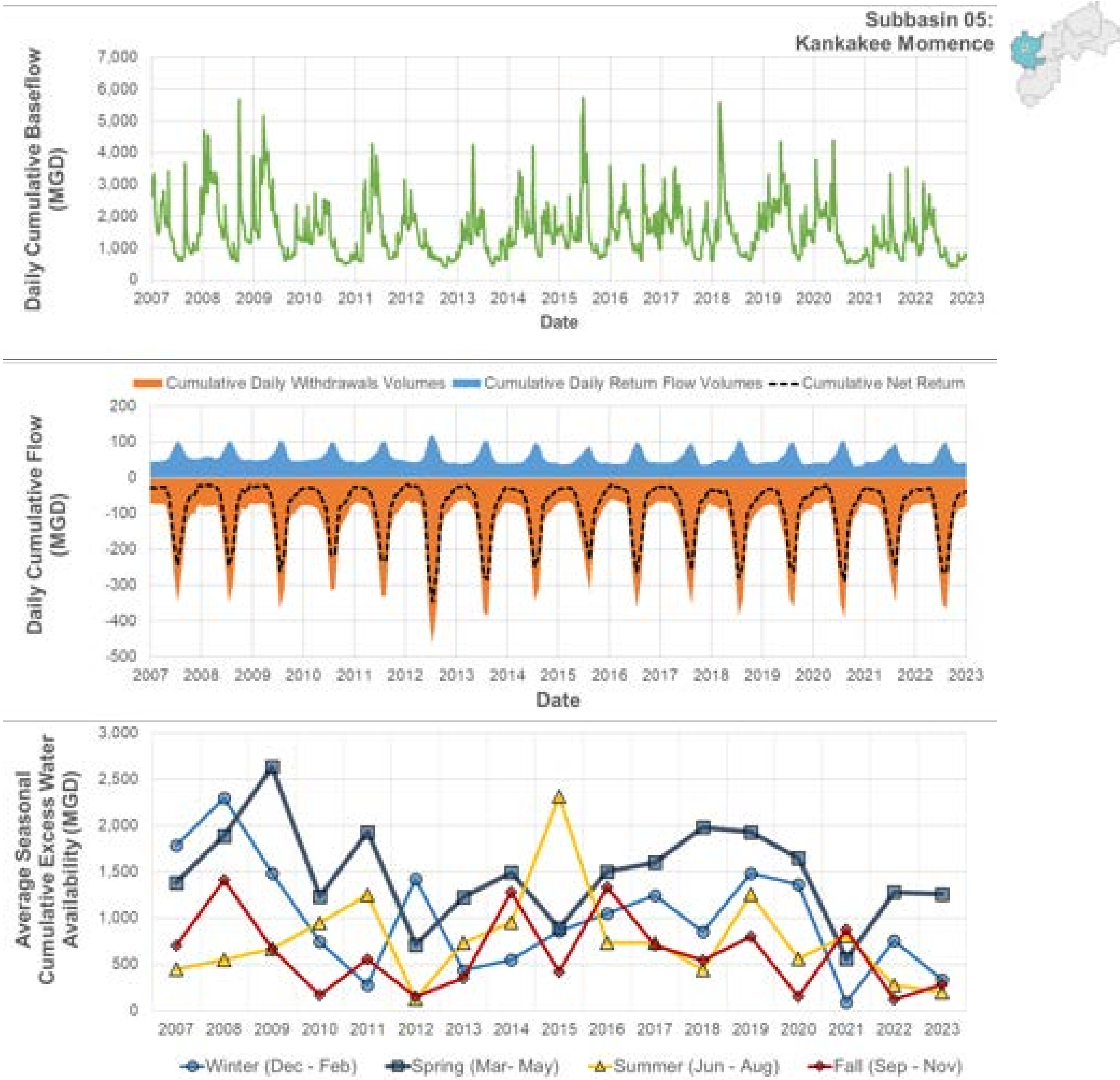


Figure F-8. Historical Daily Cumulative Natural Baseflow, Cumulative Daily Net Returns, and Average Seasonal Cumulative Excess Water Availability (regional) for Kankakee Momence (Subbasin 05)

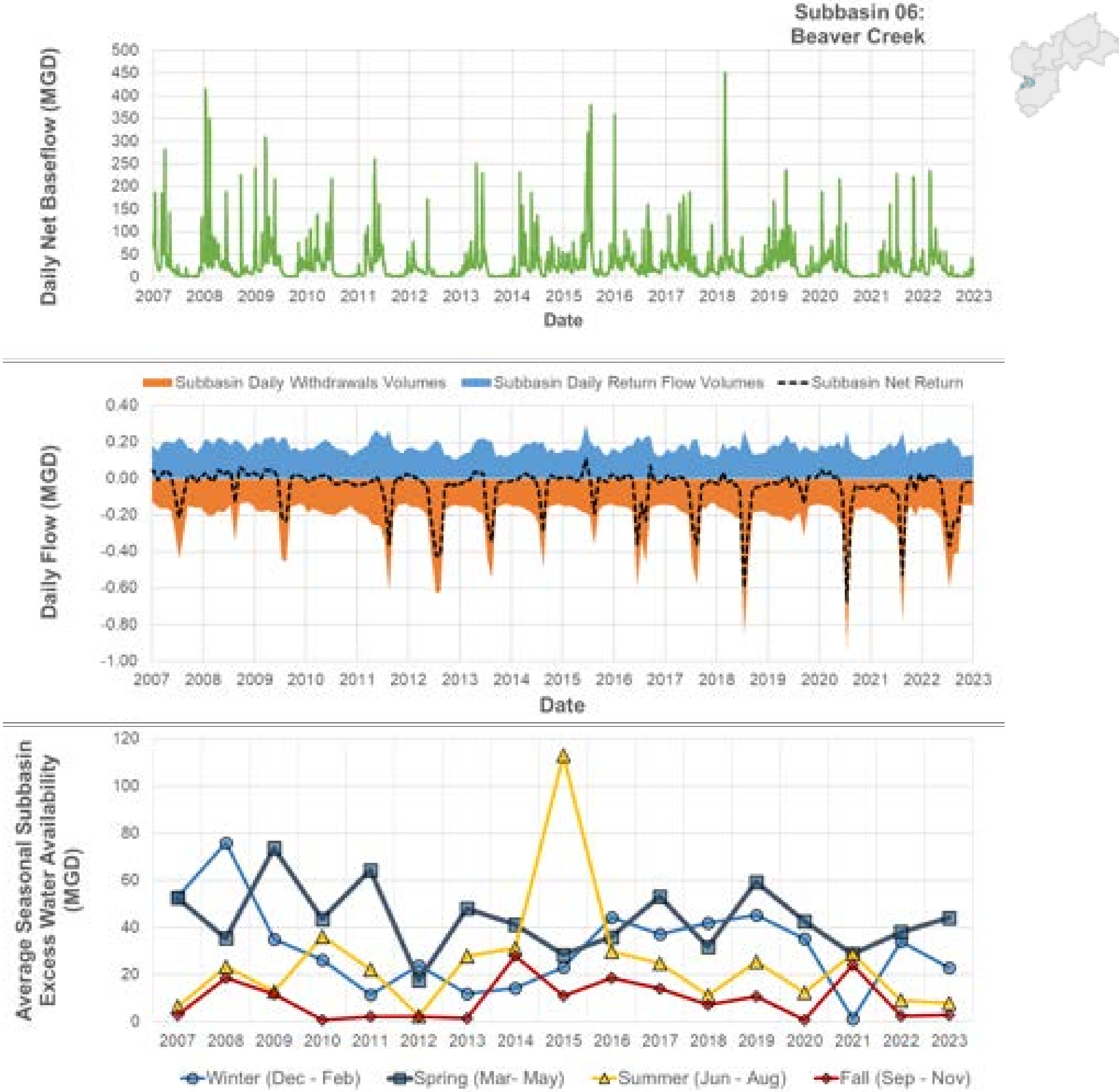


Figure F-9. Historical Daily Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Beaver Creek (Subbasin 06)

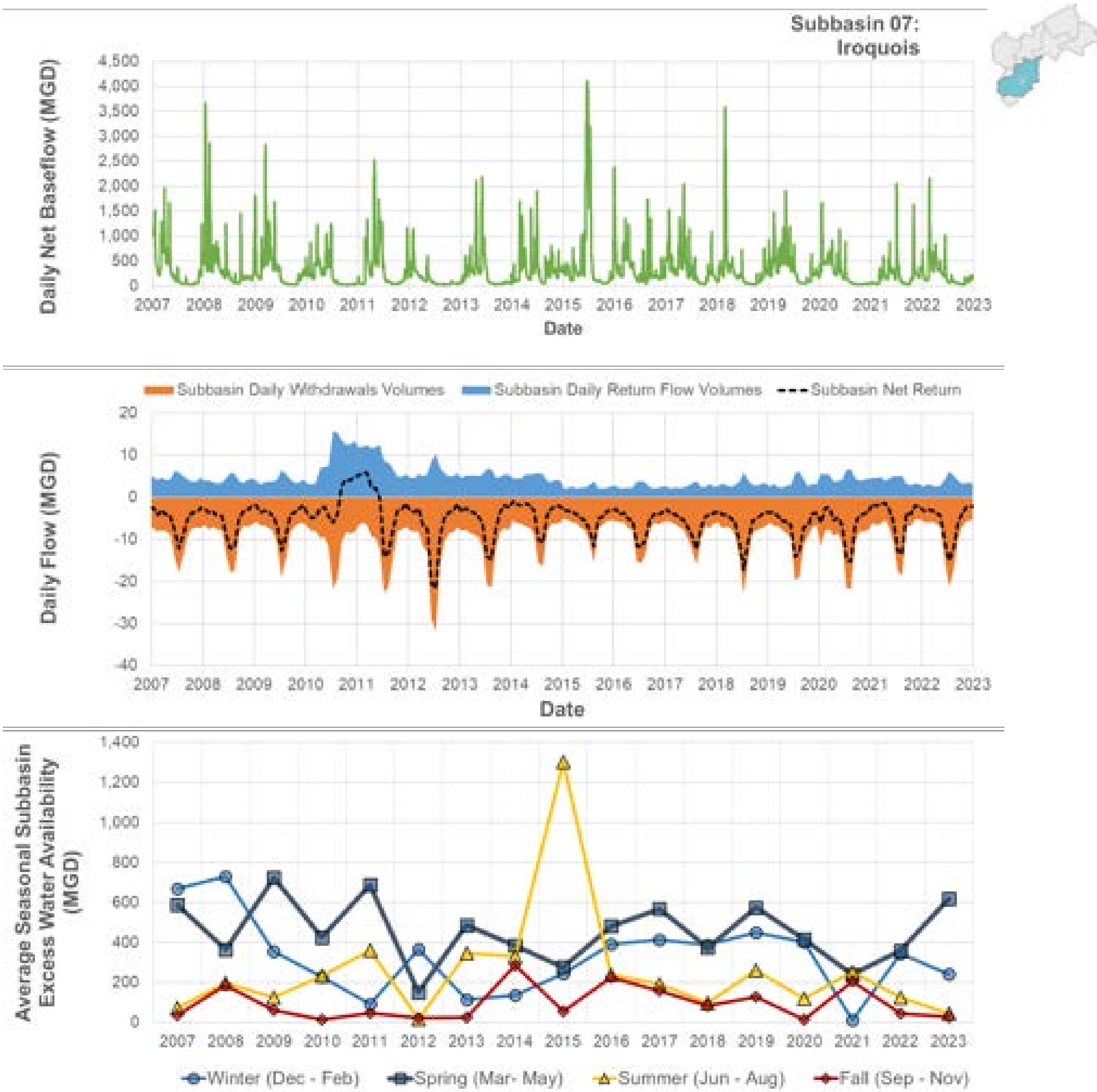


Figure F-10. Historical Daily Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Iroquois (Subbasin 07)

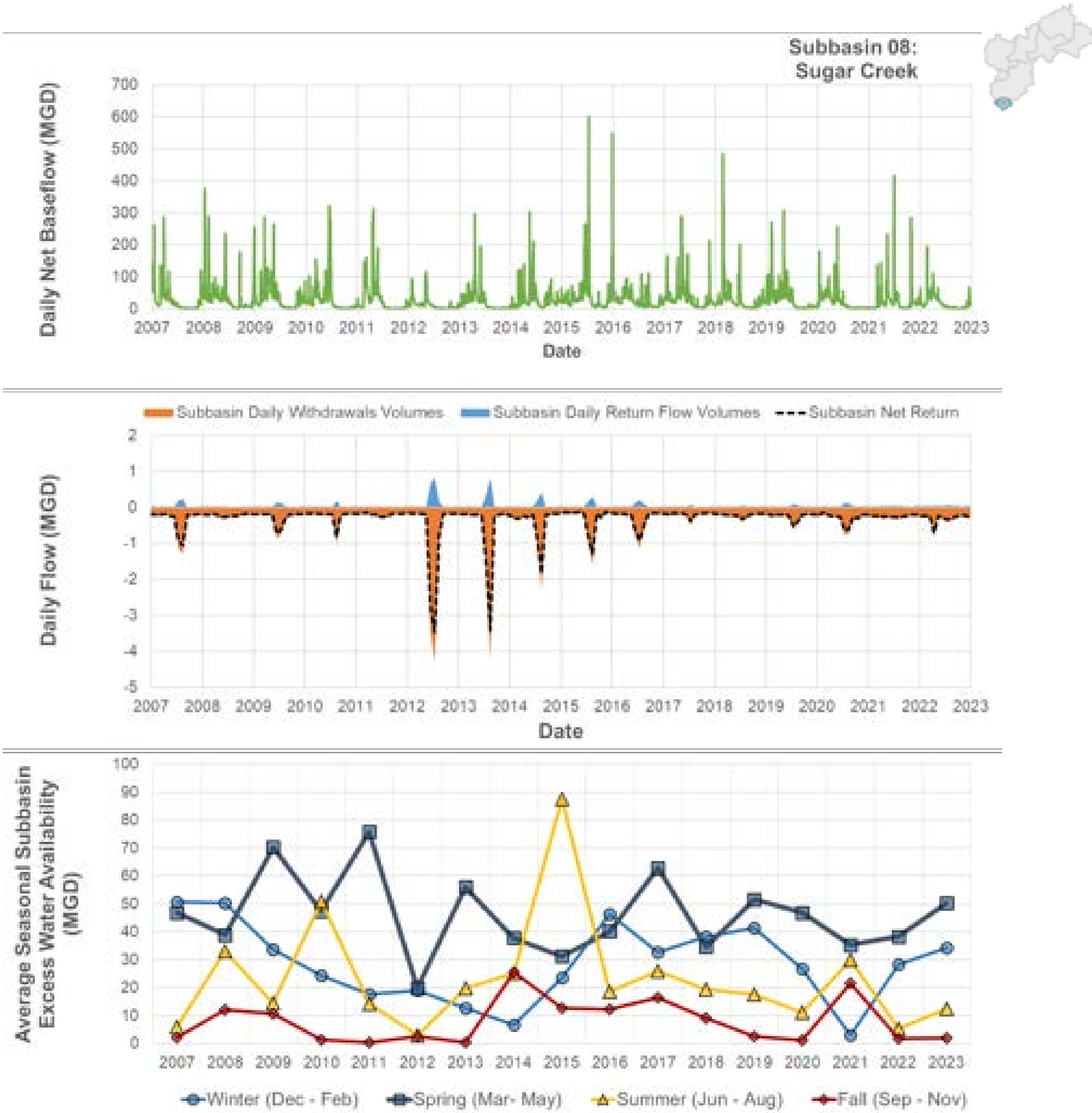


Figure F-11. Historical Daily Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Sugar Creek (Subbasin 08)

F.3 Box and Whisker Plots of Cumulative Water Budget Components, Cumulative Water Availability, and Cumulative Excess Water Availability

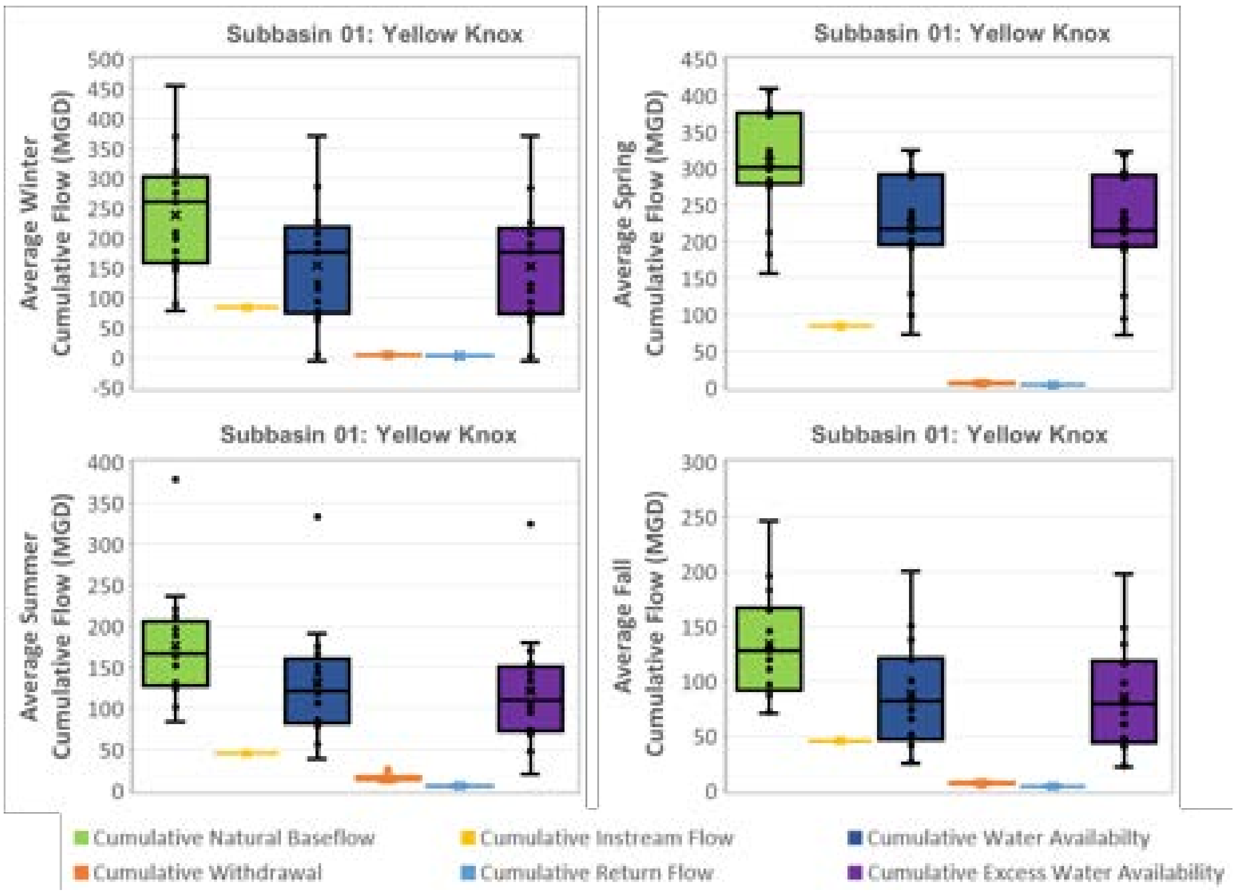


Figure F-12. Historical Seasonal Average Cumulative Water Budget Components for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) for Yellow Knox (Subbasin 01)

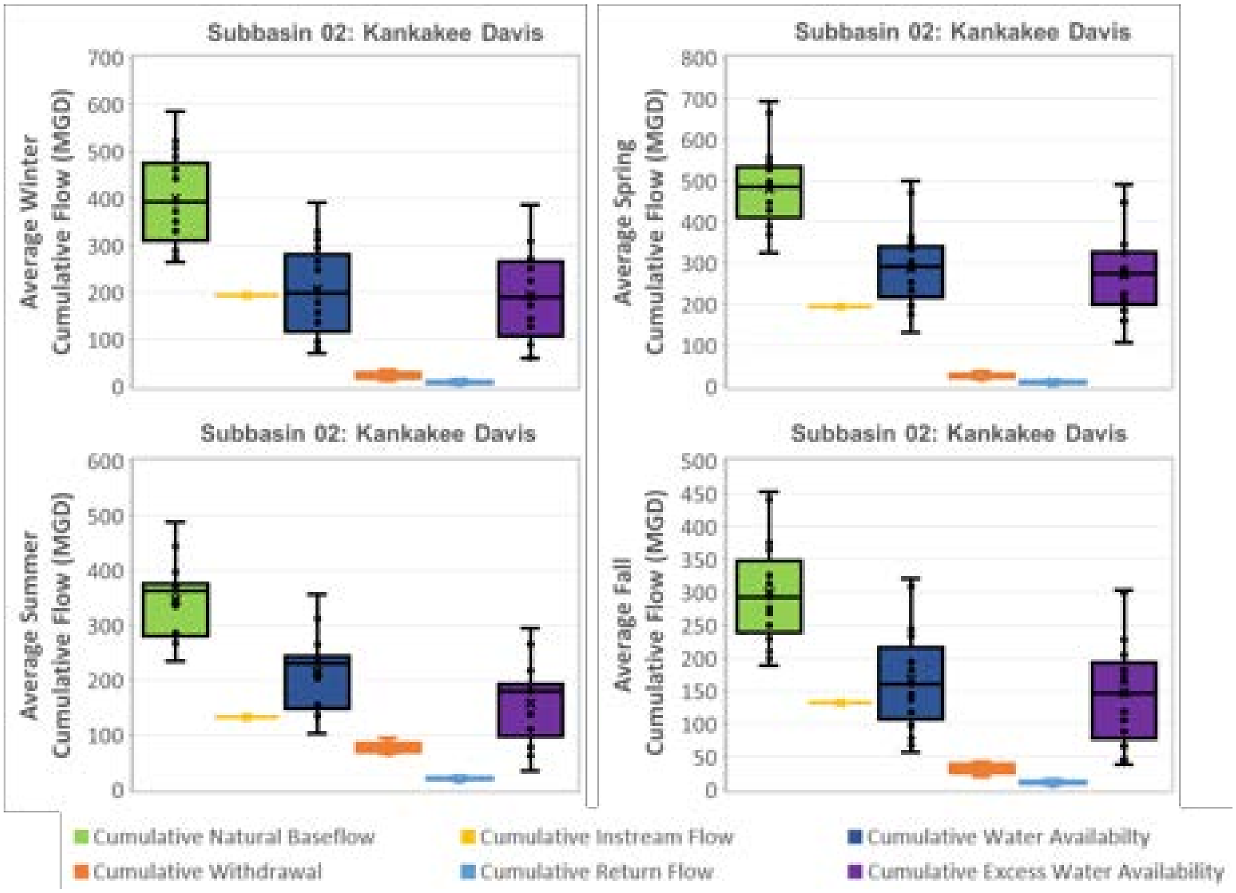


Figure F-13. Historical Seasonal Average Cumulative Water Budget Components for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) for Kankakee Davis (Subbasin 02)

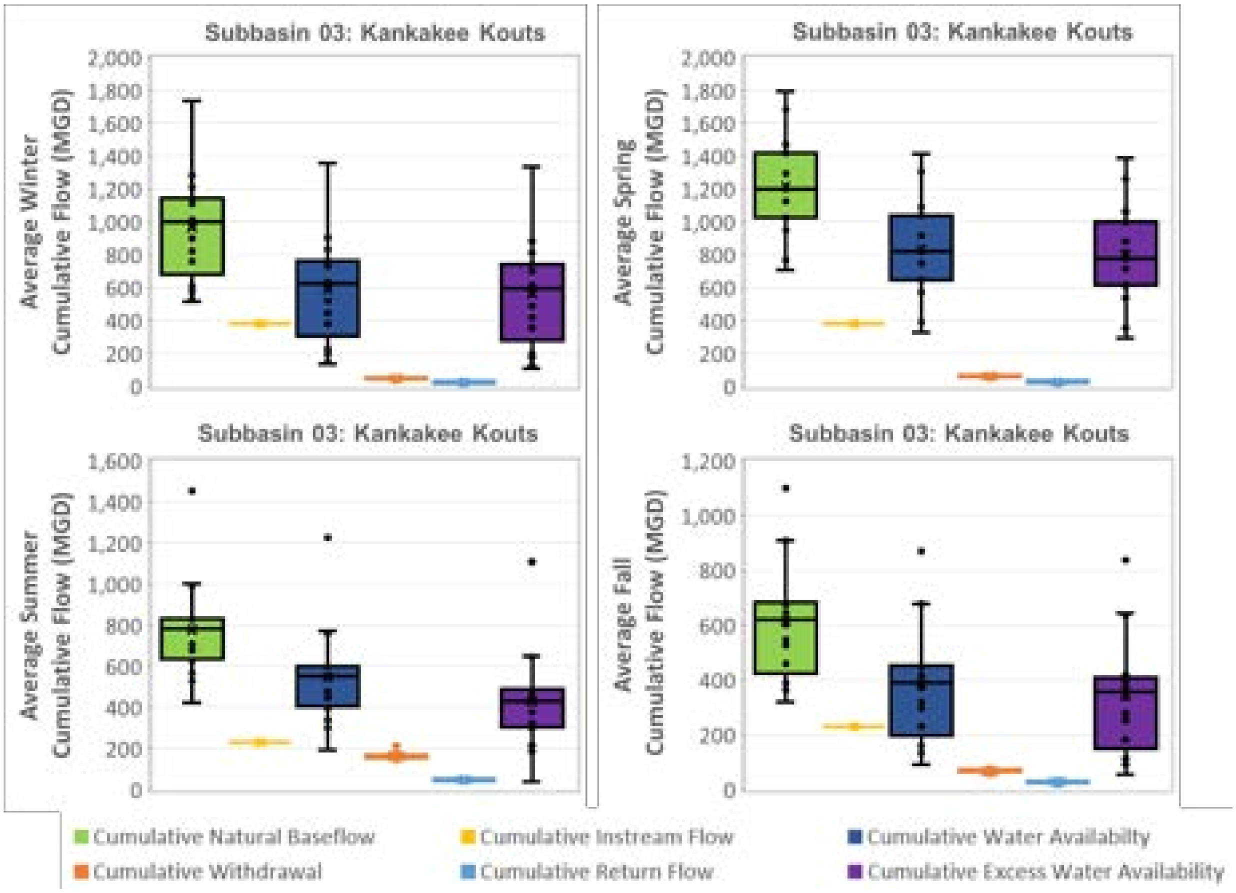


Figure F-14. Historical Seasonal Average Cumulative Water Budget Components for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) for Kankakee Kouts (Subbasin 03)

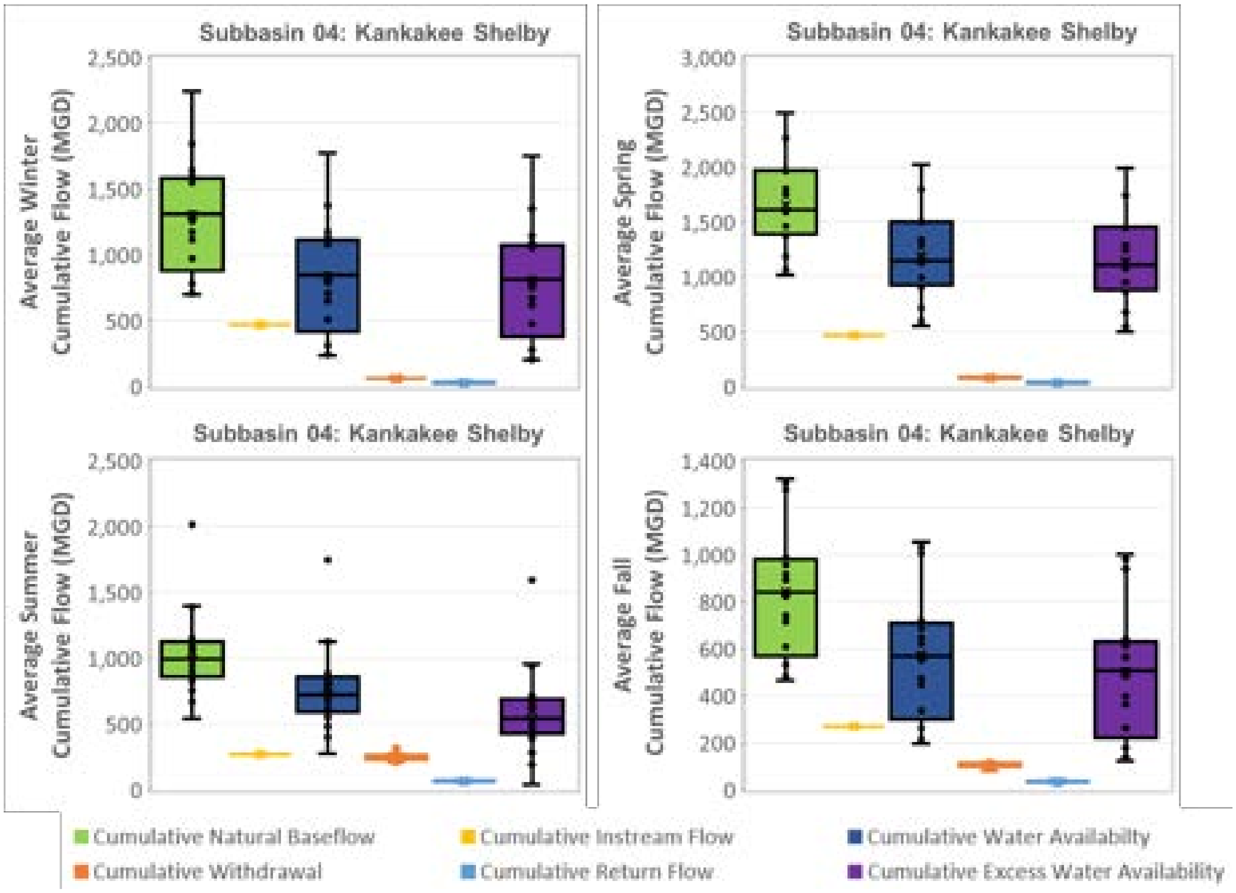


Figure F-15. Historical Seasonal Average Cumulative Water Budget Components for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) for Kankakee Shelby (Subbasin 04)

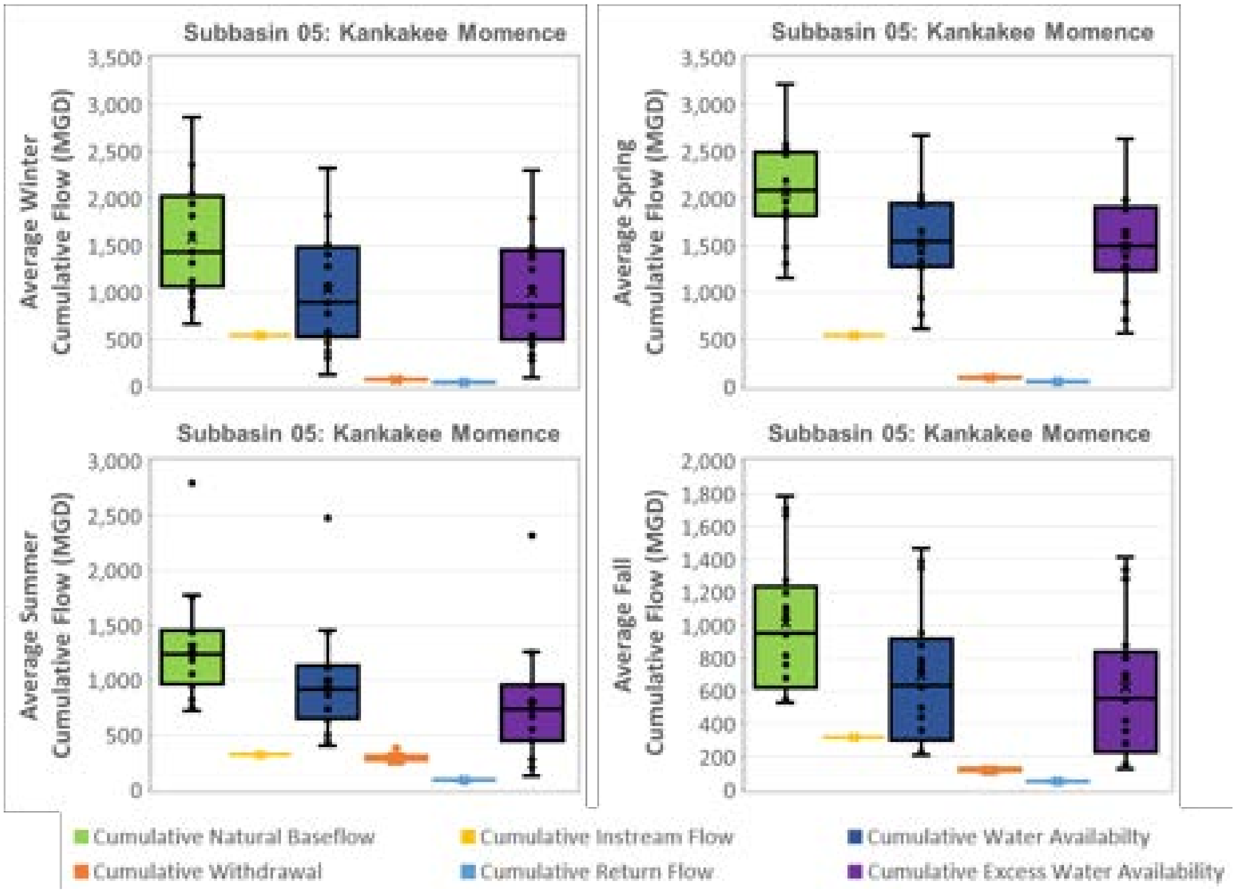


Figure F-16. Historical Seasonal Average Cumulative Water Budget Components for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) for Kankakee Momence (Subbasin 05)

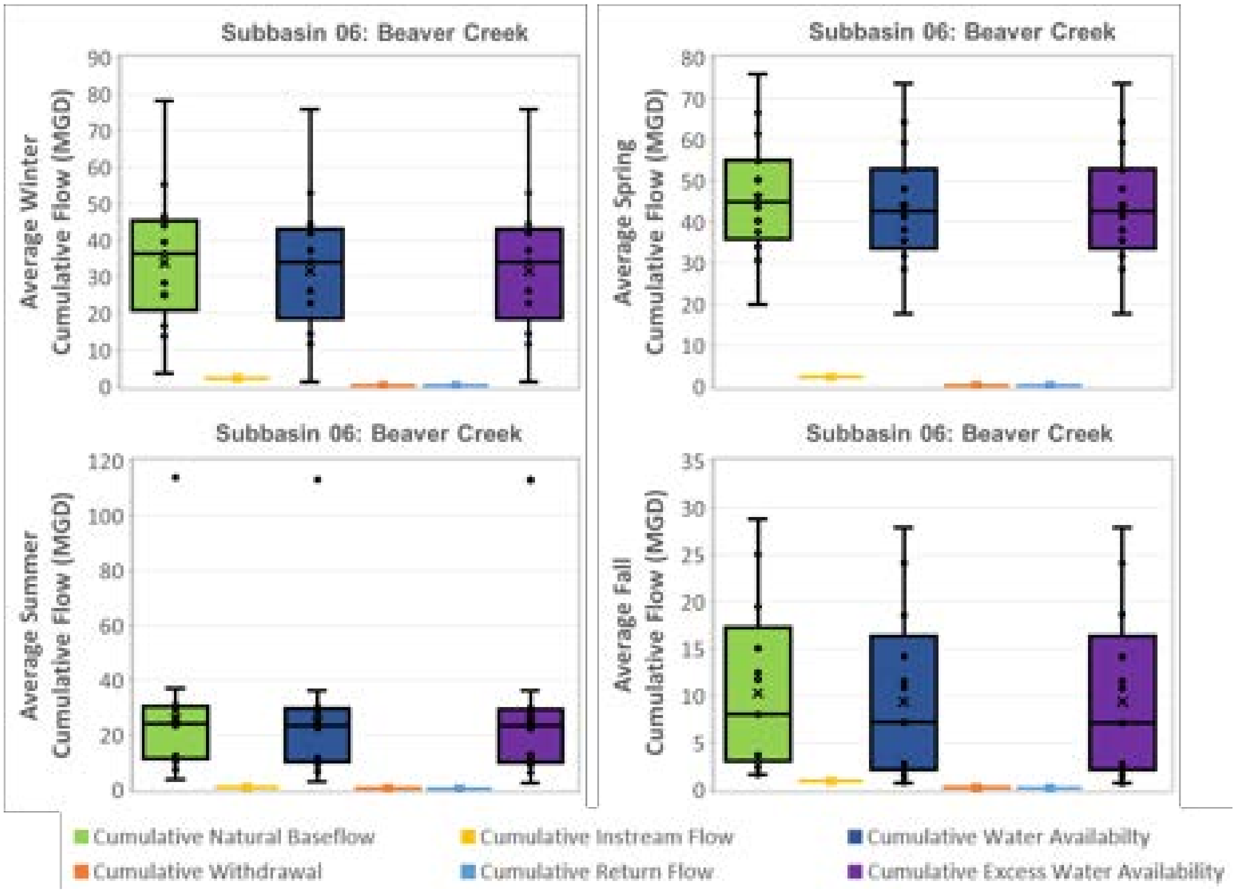


Figure F-17. Historical Seasonal Average Cumulative Water Budget Components for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) for Beaver Creek (Subbasin 06)

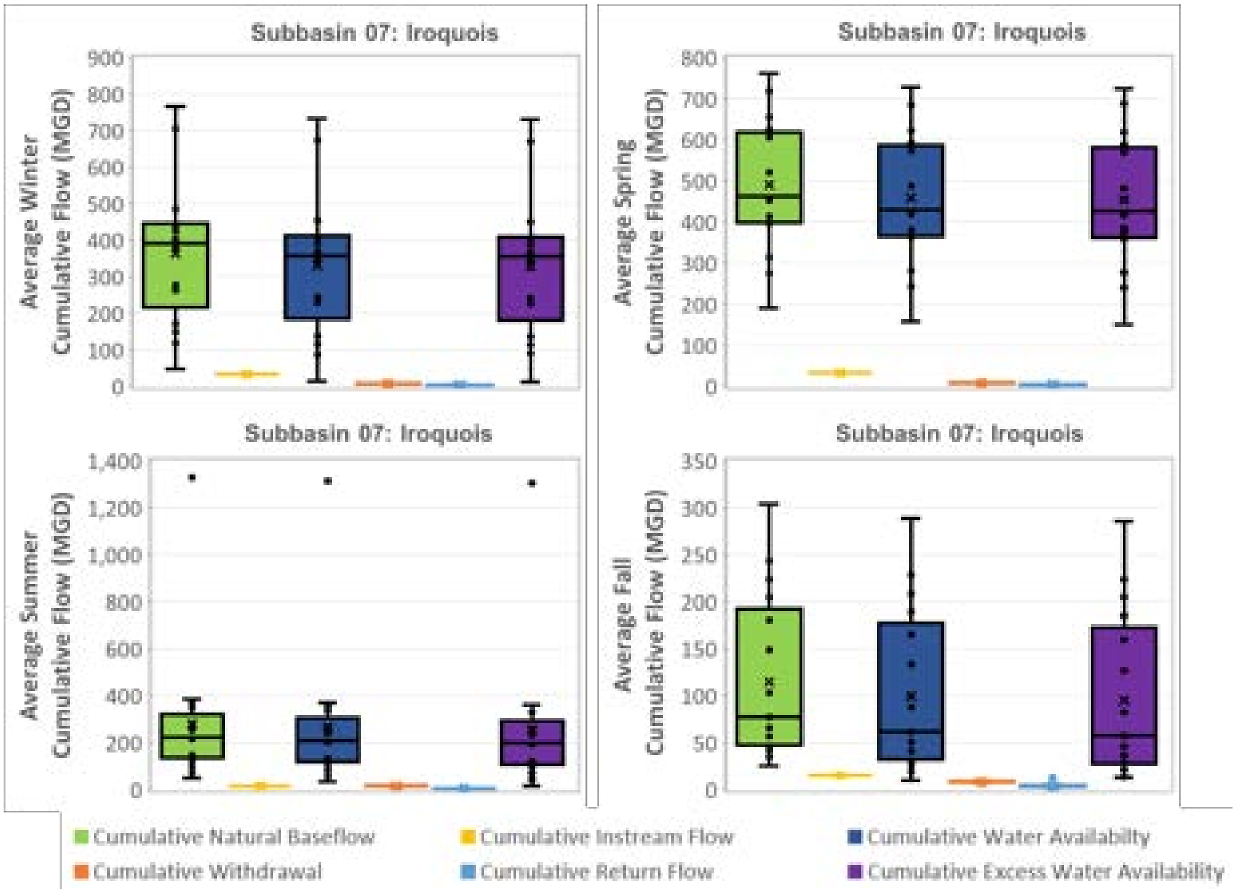


Figure F-18. Historical Seasonal Average Cumulative Water Budget Components for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) for Iroquois (Subbasin 07)

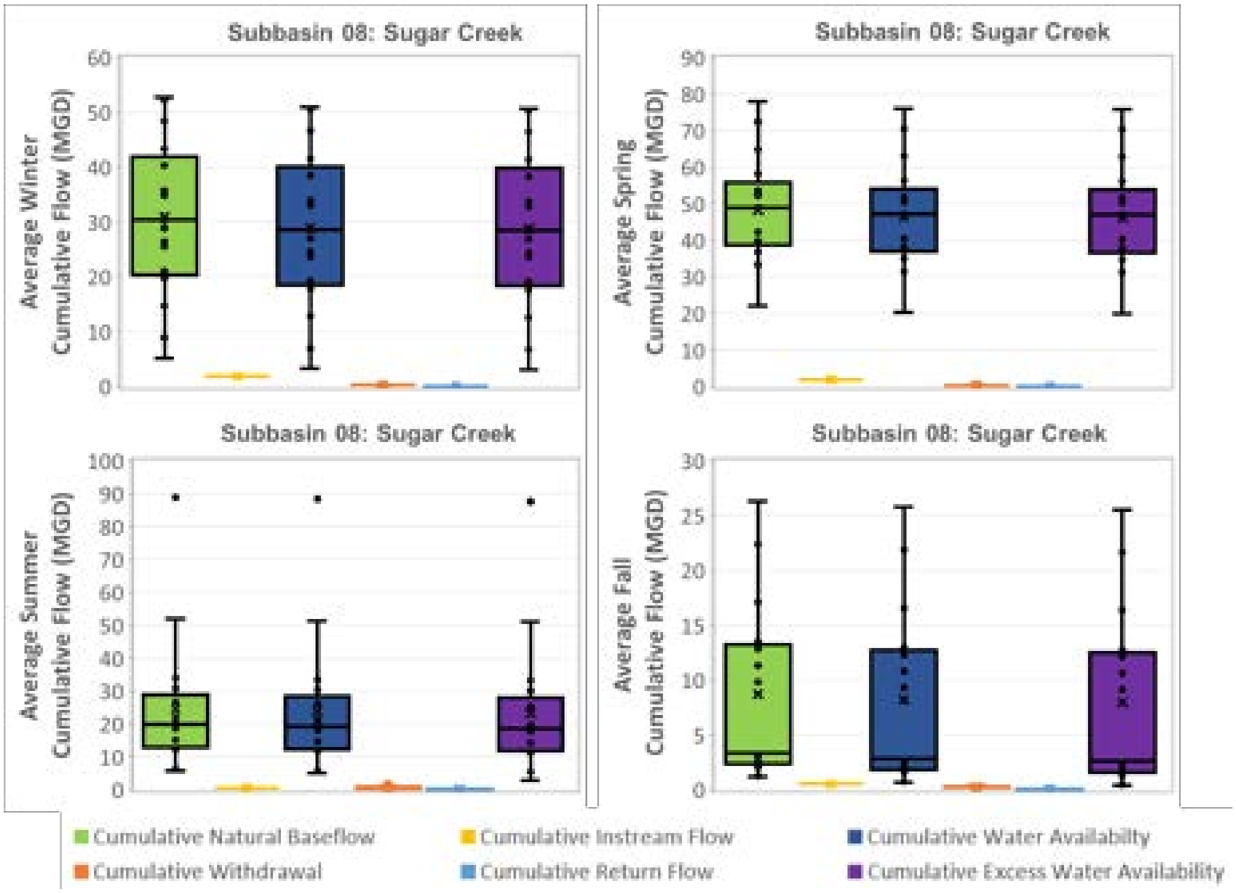


Figure F-19. Historical Seasonal Average Cumulative Water Budget Components for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) for Sugar Creek (Subbasin 08)

APPENDIX G

Future Baseline Water Availability by Subbasin

Kankakee Basin Regional Water Study

Appendix G – Future Baseline Water Availability by Subbasin

December 2025

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Appendix G Future Baseline Water Availability by Subbasin

Results from the future baseline water availability model are summarized by subbasin for the future analysis period of 2024-2075. Annual and seasonal excess water availability averaged over 5-year increments are summarized in Table G-1 through Table G-5. Annual and seasonal cumulative excess water availability averaged over 5-year increments are summarized in Table G-6 through Table G-10. Box and whisker plots for cumulative excess water availability by season and subbasin are shown in Figure G-1 through Figure G-8.

Historical and future exceedance distributions of cumulative excess water availability are shown by season and subbasin on Figure G-9 through Figure G-16. Each distribution relies on 17 years of fitting data. The historical distributions are fit based on results from 2007-2023. The future distributions are fit, as discussed in the main body of the report, using 17 representative future years between 2041 and 2075 (centered around the 2060s). The future 17 representative years are meant to be comparable to each year of the recent historical period,[1] 2007-2023. Selection of these 17 representative years is described in the main report in section 5.5.2. By selecting these years, the comparative analysis of water budget components explicitly reflects future baseline scenario assumptions, including climate change effects on natural baseflow and future projected water withdrawals, return flows, and reservoir releases.

Lastly, this appendix shows timeseries of monthly net natural baseflow, subbasin and cumulative withdrawals, subbasin and cumulative return flows, subbasin and cumulative net returns, and seasonal average subbasin and cumulative excess water availability in Figure G17 through Figure G27.

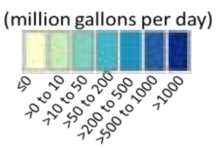
G.1 Summary Tables of Excess and Cumulative Excess Water Availability

[1] The future year, with corresponding historical year in parentheses, included: 2064 (2007), 2065 (2008), 2066 (2009), 2067 (2010), 2068 (2011), 2069 (2012), 2070 (2013), 2054 (2014 instead of 2019), 2053 (2015), 2047 (2016), 2072 (2017 instead of 2020), 2041 (2018 instead of 2010), 2050 (2019), 2059 (2020), 2060 (2021), 2056 (2022), 2045 (2023). Note that 2014, 2017, and 2018 were used instead of 2019, 2020, and 2010 respectively since they were not represented in the future sequence.

Table G-1. Annual 5-Year Increments of Average Excess Water Availability by Subbasin (MGD)

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	156	136	166	120	111	141	127	155	173	165	128	165	147	140
Kankakee Davis (02)	225	165	239	165	143	184	173	214	242	218	157	207	196	188
Kankakee Kouts (03)	231	182	227	161	147	212	164	203	250	268	167	242	189	180
Kankakee Shelby (04)	263	203	251	208	196	227	209	225	257	277	225	263	241	205
Kankakee Momence (05)	274	227	211	155	118	209	209	165	286	291	141	251	246	188
Beaver (06)	30	27	28	24	22	27	25	28	33	35	26	31	28	29
Iroquois (07)	295	293	293	243	216	281	249	314	347	381	249	330	289	310
Sugar (08)	30	26	26	23	23	26	26	32	31	34	26	30	29	33

Notes: Annual values are calculated as the average excess water availability from January through December. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day



Future Baseline Water Availability by Subbasin
December 2025

Table G-2. Winter 5-Year Increments of Average Excess Water Availability by Subbasin (MGD

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	215	106	193	109	73	164	119	165	159	140	101	209	155	131
Kankakee Davis (02)	280	136	247	161	151	236	204	261	284	274	212	319	280	243
Kankakee Kouts (03)	355	156	252	163	131	291	160	197	268	285	177	375	213	188
Kankakee Shelby (04)	351	160	278	218	176	265	226	226	257	272	238	346	293	208
Kankakee Momence (05)	382	162	254	139	68	256	206	159	282	252	106	342	281	142
Beaver (06)	47	17	41	25	14	30	19	30	27	26	18	37	24	24
Iroquois (07)	495	190	409	261	143	309	198	312	265	269	186	390	250	257
Sugar (08)	40	16	37	25	13	24	19	34	24	25	16	29	23	29

Notes:
Winter values are calculated as the average excess water availability from December through February. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day

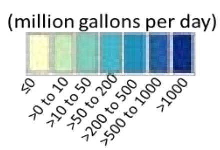
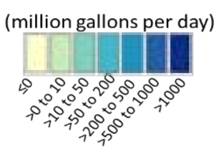


Table G-3. Spring 5-Year Increments of Average Excess Water Availability by Subbasin (MGD)

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	250	194	254	212	154	216	216	282	302	278	194	264	263	271
Kankakee Davis (02)	318	219	336	244	198	247	274	355	349	306	223	279	309	309
Kankakee Kouts (03)	378	244	382	276	228	327	328	422	443	422	270	375	379	361
Kankakee Shelby (04)	422	267	395	341	306	362	375	429	452	438	363	429	441	394
Kankakee Momence (05)	420	330	366	308	242	393	422	405	572	492	295	469	497	437
Beaver (06)	51	40	45	45	42	51	56	60	72	64	50	61	66	64
Iroquois (07)	526	397	483	468	399	533	561	724	755	645	474	633	662	750
Sugar (08)	51	44	47	47	48	56	62	70	76	72	57	66	73	74

Notes:
Spring values are calculated as the average excess water availability from March through May. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day

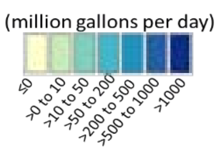


Future Baseline Water Availability by Subbasin
December 2025

Table G-4. Summer 5-Year Increments of Average Excess Water Availability by Subbasin (MGD)

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	105	155	117	100	130	128	114	103	142	167	134	133	118	105
Kankakee Davis (02)	143	171	196	154	141	125	149	146	195	208	135	121	147	136
Kankakee Kouts (03)	115	216	144	132	144	126	137	130	166	292	144	128	139	132
Kankakee Shelby (04)	146	226	167	154	170	142	158	125	183	286	174	148	164	130
Kankakee Momence (05)	149	312	126	98	73	85	192	66	173	359	78	89	197	137
Beaver (06)	20	39	21	17	23	21	22	16	28	46	24	23	23	22
Iroquois (07)	157	472	182	163	228	231	232	161	295	557	246	247	246	189
Sugar (08)	26	30	19	16	20	20	22	17	20	34	21	20	23	24

Notes:
Summer values are calculated as the average excess water availability from June through August. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day



Future Baseline Water Availability by Subbasin
December 2025

Table G-5. Fall 5-Year Increments of Average Excess Water Availability by Subbasin (MGD)

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	77	81	106	59	78	58	64	74	83	82	73	54	59	59
Kankakee Davis (02)	181	129	182	98	75	120	76	97	132	93	53	98	58	65
Kankakee Kouts (03)	116	104	136	71	75	105	34	66	115	82	65	94	26	42
Kankakee Shelby (04)	180	150	172	121	119	133	92	119	125	126	110	123	84	90
Kankakee Momence (05)	189	94	115	78	75	86	43	25	111	72	71	83	41	30
Beaver (06)	8	9	10	8	9	4	3	5	7	7	9	3	3	4
Iroquois (07)	74	87	121	79	82	41	22	55	69	64	78	37	20	39
Sugar (08)	7	8	8	6	8	2	2	5	4	6	7	2	2	3

Notes:
Fall values are calculated as the average excess water availability from September through November. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day

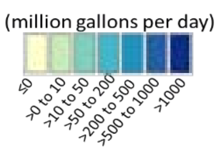
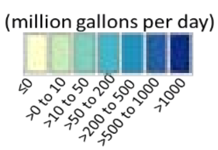


Table G-6. Annual 5-Year Increments Average of Cumulative Excess Water Availability by Subbasin (MGD)

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	156	136	166	120	111	141	127	155	173	165	128	165	147	140
Kankakee Davis (02)	225	165	239	165	143	184	173	214	242	218	157	207	196	188
Kankakee Kouts (03)	609	481	630	444	398	535	462	569	663	649	449	611	530	505
Kankakee Shelby (04)	873	684	881	652	594	762	671	795	920	926	674	874	771	711
Kankakee Momence (05)	1,147	909	1,087	799	697	967	877	953	1,201	1,216	797	1,121	1,015	895
Beaver (06)	30	27	28	24	22	27	25	28	33	35	26	31	28	29
Iroquois (07)	295	293	293	243	216	281	249	314	347	381	249	330	289	310
Sugar (08)	30	26	26	23	23	26	26	32	31	34	26	30	29	33

Notes:
Annual values are calculated as the average cumulative excess water availability from January through December. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day

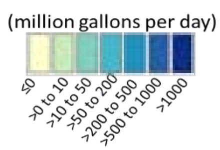


Future Baseline Water Availability by Subbasin
December 2025

Table G-7. Winter 5-Year Increments Average of Cumulative Excess Water Availability by Subbasin (MGD)

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	215	106	193	109	73	164	119	165	159	140	101	209	155	131
Kankakee Davis (02)	280	136	247	161	151	236	204	261	284	274	212	319	280	243
Kankakee Kouts (03)	845	395	687	429	351	687	480	615	709	696	486	898	645	557
Kankakee Shelby (04)	1,195	555	966	647	527	953	706	841	965	968	724	1,244	938	765
Kankakee Momence (05)	1,578	710	1,201	756	543	1,197	912	969	1,232	1,217	764	1,574	1,219	887
Beaver (06)	47	17	41	25	14	30	19	30	27	26	18	37	24	24
Iroquois (07)	495	190	409	261	143	309	198	312	265	269	186	390	250	257
Sugar (08)	40	16	37	25	13	24	19	34	24	25	16	29	23	29

Notes:
Winter values are calculated as the average cumulative excess water availability from December through February. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day



Future Baseline Water Availability by Subbasin
December 2025

Table G-8. Spring 5-Year Increments Average of Cumulative Excess Water Availability by Subbasin (MGD)

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	250	194	254	212	154	216	216	282	302	278	194	264	263	271
Kankakee Davis (02)	318	219	336	244	198	247	274	355	349	306	223	279	309	309
Kankakee Kouts (03)	945	657	972	732	580	789	817	1,057	1,092	1,005	686	917	950	938
Kankakee Shelby (04)	1,367	923	1,368	1,073	886	1,151	1,192	1,486	1,544	1,443	1,049	1,346	1,391	1,333
Kankakee Momence (05)	1,787	1,253	1,733	1,379	1,124	1,544	1,615	1,890	2,116	1,935	1,341	1,815	1,888	1,770
Beaver (06)	51	40	45	45	42	51	56	60	72	64	50	61	66	64
Iroquois (07)	526	397	483	468	399	533	561	724	755	645	474	633	662	750
Sugar (08)	51	44	47	47	48	56	62	70	76	72	57	66	73	74

Notes:
Spring values are calculated as the average cumulative excess water availability from March through May. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day

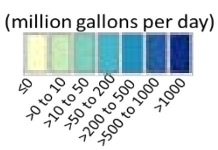


Table G-9. Summer 5-Year Increments Average of Cumulative Excess Water Availability by Subbasin (MGD)

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	105	155	117	100	130	128	114	103	142	167	134	133	118	105
Kankakee Davis (02)	143	171	196	154	141	125	149	146	195	208	135	121	147	136
Kankakee Kouts (03)	360	542	455	384	411	375	399	378	500	667	409	378	403	374
Kankakee Shelby (04)	506	767	622	538	581	517	557	504	682	953	583	526	567	503
Kankakee Momence (05)	654	1,077	746	635	651	599	748	567	853	1,311	658	611	762	639
Beaver (06)	20	39	21	17	23	21	22	16	28	46	24	23	23	22
Iroquois (07)	157	472	182	163	228	231	232	161	295	557	246	247	246	189
Sugar (08)	26	30	19	16	20	20	22	17	20	34	21	20	23	24

Notes:
Summer values are calculated as the average cumulative excess water availability from June through August. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day

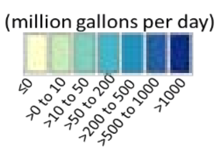
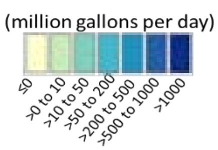


Table G-10. Fall 5-Year Increments Average of Cumulative Excess Water Availability by Subbasin (MGD)

Subbasin	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Yellow Knox (01)	77	81	106	59	78	58	64	74	83	82	73	54	59	59
Kankakee Davis (02)	181	129	182	98	75	120	76	97	132	93	53	98	58	65
Kankakee Kouts (03)	372	311	423	225	225	281	172	235	328	255	188	244	141	164
Kankakee Shelby (04)	551	461	594	346	344	414	263	354	454	381	297	367	225	254
Kankakee Momence (05)	740	554	708	424	418	499	306	378	564	452	366	449	265	284
Beaver (06)	8	9	10	8	9	4	3	5	7	7	9	3	3	4
Iroquois (07)	74	87	121	79	82	41	22	55	69	64	78	37	20	39
Sugar (08)	7	8	8	6	8	2	2	5	4	6	7	2	2	3

Notes:
Fall values are calculated as the average cumulative excess water availability from September through November. The 2010 value represents the average for years 2007-2010, the 2015 value represents the average for years 2011-2015, and so on through 2075.
Key:
MGD = million gallons per day



G.2 Box and Whisker Plots of Cumulative Water Budget Components, Cumulative Water Availability, and Cumulative Excess Water Availability

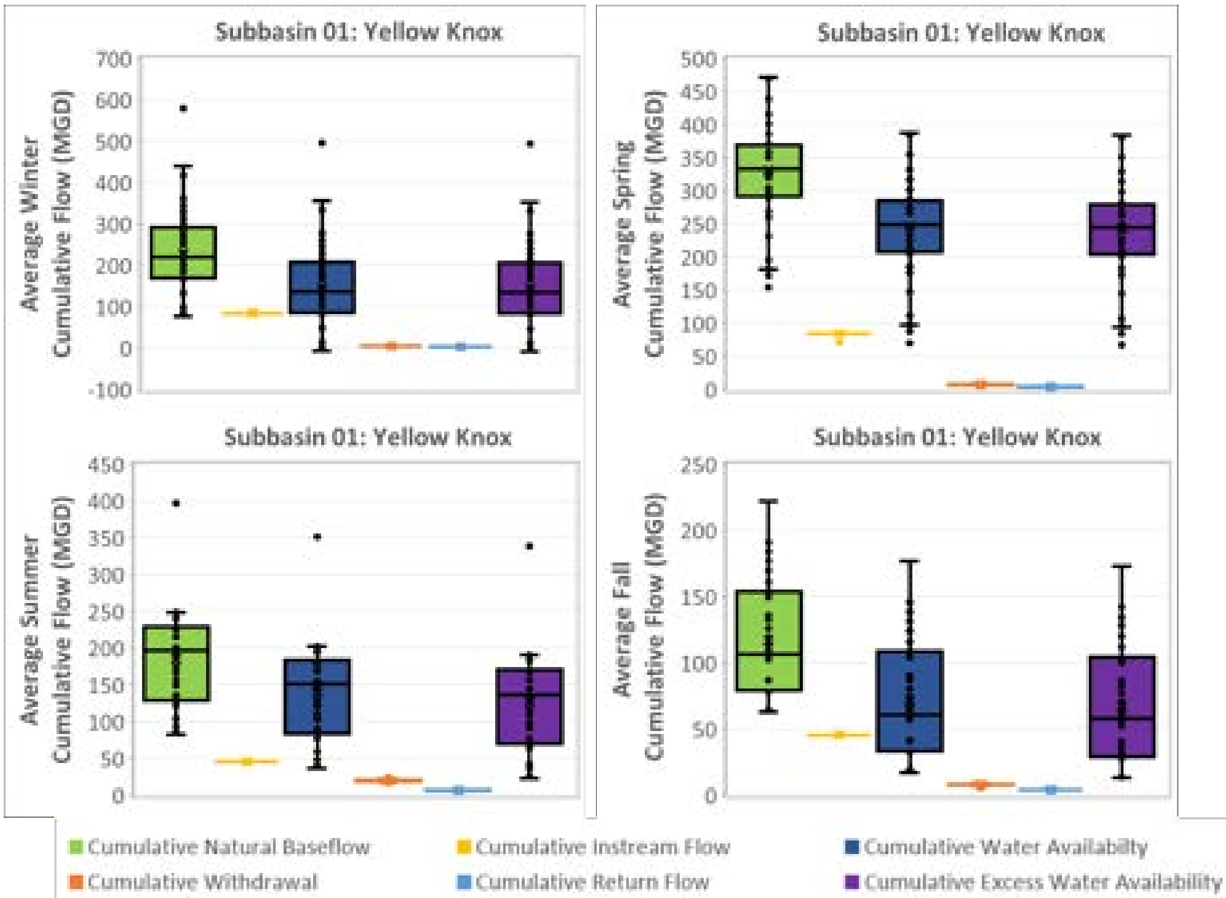


Figure G-1. Box Plots of Future (2024-2075) Cumulative Excess Water Availability Component for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) Seasons for Yellow Knox (Subbasin 01)

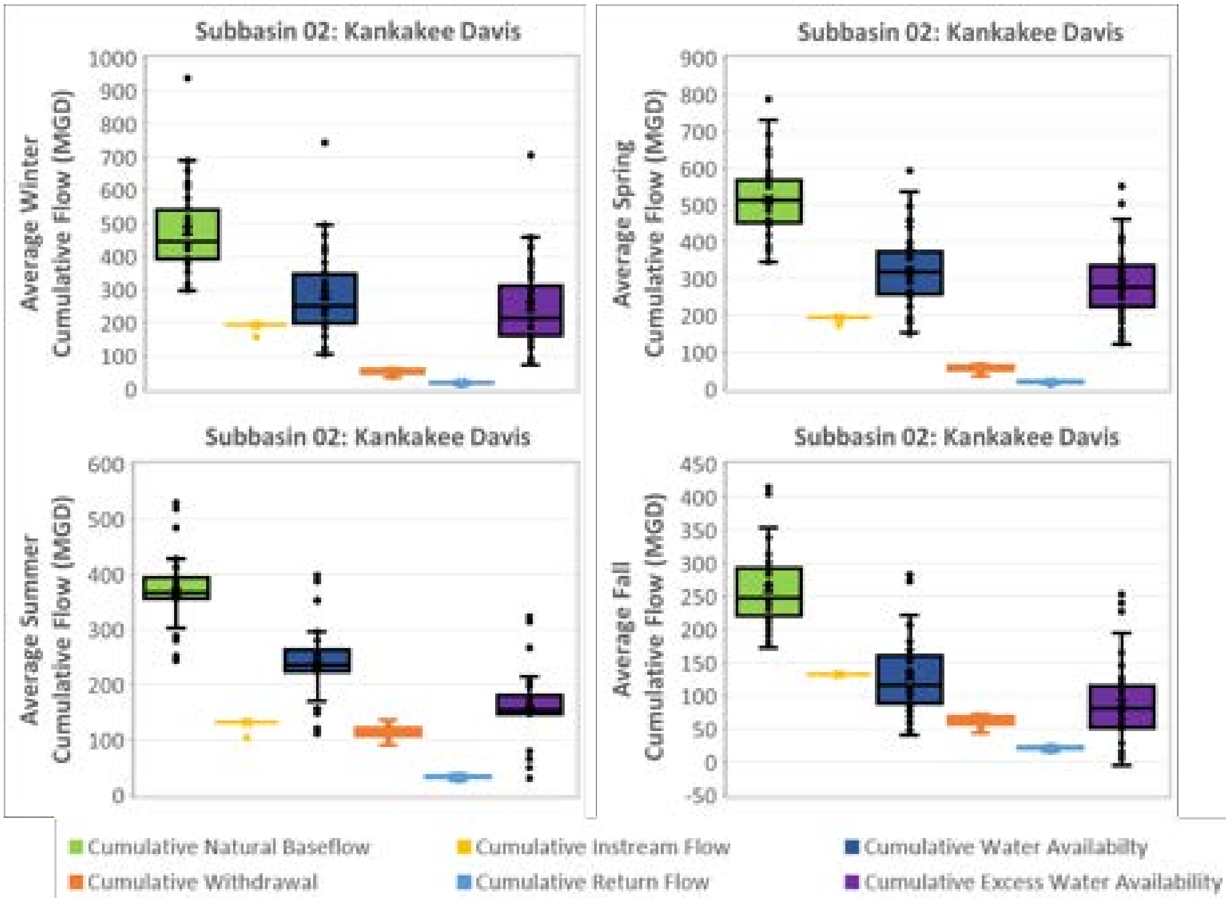


Figure G-2. Box Plots of Future (2024-2075) Cumulative Excess Water Availability (regional) Component for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) Seasons for Kankakee Davis (Subbasin 02)

Future Baseline Water Availability by Subbasin
December 2025

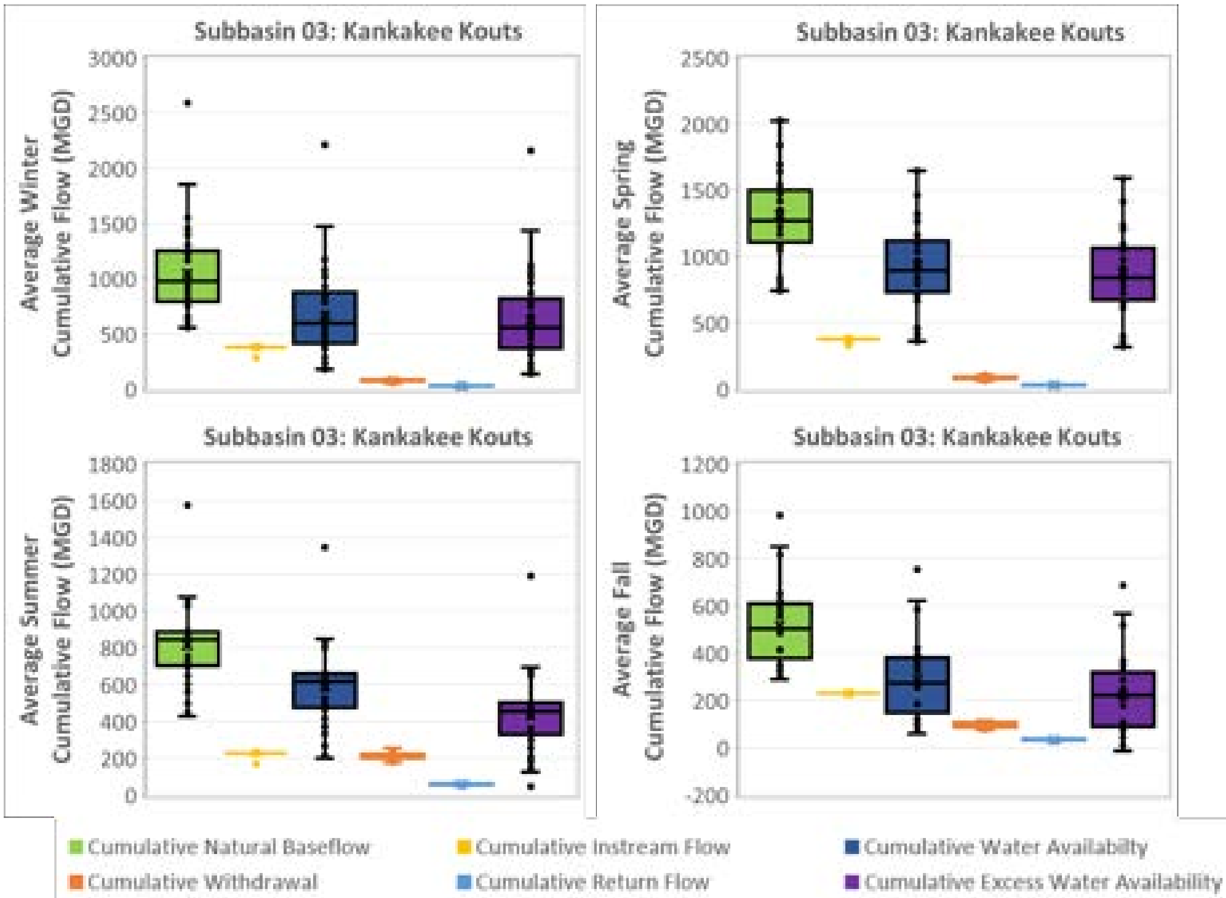


Figure G-3. Box Plots of Future (2024-2075) Cumulative Excess Water Availability (regional) Component for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) Seasons for Kankakee Kouts (Subbasin 03)

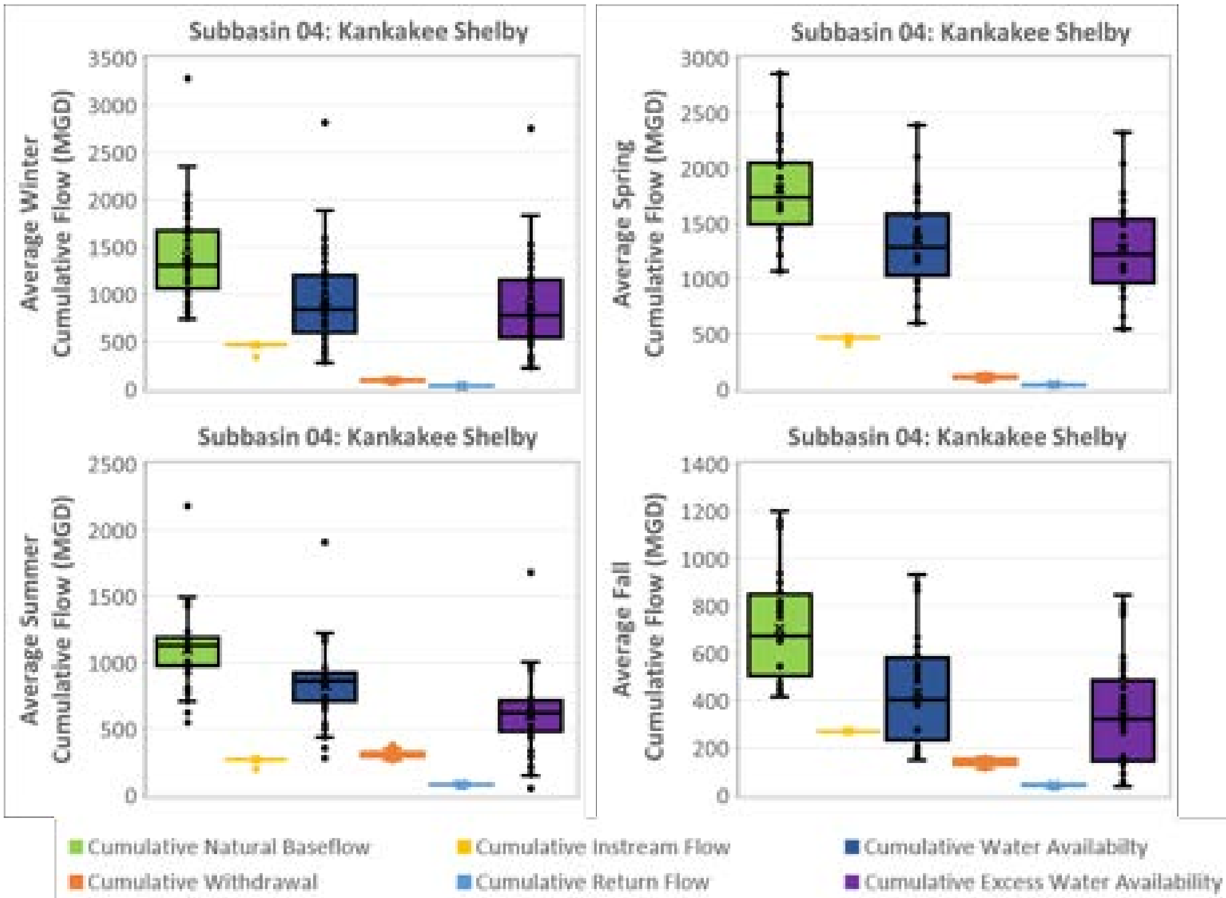


Figure G-4. Box Plots of Future (2024-2075) Cumulative Excess Water Availability (regional) Component for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) Seasons for Kankakee Shelby (Subbasin 04)

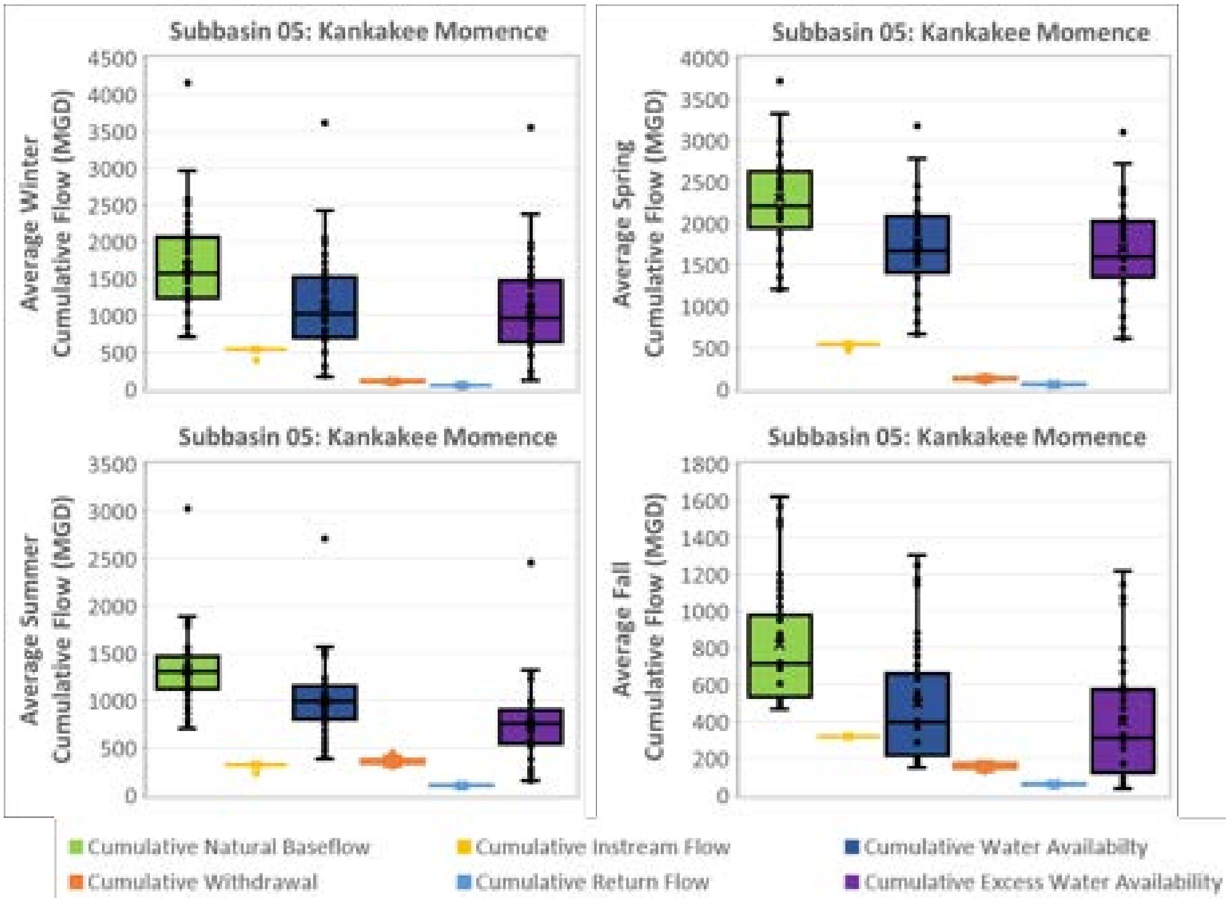


Figure G-5. Box Plots of Future (2024-2075) Cumulative Excess Water Availability (regional) Component for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) Seasons for Kankakee Momence (Subbasin 05)

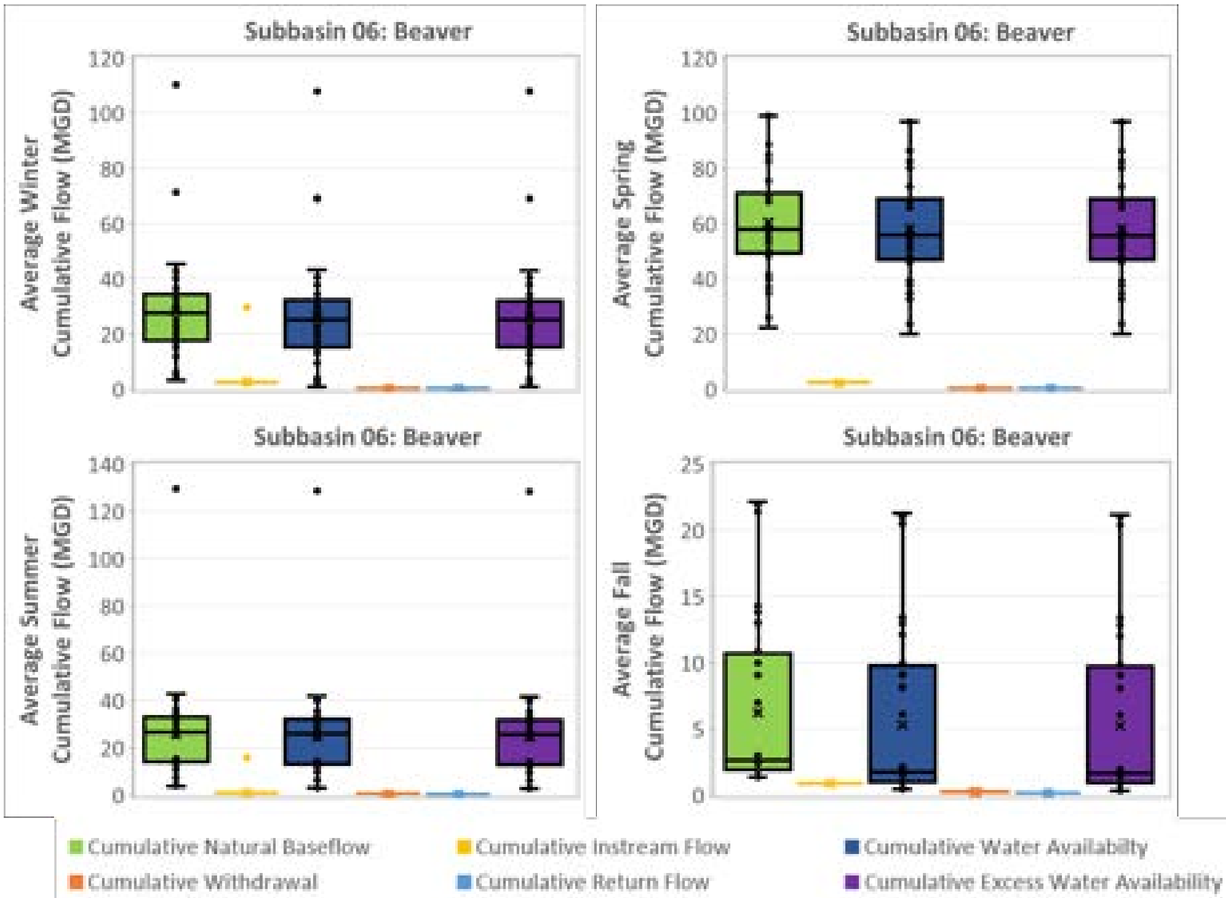


Figure G-6. Box Plots of Future (2024-2075) Cumulative Excess Water Availability (regional) Component for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) Seasons for Beaver (Subbasin 06)

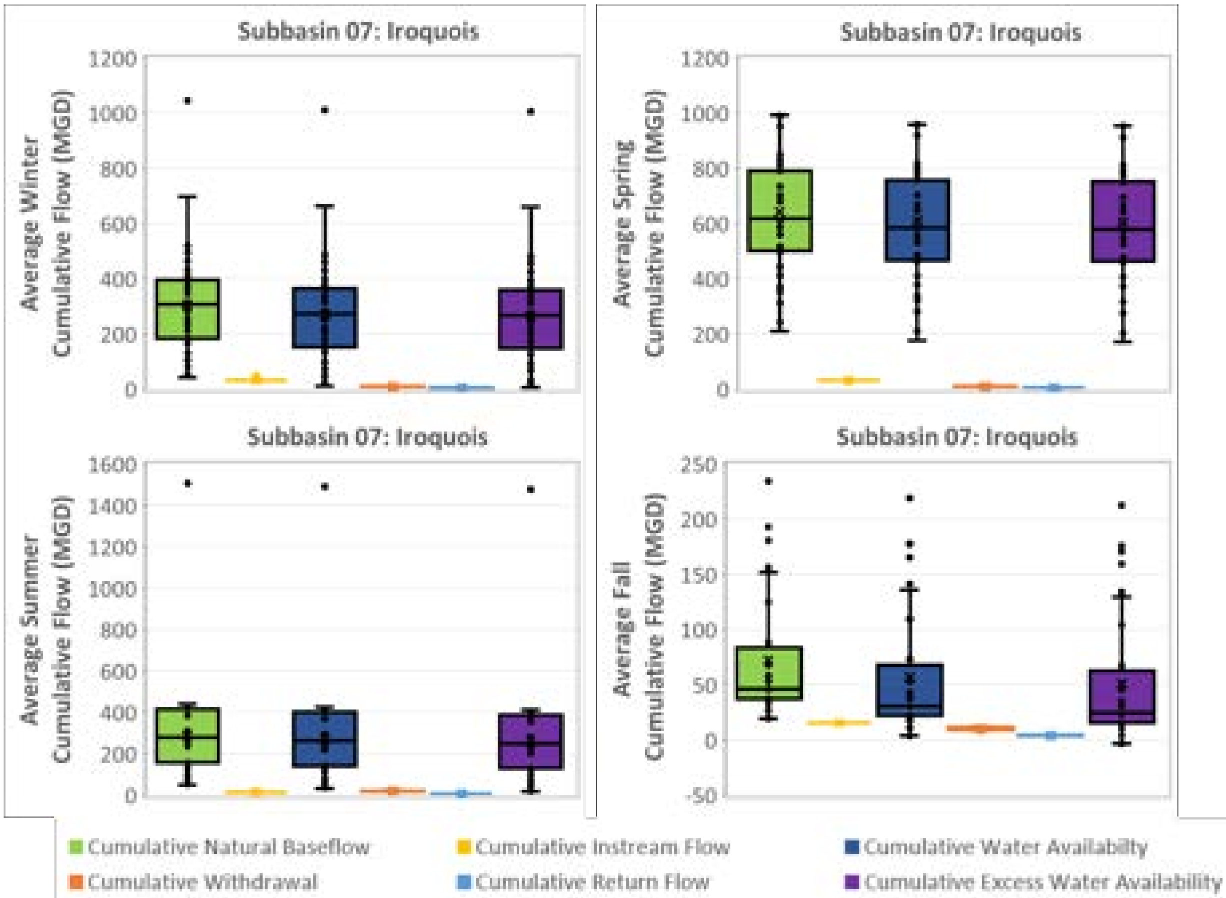


Figure G-7. Box Plots of Future (2024-2075) Cumulative Excess Water Availability (regional) Component for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) Seasons for Iroquois (Subbasin 07)

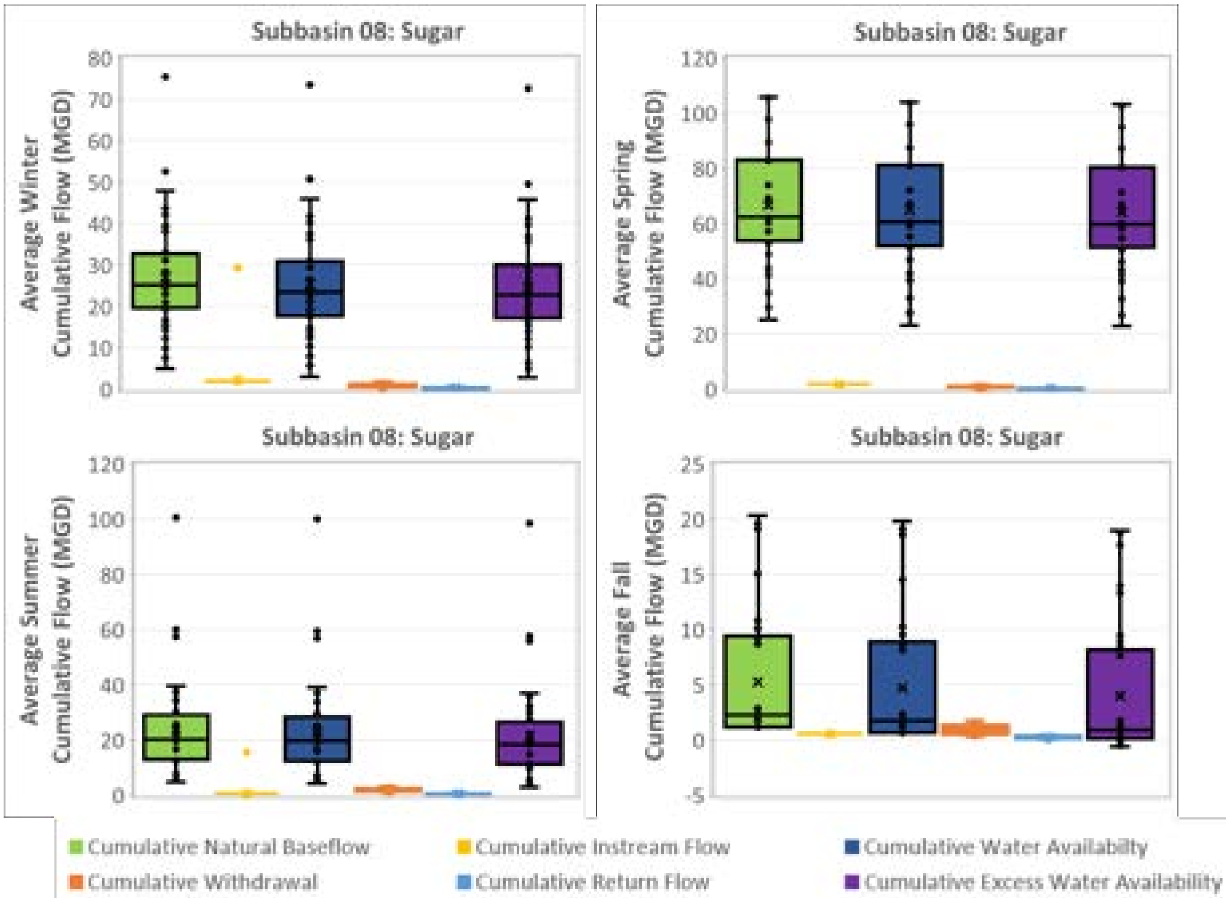


Figure G-8. Box Plots of Future (2024-2075) Cumulative Excess Water Availability (regional) Component for Winter (top left), Spring (top right), Summer (bottom left), and Fall (bottom right) Seasons for Sugar (Subbasin 08)

G.3 Relative Changes in Future Exceedance Values of Seasonal Cumulative Excess Water Availability

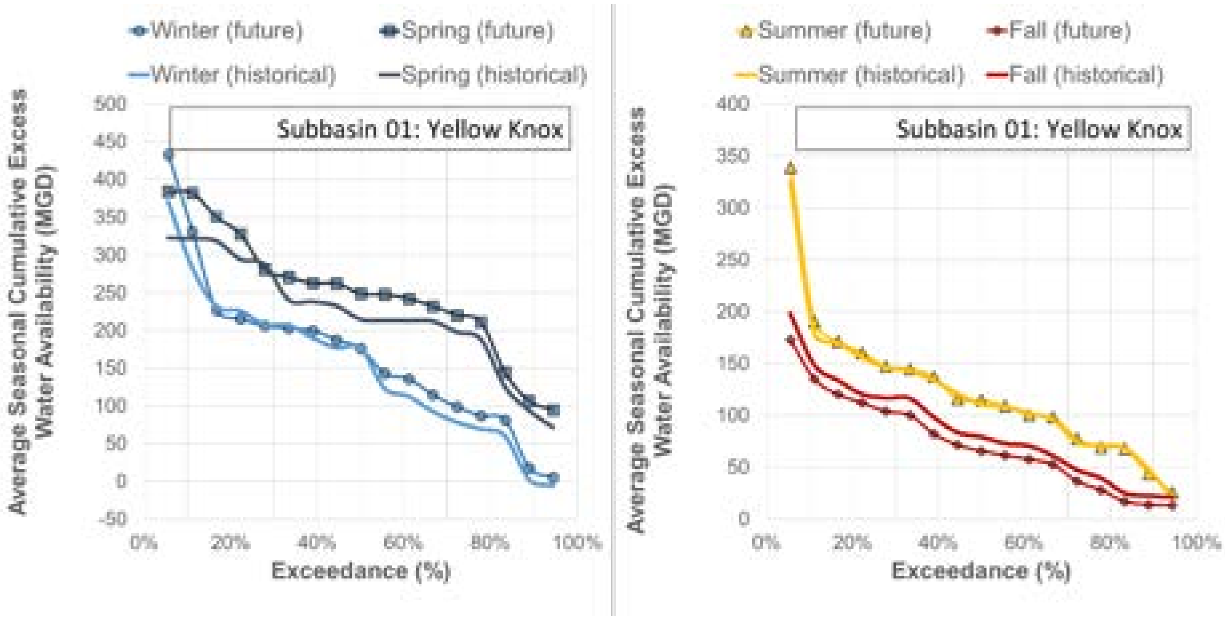


Figure G-9. Historical and Future (representative years) Cumulative Excess Water Availability (regional) Exceedance Curves by Season for Yellow Knox (Subbasin 01)

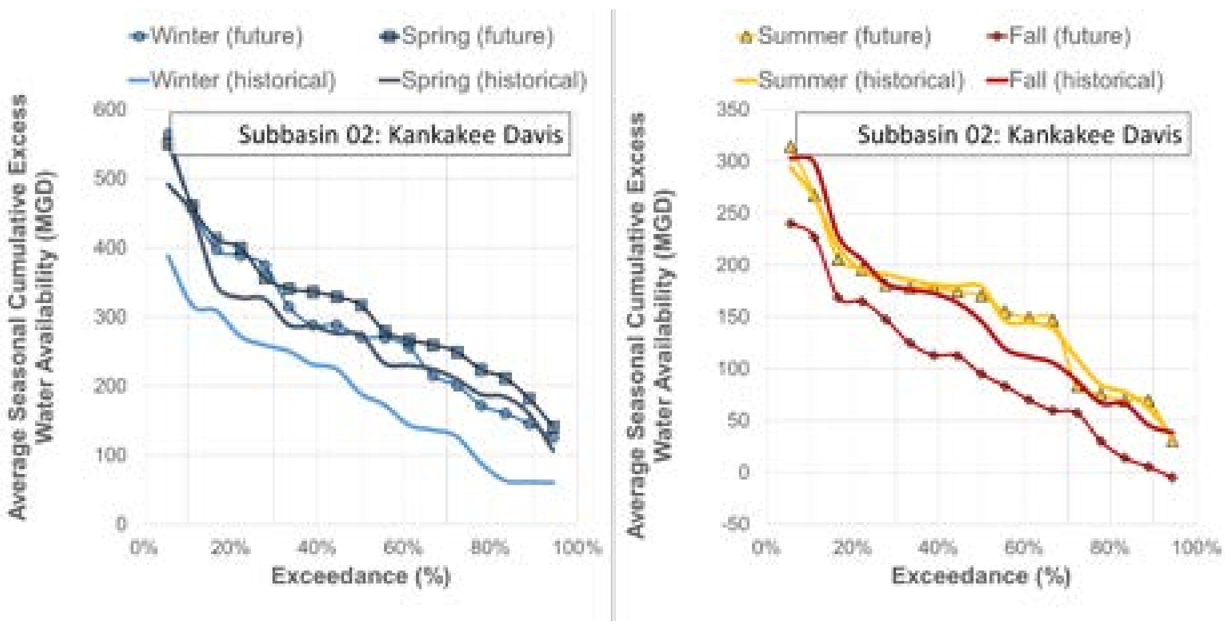


Figure G-10. Historical and Future (representative years) Cumulative Excess Water Availability (regional) Exceedance Curves by Season for Kankakee Davis (Subbasin 02)

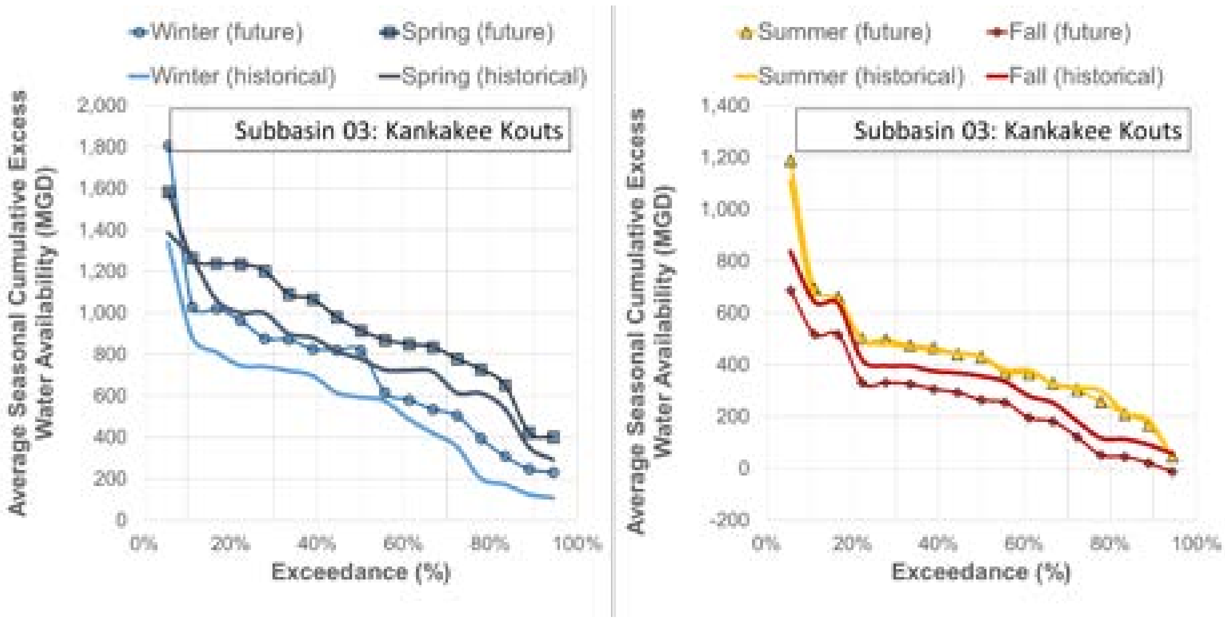


Figure G-11. Historical and Future (representative years) Cumulative Excess Water Availability (regional) Exceedance Curves by Season for Kankakee Kouts (Subbasin 03)

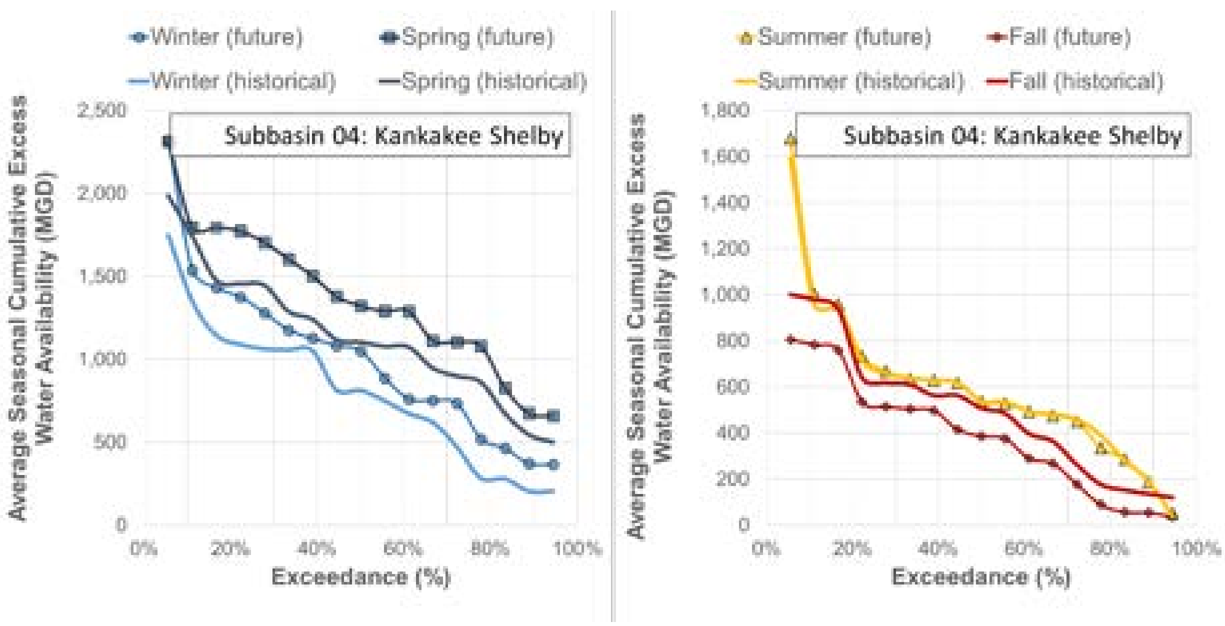


Figure G-12. Historical and Future (representative years) Cumulative Excess Water Availability (regional) Exceedance Curves by Season for Kankakee Shelby (Subbasin 04)

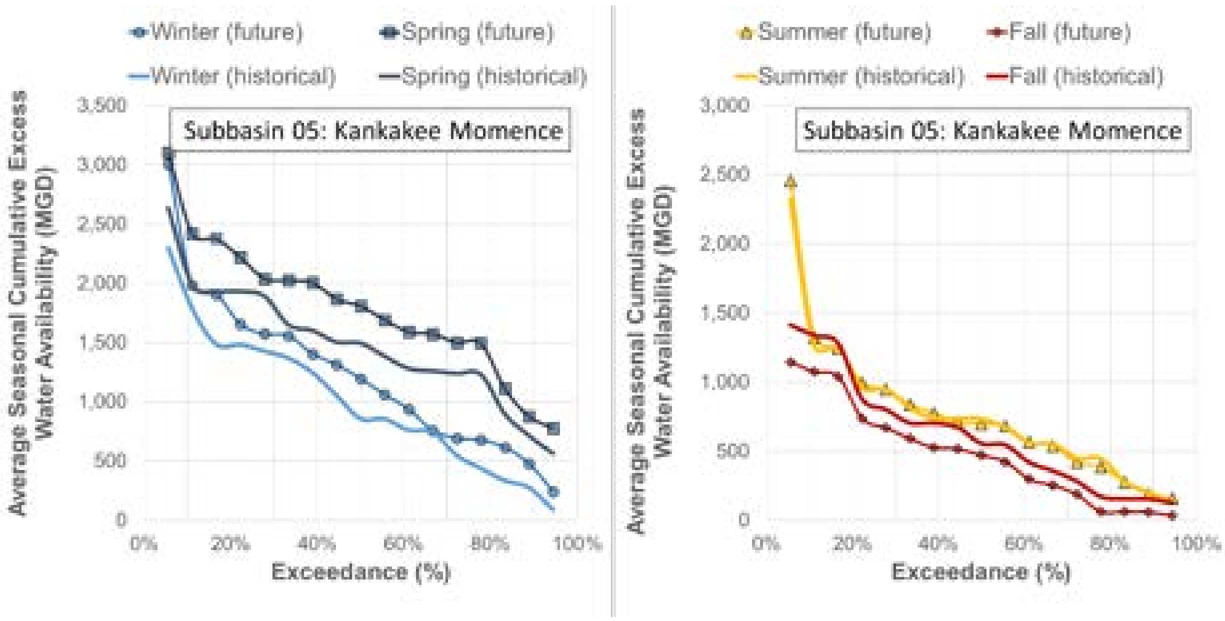


Figure G-13. Historical and Future (representative years) Cumulative Excess Water Availability (regional) Exceedance Curves by Season for Kankakee Momence (Subbasin 05)

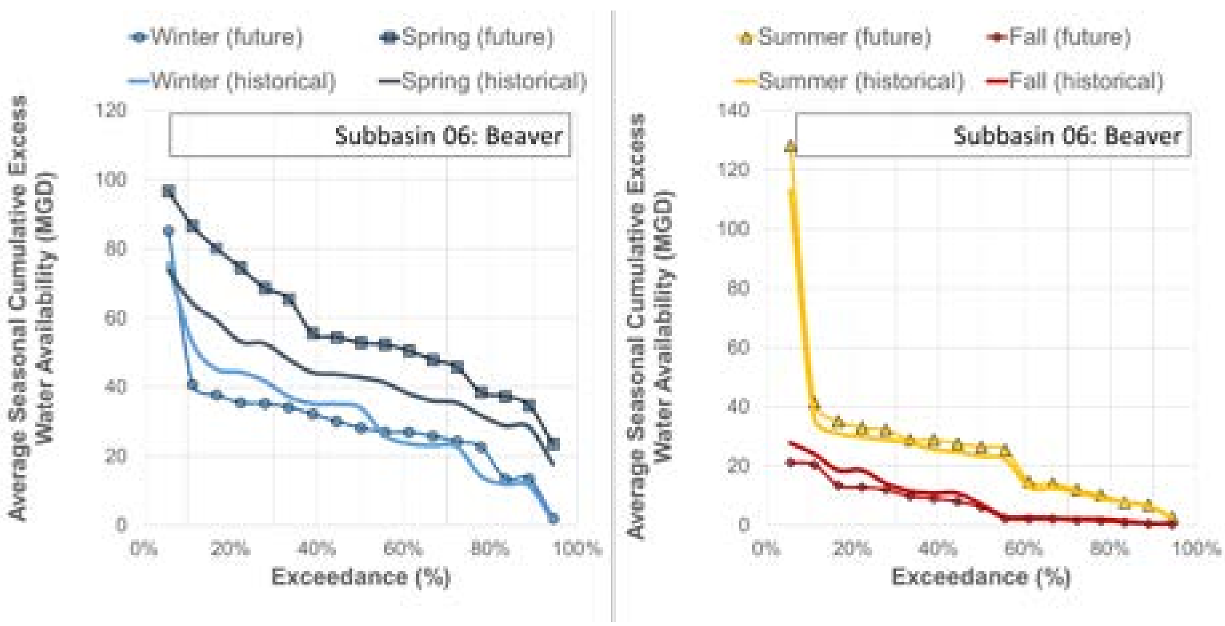


Figure G-14. Historical and Future (representative years) Cumulative Excess Water Availability (regional) Exceedance Curves by Season for Beaver (Subbasin 06)

Future Baseline Water Availability by Subbasin
December 2025

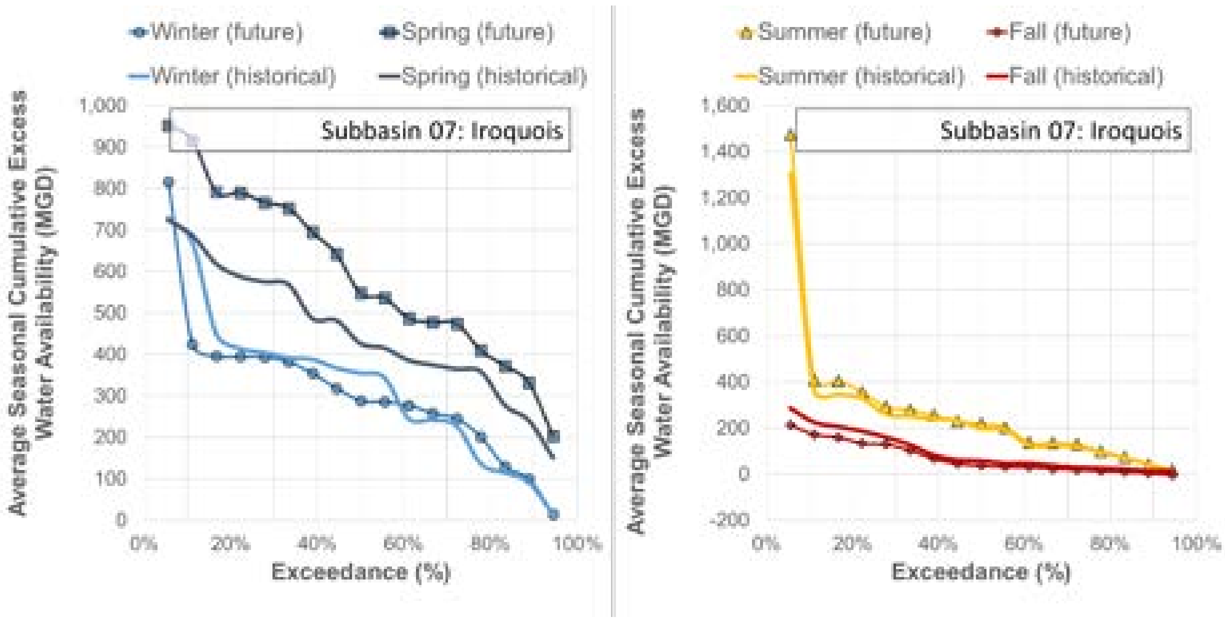


Figure G-15. Historical and Future (representative years) Cumulative Excess Water Availability (regional) Exceedance Curves by Season for Iroquois (Subbasin 07)

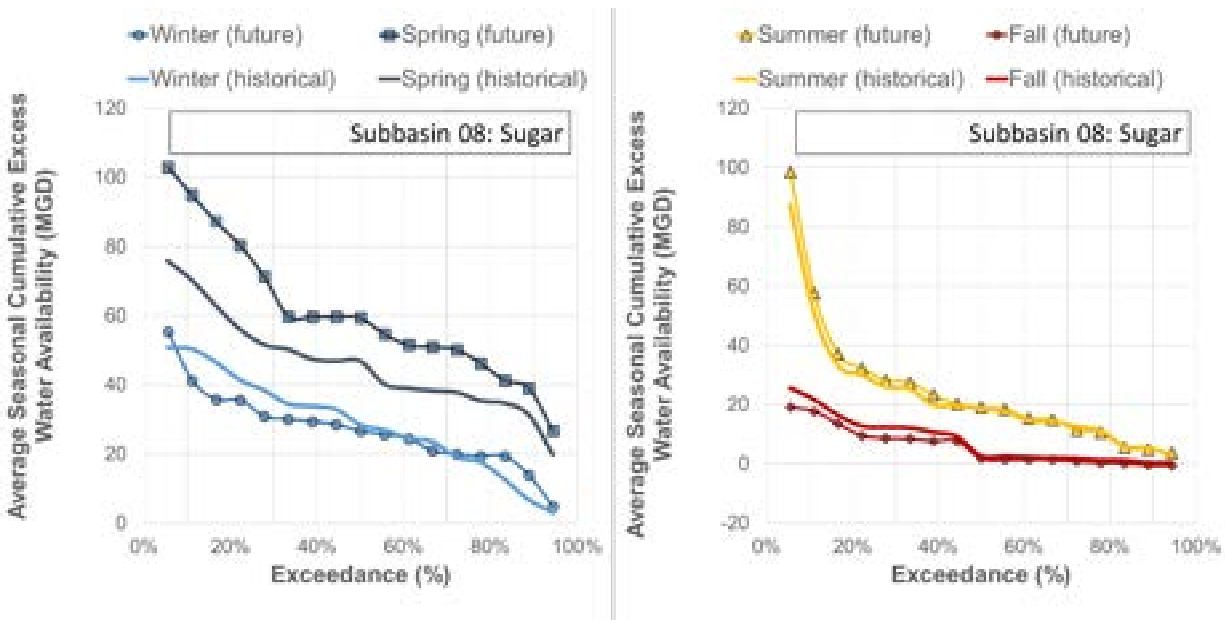


Figure G-16. Historical and Future (representative years) Cumulative Excess Water Availability (regional) Exceedance Curves by Season for Sugar (Subbasin 08)

G.4 Timeseries of Subbasin and Cumulative Water Budget Components and Subbasin and Cumulative Excess Water Availability

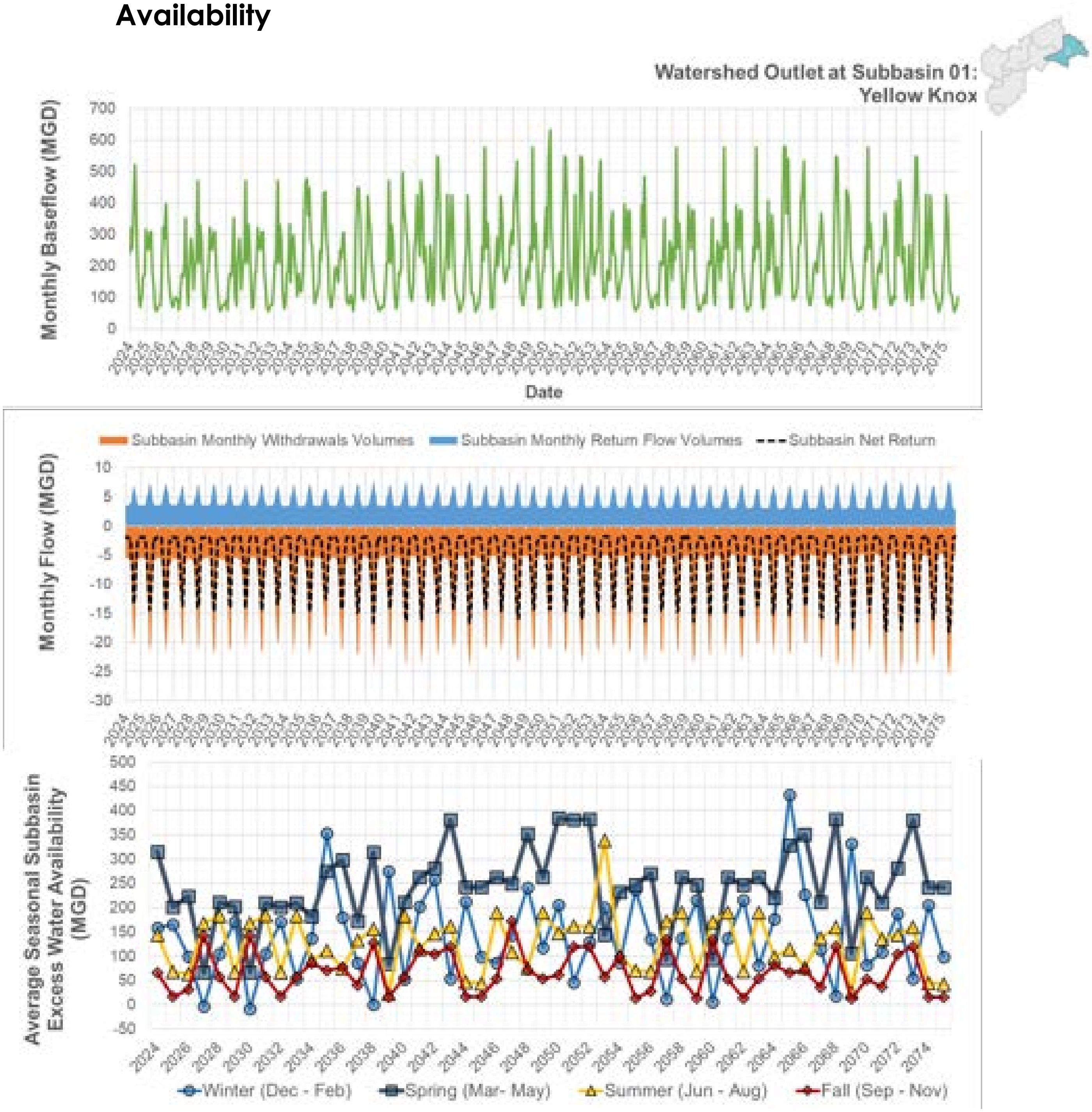


Figure G-17. Future Monthly Net Natural Baseflow, Monthly Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Yellow Knox (Subbasin 01)

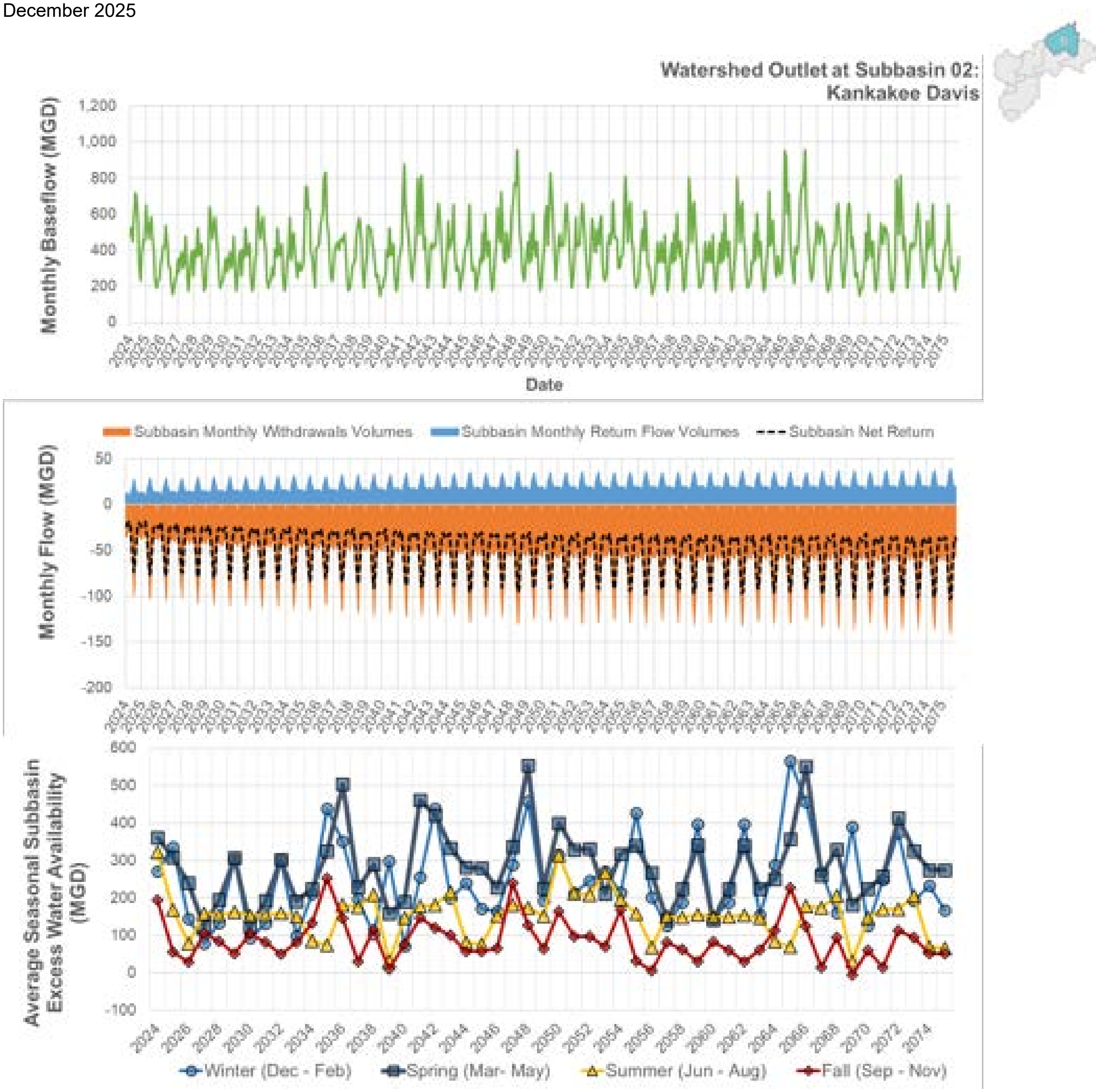


Figure G-18. Future Monthly Net Natural Baseflow, Monthly Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Kankakee Davis (Subbasin 02

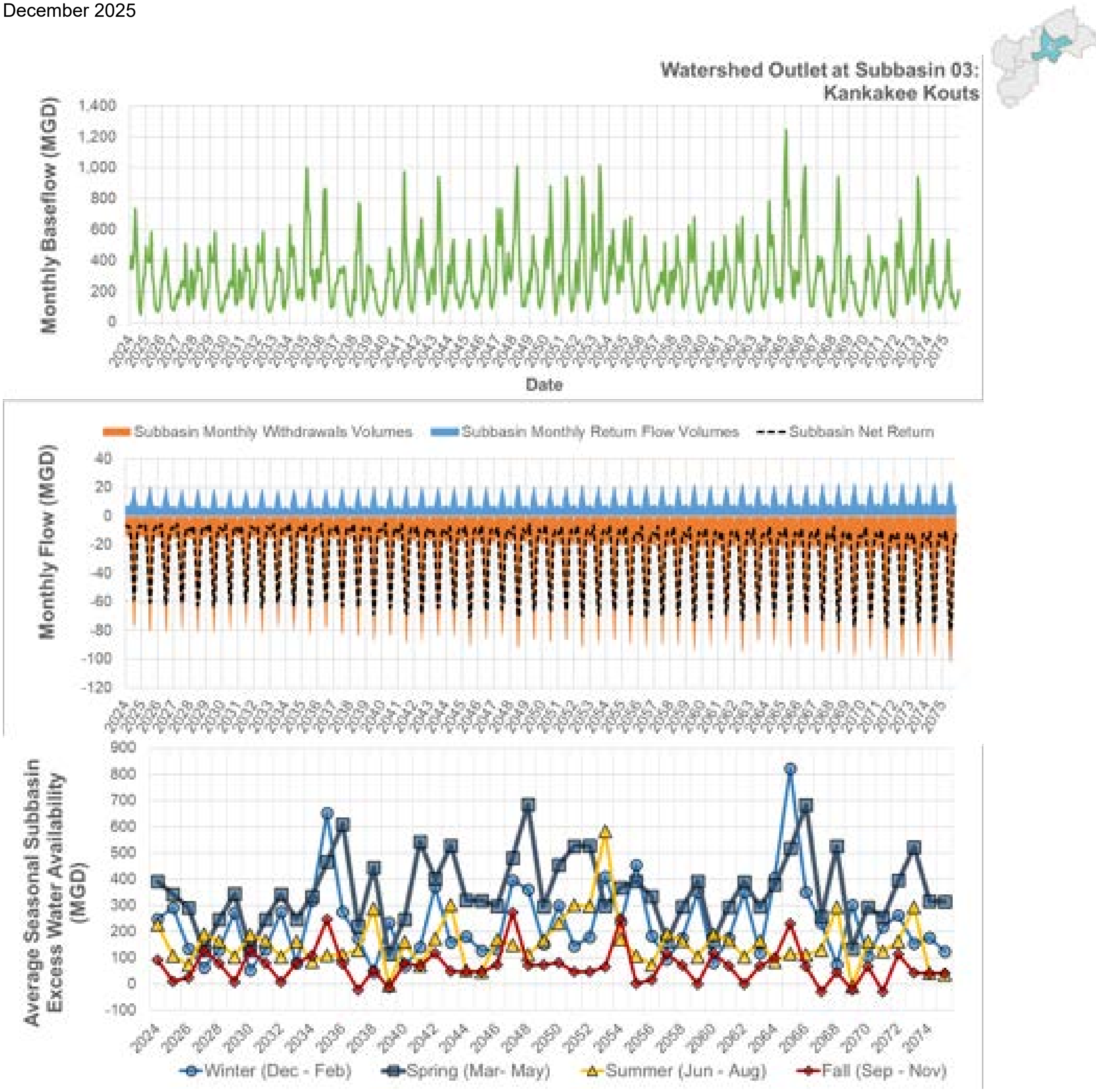


Figure G-19. Future Monthly Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Kankakee Kouts (Subbasin 03)

Future Baseline Water Availability by Subbasin
December 2025

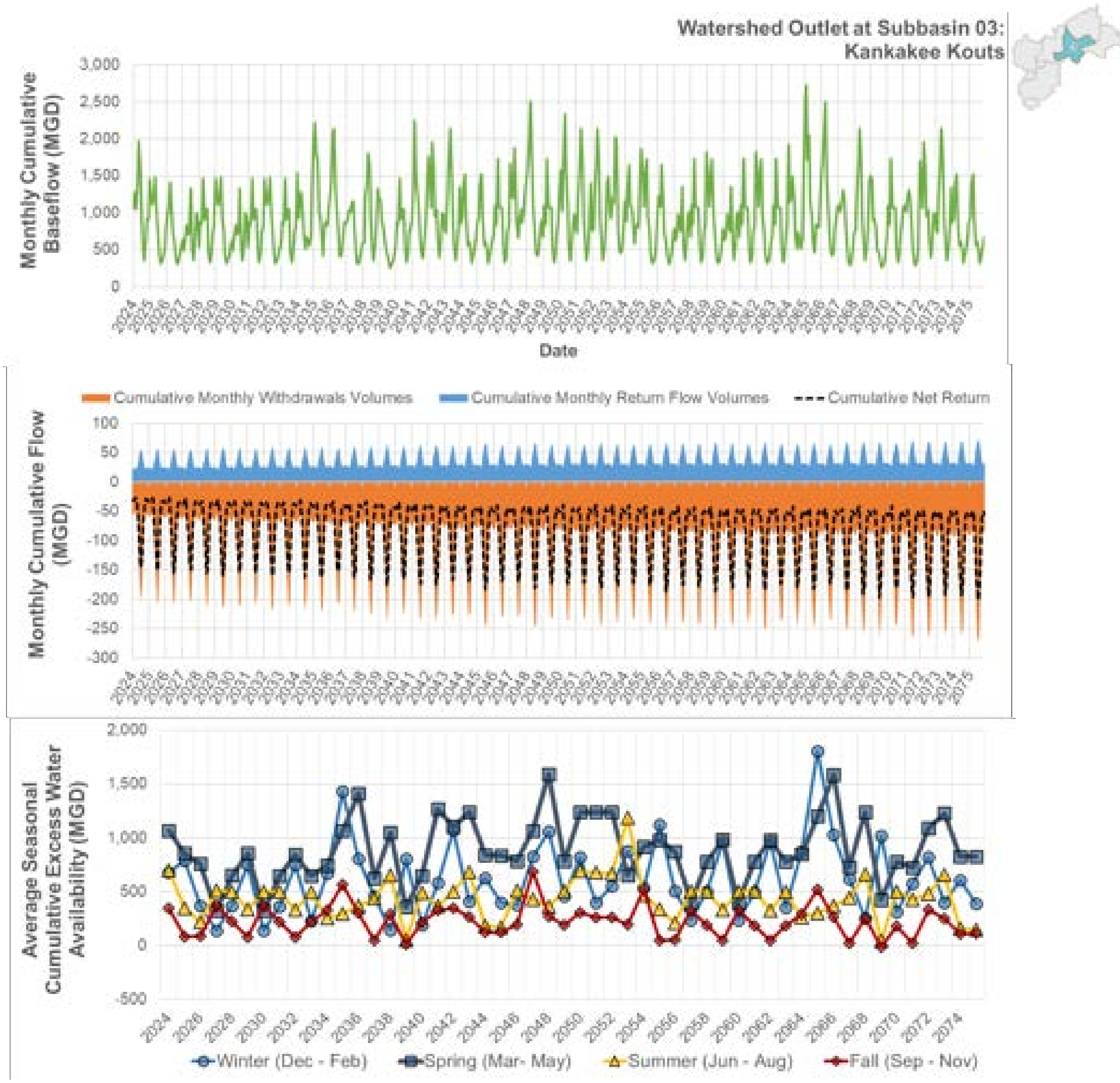


Figure G-20. Future Monthly Cumulative Natural Baseflow, Cumulative Net Returns, and Average Seasonal Cumulative Excess Water Availability (regional) for Kankakee Kouts (Subbasin 03)

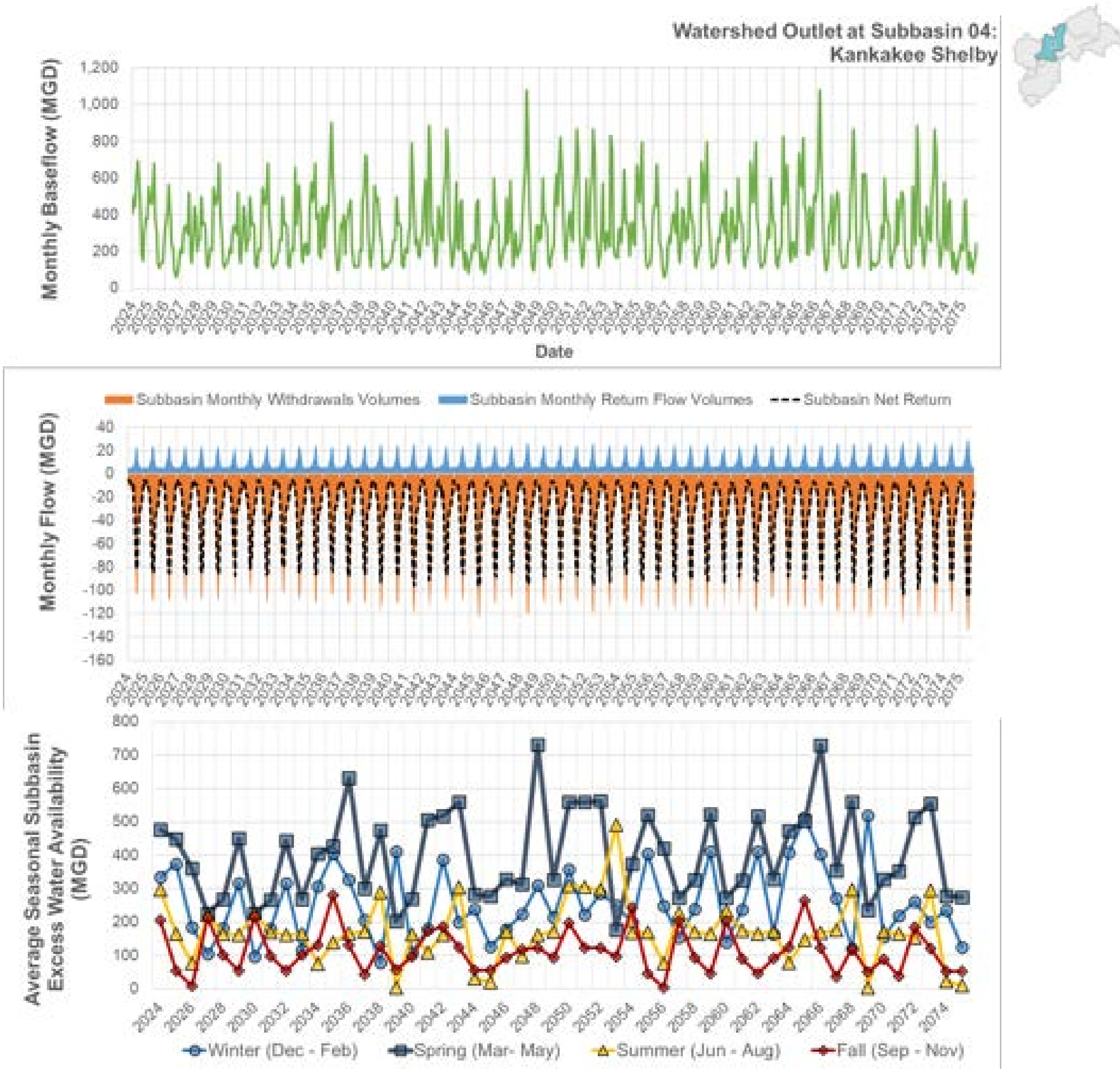


Figure G-21. Future Monthly Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Kankakee Shelby (Subbasin 04)

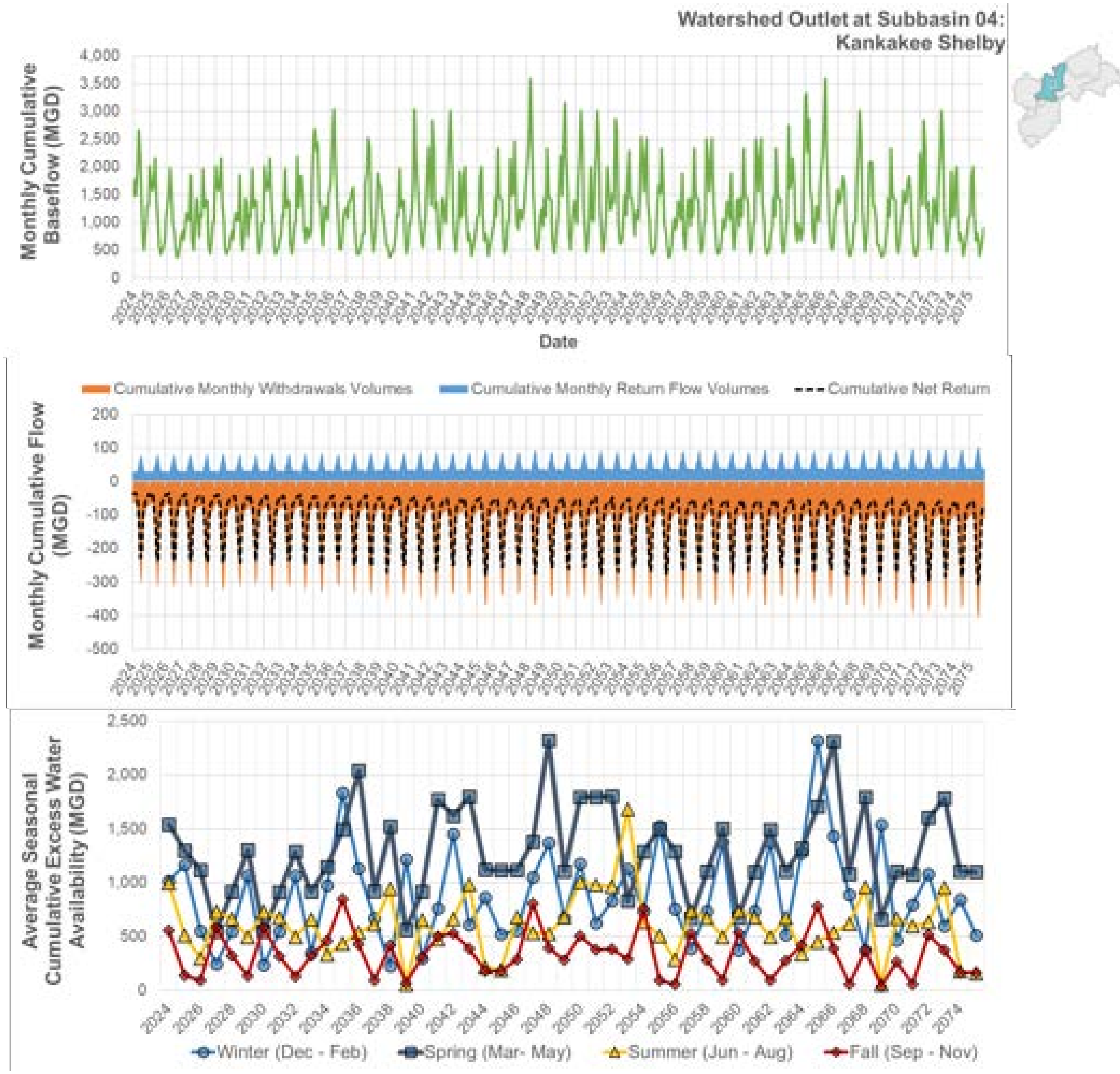


Figure G-22. Future Monthly Cumulative Natural Baseflow, Cumulative Daily Net Returns, and Average Seasonal Cumulative Excess Water Availability (regional) for Kankakee Shelby (Subbasin 04)

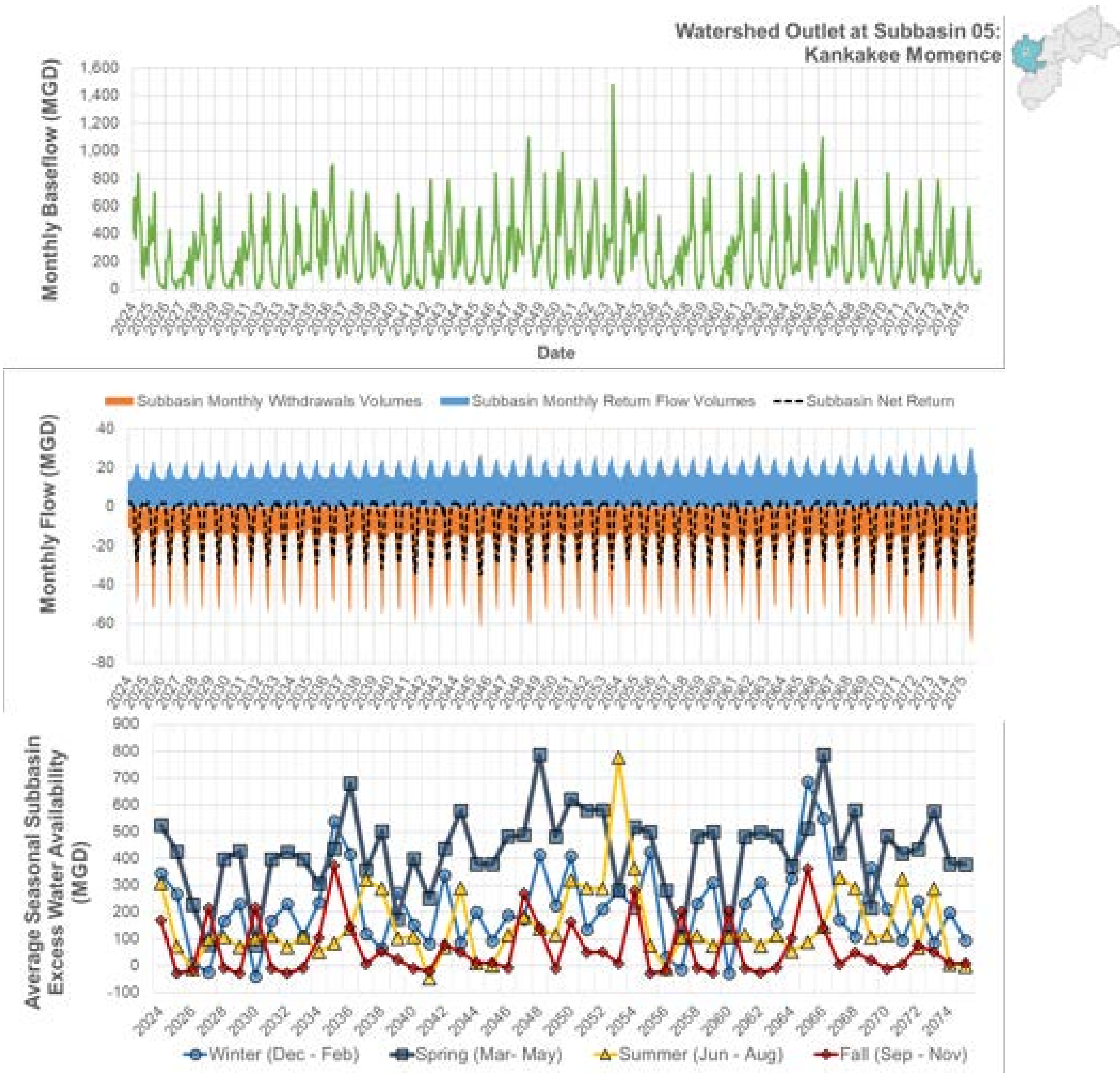


Figure G-23. Future Monthly Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Kankakee Momence (Subbasin 05)

Future Baseline Water Availability by Subbasin
December 2025

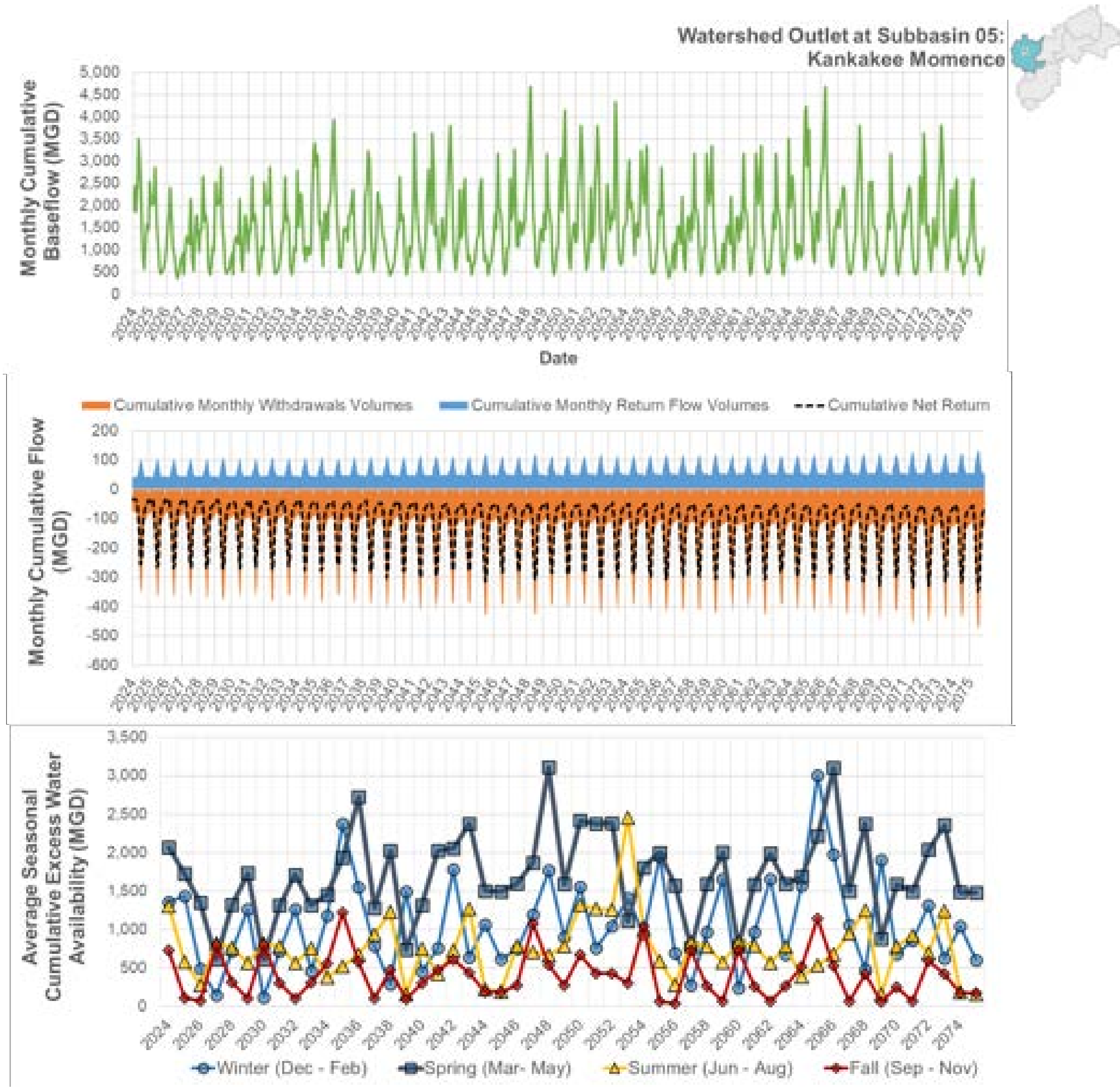


Figure G-24. Future Monthly Cumulative Natural Baseflow, Daily Cumulative Net Returns, and Average Seasonal Cumulative Excess Water Availability (regional) for Wabash Kankakee Momence (Subbasin 05)

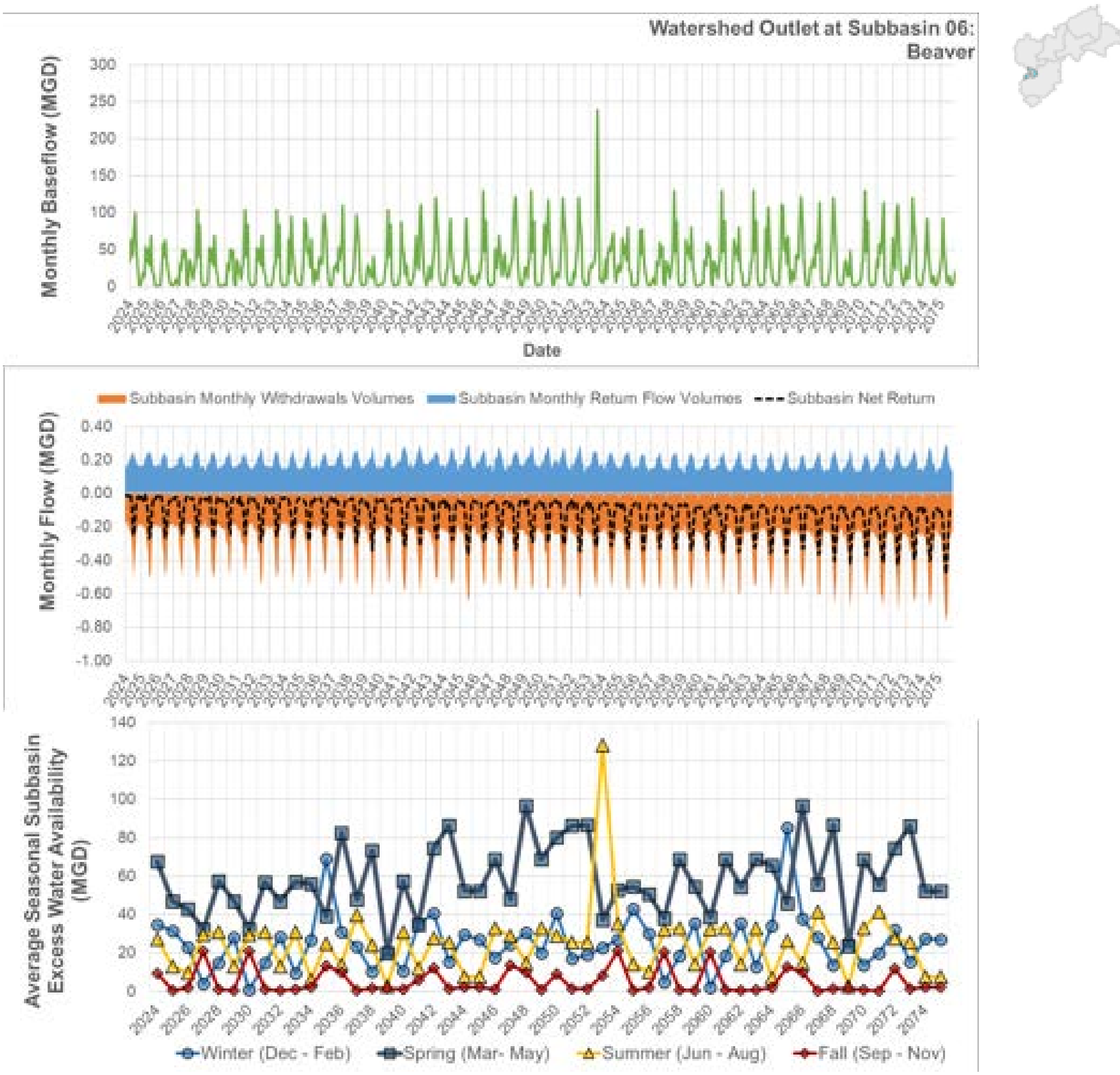


Figure G-25. Future Monthly Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Beaver (Subbasin 06)

Future Baseline Water Availability by Subbasin
December 2025

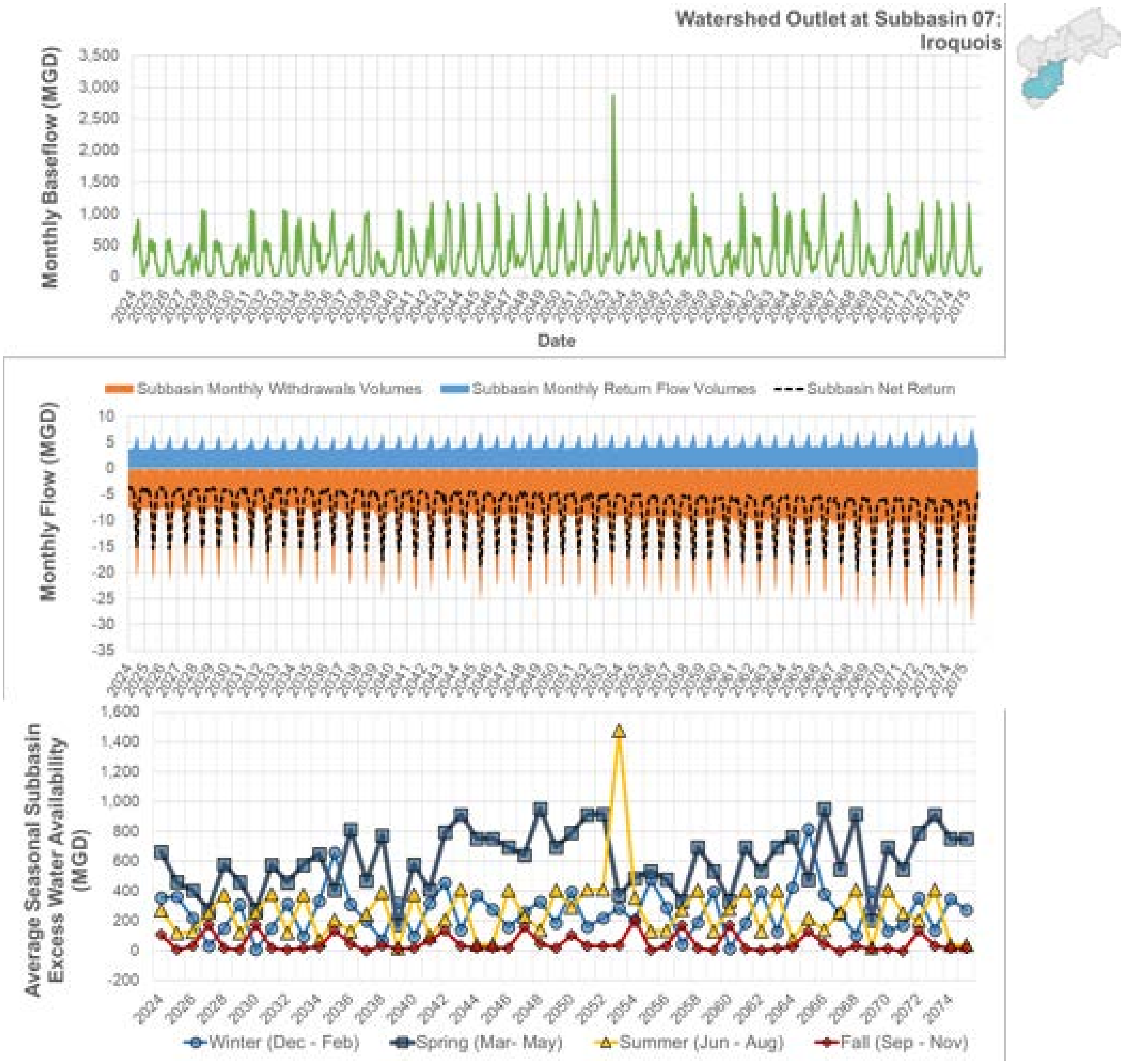


Figure G-26. Future Monthly Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Iroquois (Subbasin 07)

Future Baseline Water Availability by Subbasin
December 2025

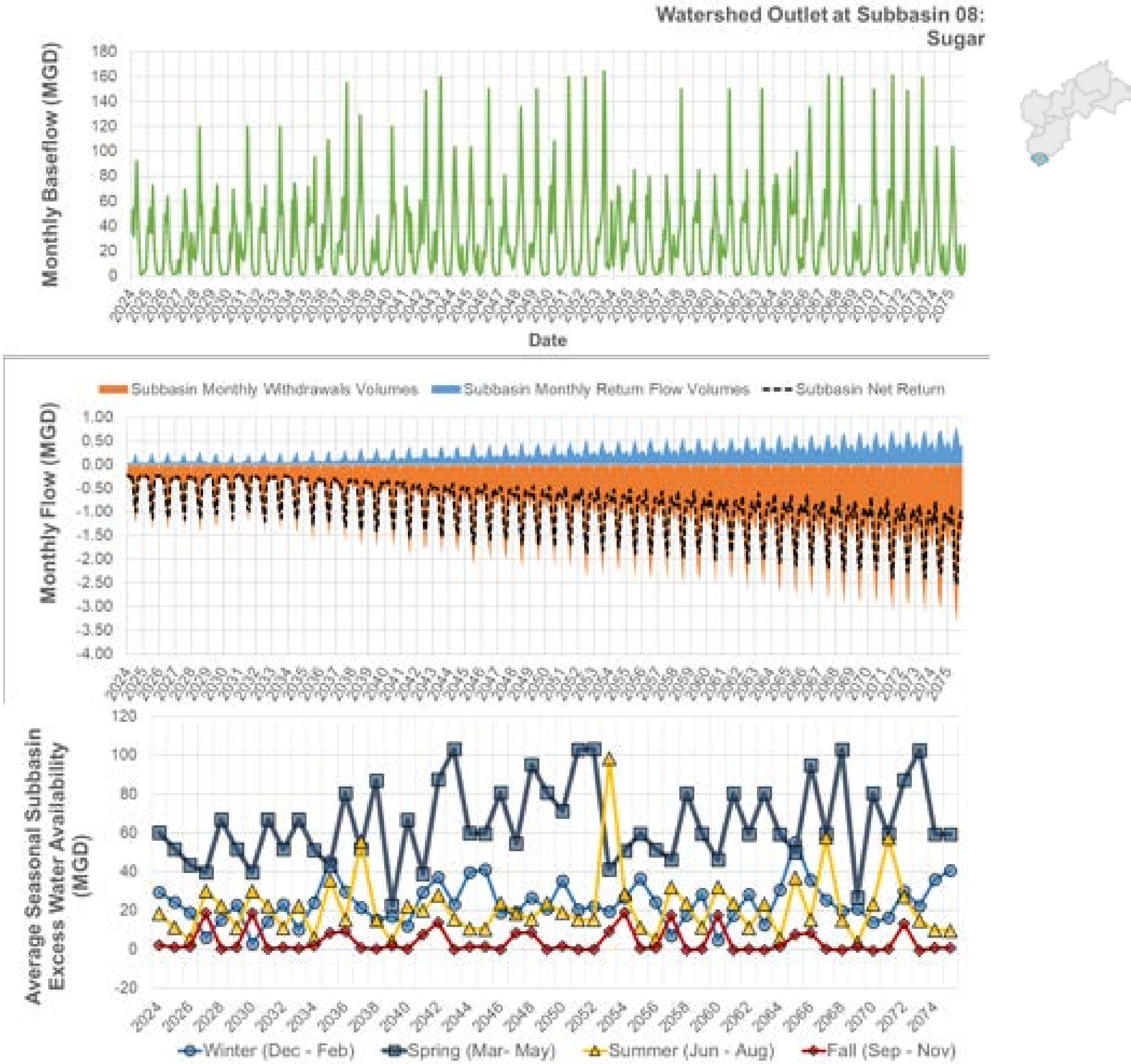


Figure G-27. Future Monthly Net Natural Baseflow, Daily Net Returns, and Average Seasonal Subbasin Excess Water Availability (local) for Sugar (Subbasin 08)

APPENDIX H

Water Quality

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Kankakee Basin Regional Water Study

Appendix H – Water Quality

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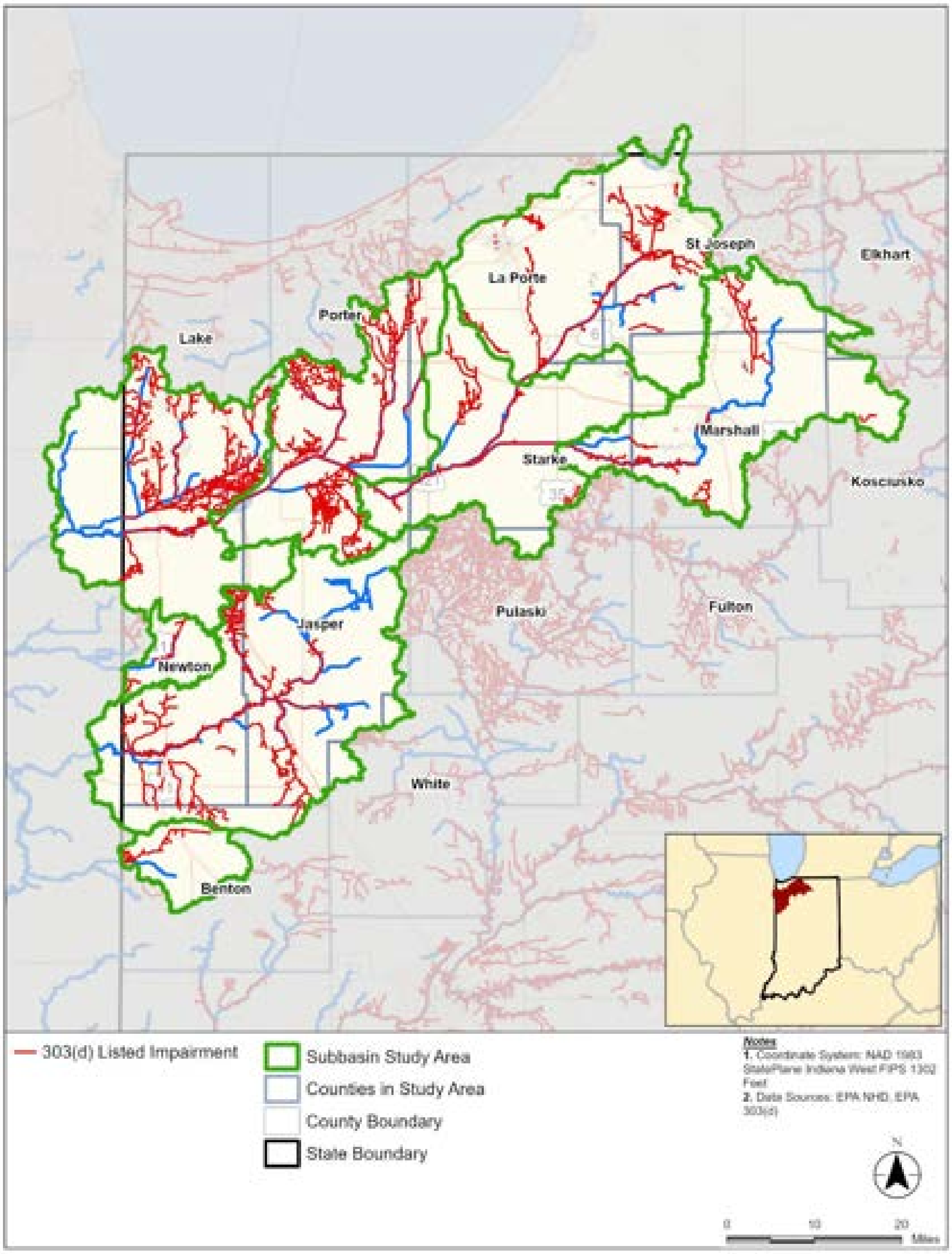
Appendix H Water Quality

This appendix includes additional summarizing table and figures supporting Chapter 8 – Water Quality. Note that most figures reference base data from the United States Geological Survey National Hydrography Dataset (2024a).



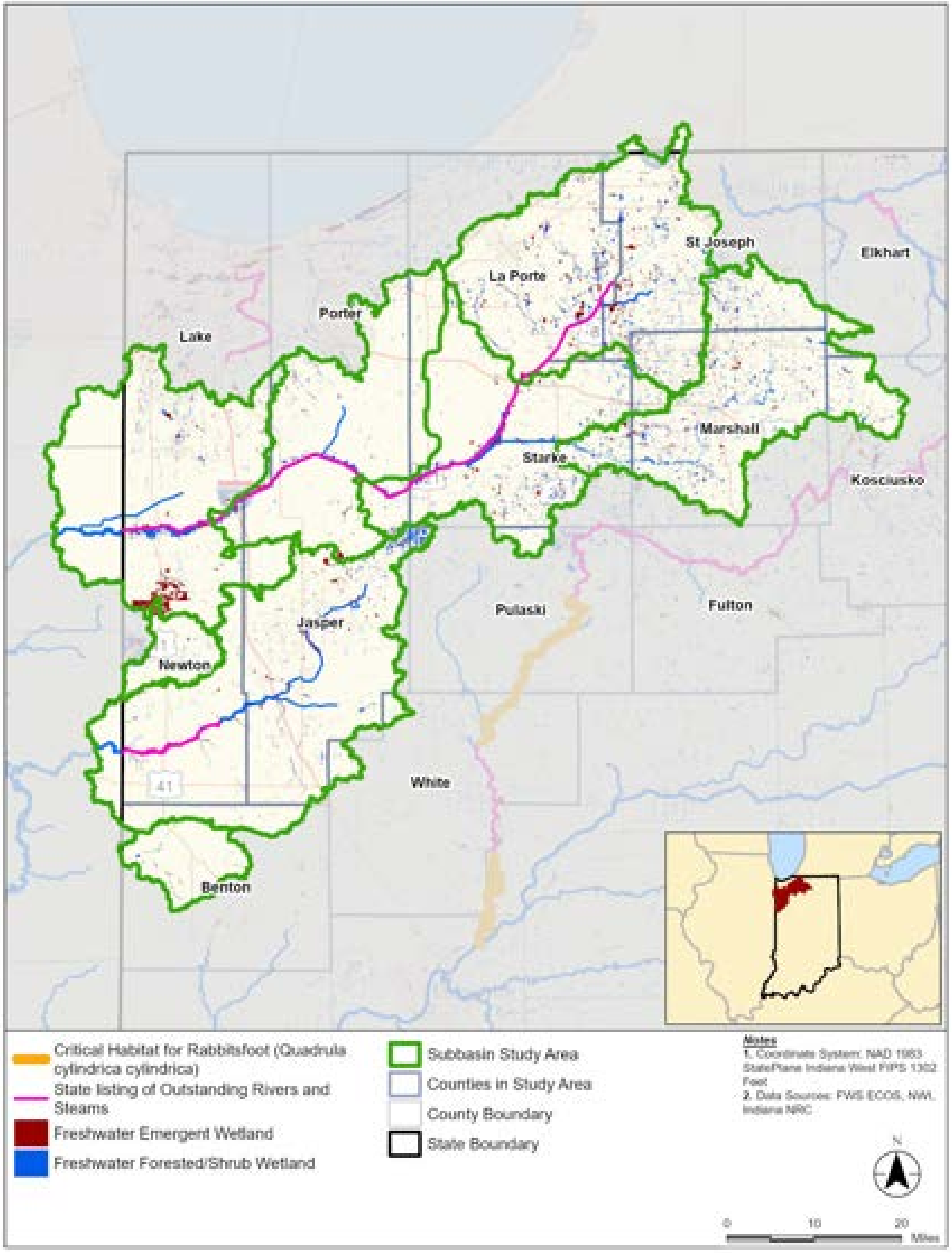
Source: US EPA Listing of Impaired Waters under CWA Section 303(d) (EPA 2024a)
Notes: Tracking and Implementation System (ATTAINS) and numerous waterways in the Study Area remain unassessed.

Figure H-1. Federally Listed (303(d)) Impaired Waterways in Indiana

Table H-1. Count of Stream Segments or Waterbodies with 303(d) Impairments for Assessed Waterways in Study Area (2024)

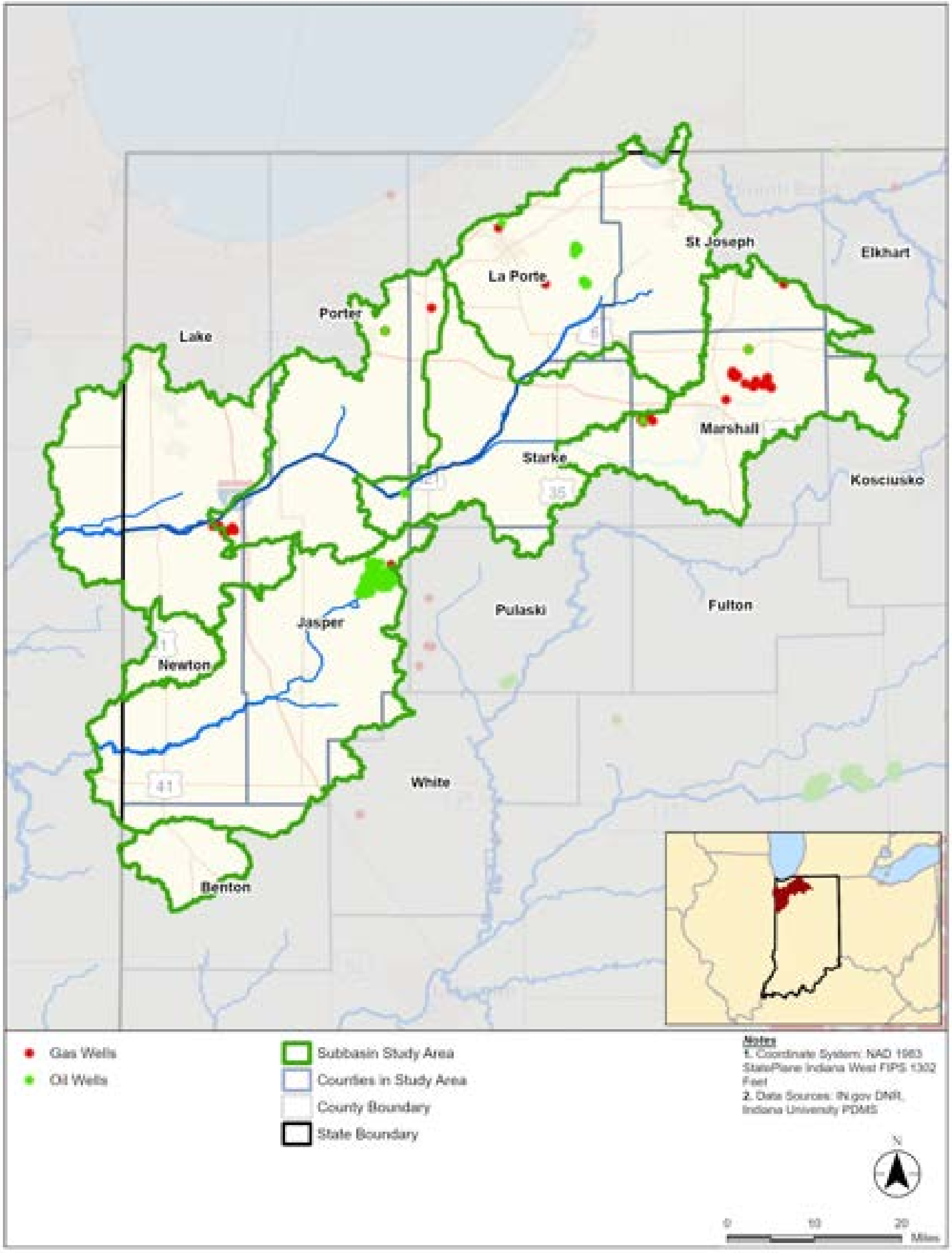
County	Mercury in Fish Tissue	Biological Integrity	Chloride	Dissolved Oxygen	E. Coli	Nutrients	PCBs in Fish Tissue	pH
Benton	-	4	1	-	21	1	5	-
Elkhart	-	-	-	-	1	-	-	-
Fulton	-	-	-	-	1	-	-	-
Jasper	-	10	12	21	77	8	23	-
Kosciusko	-	1	-	1	7	1	-	1
Lake	-	48	1	2	59	2	6	-
LaPorte	-	20	-	-	59	-	10	-
Marshall	-	5	-	-	51	-	4	-
Newton	-	30	16	8	80	8	14	-
Porter	-	32	-	-	26	-	9	-
Pulaski	-	-	-	-	11	-	-	-
St. Joseph	1	21	-	-	57	-	16	-
Starke	-	7	-	-	108	1	12	-
Total in Study Area:	**1**	**178**	**30**	**32**	**558**	**21**	**99**	**1**

Source: EPA 2024a
Note: Analytical results vary by study and dates collected. Tracking and Implementation System (ATTAINS) and numerous waterways in the Study Area remain unassessed.



Note: No data shown west of Indiana-Illinois state line. Blue lines are streams not listed as Critical Habitat for Rabbitsfoot (nor listed as Outstanding Rivers and Streams). **No critical habitat for Rabbitsfoot in Study Area.**

Figure H-2. Potentially Sensitive Receiving Waters and Habitats in Indiana



Source: Indiana University Petroleum Database Management System 2024.

Figure H-3. Active and Legacy Oil and Gas Wells in Indiana

Source: IDNR 2024 and EPA 2024b
Notes: **No coal mines in Study Area.**

Figure H-4. Active and Legacy Coal Mines and Generating Facilities in Indiana

Source: IDEM 2024 and EPA 2024c

Figure H-5. Emerging Contaminants (PFAS Constituents) Sampled in Surface and Groundwater Sources in Indiana (2021-2024)

Indiana's Groundwater Monitoring Network has recorded 368 instances in which organic compounds exceeded their respective MCLs from August 2008 to July 2016. 1,2-Dibromoethane accounts for 301 of these exceedances, 1,2-Dibromo-3-Chloropropane accounts for 44, Alachlor ethane sulfonic acid accounts for 16, Pentachlorophenol accounts for 3, Alachlor oxalamic acid accounts for 3, and Benzene accounts for 1. The counties within the Kankakee River Watershed where these exceedances were recorded include Benton, Elkhart, Fulton, Jasper, Kosciusko, Lake, LaPorte, Marshall, Newton, Porter, Pulaski, St. Joseph, and Starke.

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APPENDIX I

Historical and Projected Future Water Demand Summaries by County

Kankakee Basin Regional Water Study

Appendix I – Historical and Projected Future Water Demand Summaries by County

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Appendix I Historical and Projected Future Water Demand Summaries by County

This Appendix presents a single-page summary of the historical and projected future water demand for each county in the Study Area. Each summary includes:

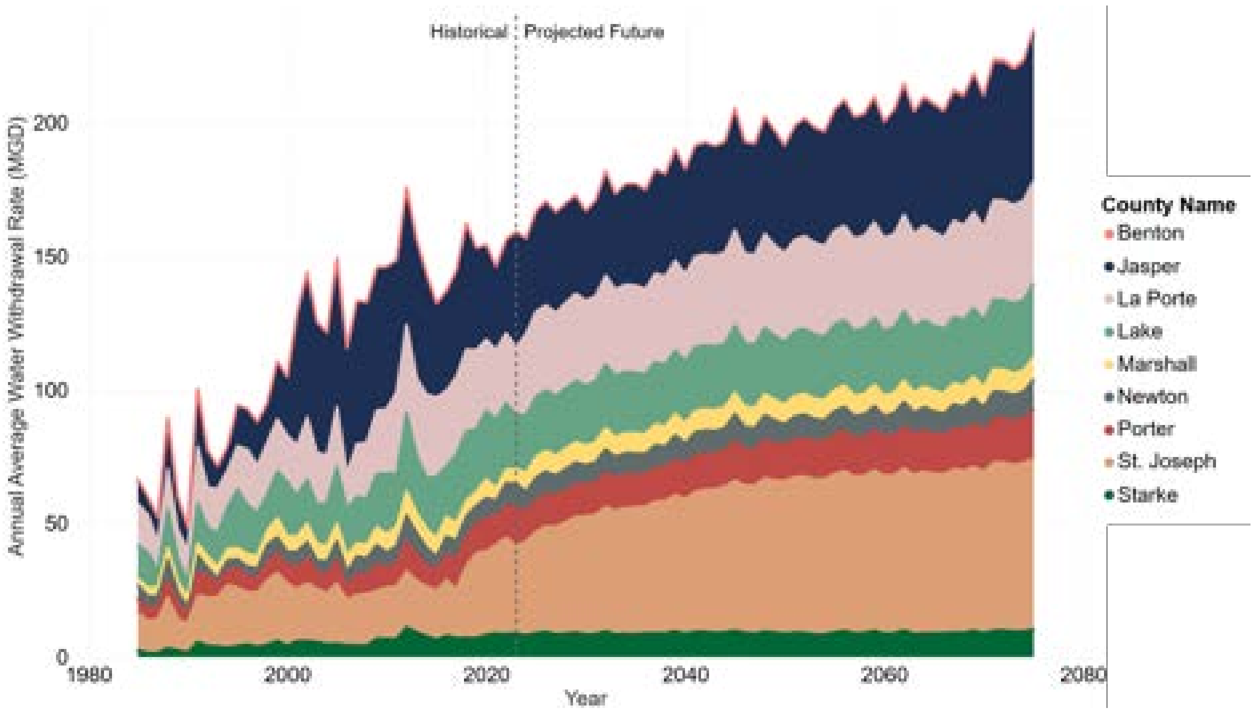
- A reference map showing the county, major cities, the county's location within the Kankakee Basin, and the subbasin(s) of the county.
- Historical and projected future water demand by source type (e.g., surface water intakes and groundwater wells). The historical water source type data was taken from the significant water withdrawal facility database.[1] The projected future water use type was calculated assuming the water source by county and sector (e.g., public supply, industrial, etc.) would remain constant. The demand by future water source should not be interpreted as an estimate of available, sustainable groundwater or surface water withdrawal volumes.
- Historical and future projected water demand by water use sector.

Data is presented for the period 1985-2075. There is limited historical data for some sectors. For example, reported water use for energy production only began in 2001, which caused a jump in demand for some counties. Similarly, this Study's estimates for self-supplied water demand begins in 2009 due to availability of population data. Detailed methodology and explanation for differing data availability is provided in Appendix C.

Figure I-1 shows historical and projected water demand for all of Kankakee Basin by county. Between 2000 and 2023 the volume of average annual water withdrawals was highest in Jasper County (31% of total basin withdrawals). The volume of average annual water withdrawals during that same time period in La Porte County, St, Joseph County, and Lake County was fairly equal at 17%, 16%, and 15% of total withdrawals, respectively. By 2050, water withdrawals in St. Joseph County are projected to be the largest in the study area, increasing to 26% of total basin withdrawals. Whereas water withdrawals in Jasper County decline to 21% of total withdrawals for the same period (down from 31% in 2023). Projected future water withdrawals in La Porte County and Lake County are expected to be 18% and 13% of total basin withdrawals during this period, respectively.

[1] Indiana Department of Natural Resources (IDNR). 2025. Significant Water Withdrawal Facility data 1985 to 2023. https://www.in.gov/dnr/water/water-availability-use-rights/significant-water-withdrawal-facility-data/

Historical and Projected Future Water Demand Summaries by County
December 2025

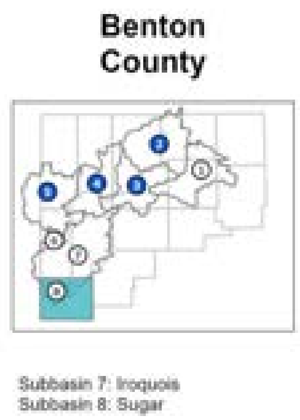


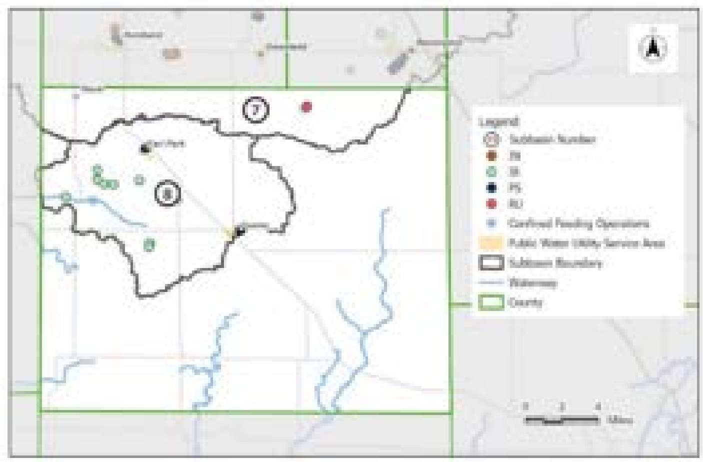
Key:
MGD = million gallons per day

Figure I-1. Historical (1985 to 2023) and Projected Future (2023 to 2072) Average Annual Water Demand in Kankakee Basin, by County (MGD)

Historical and Projected Future Water Demand Summaries by County
December 2025

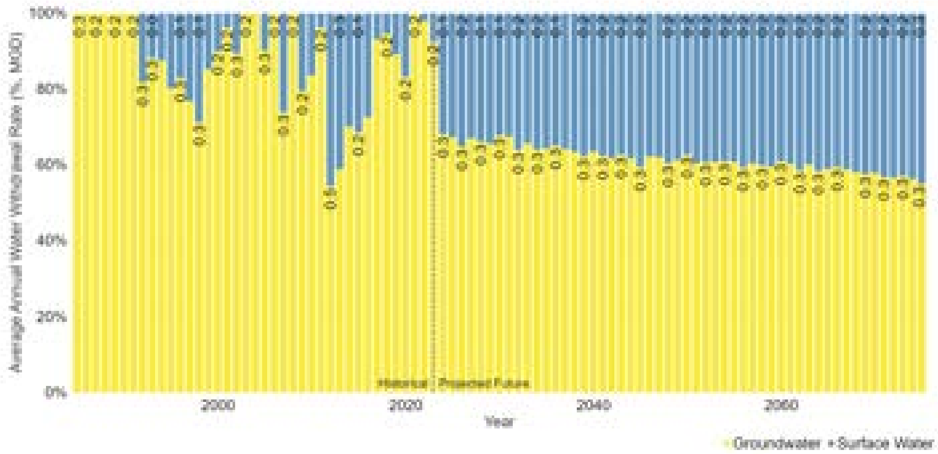
I.1 Benton County





Key:
MGD = million gallons per day

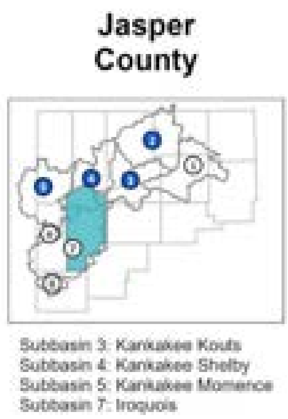
Historical and Projected Future Water Demand by Water Use Sector (MGD)

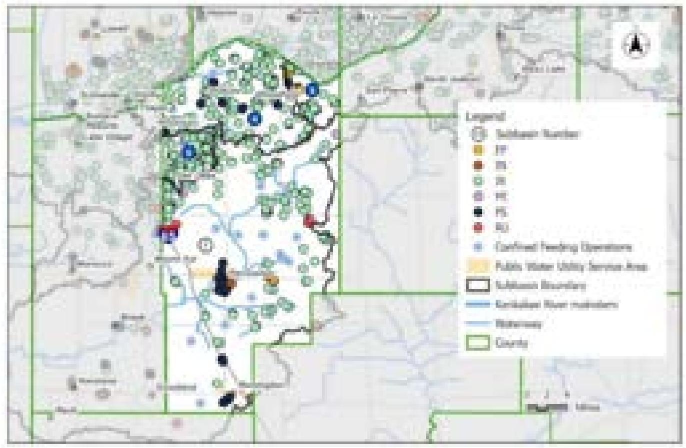


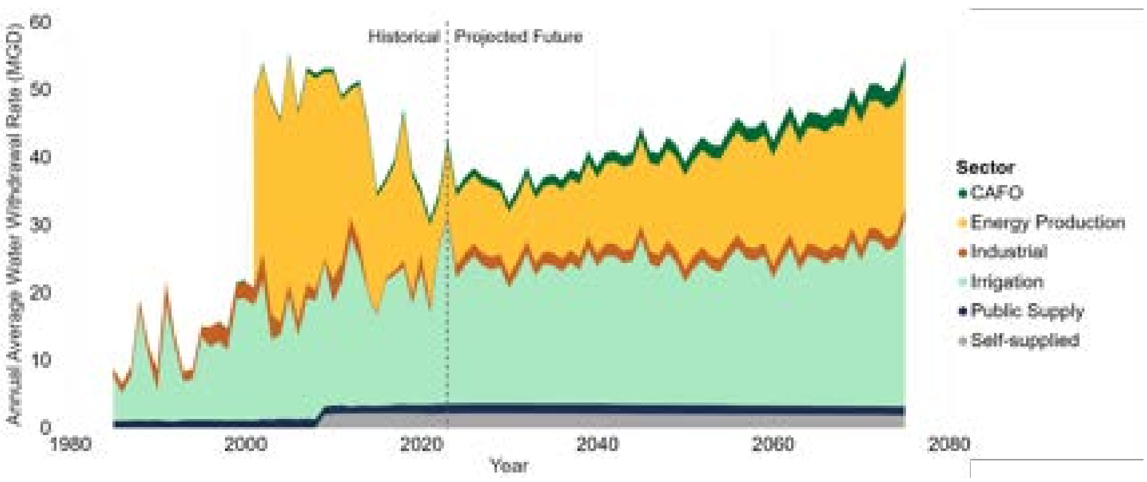
Key:
MGD = million gallons per day

Historical and Projected Future Water Demand by Source Type (MGD)

I.2 Jasper County







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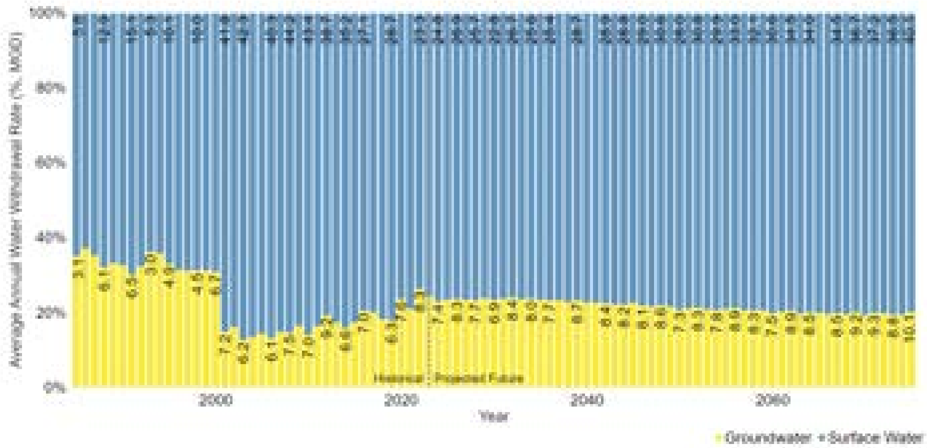
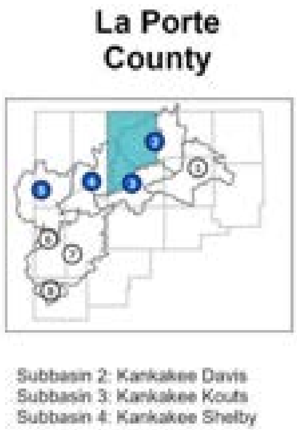
Historical and Projected Future Water Demand by Water Use Sector (MGD)

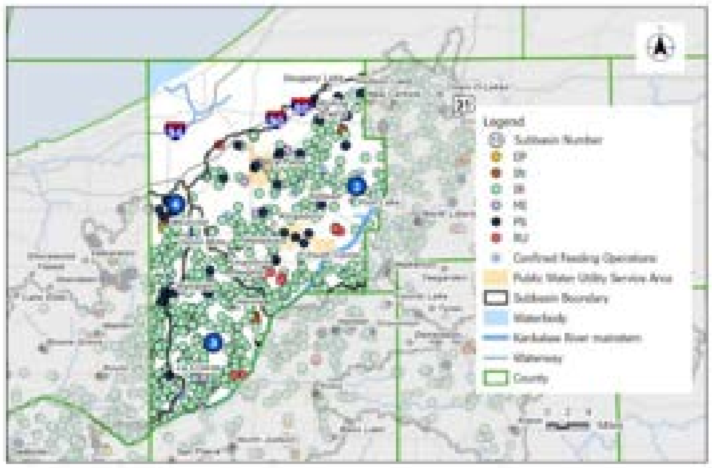


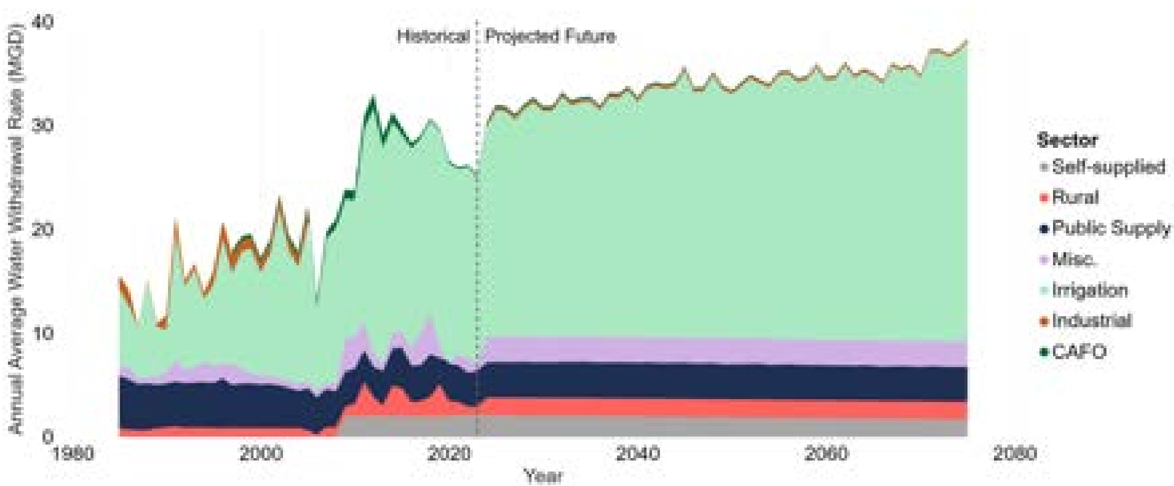
Key:
MGD = million gallons per day

Historical and Projected Future Water Demand by Source Type (MGD)

I.3 La Porte County







Key:
MGD = million gallons per day

Historical and Projected Future Water Demand by Water Use Sector (MGD)

Historical and Projected Future Water Demand Summaries by County
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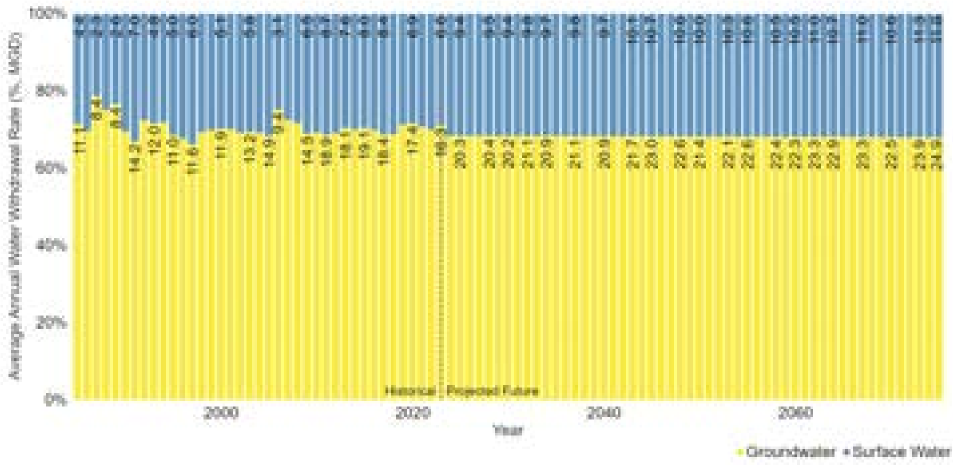

Key:
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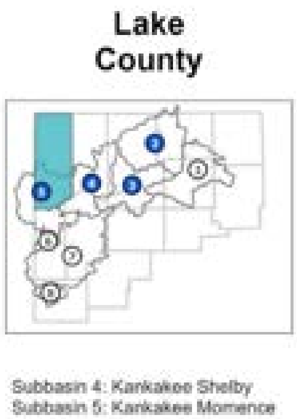
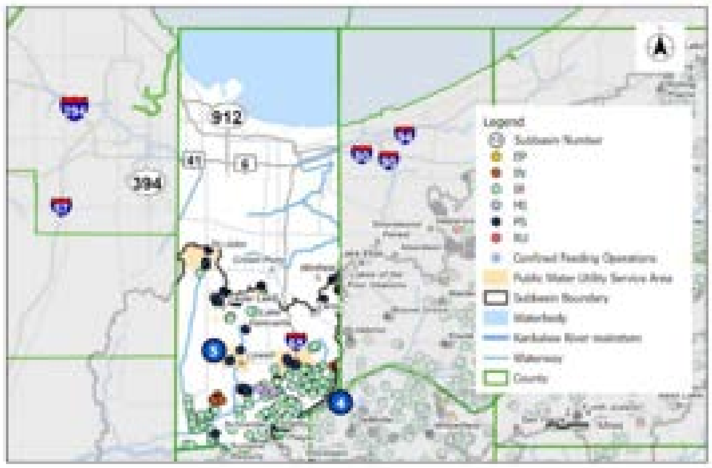
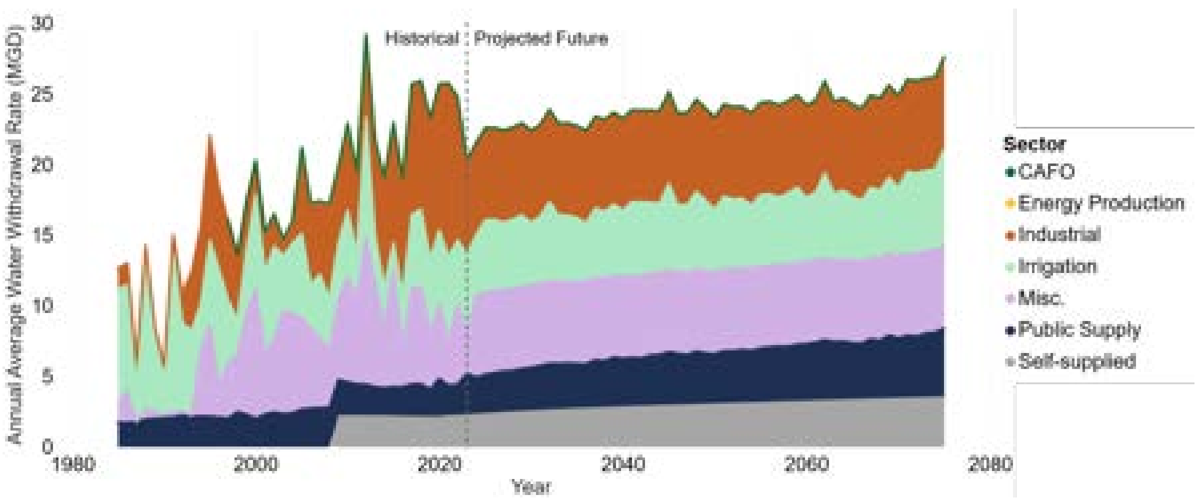
Historical and Projected Future Water Demand by Source Type (MGD)

I.4 Lake County







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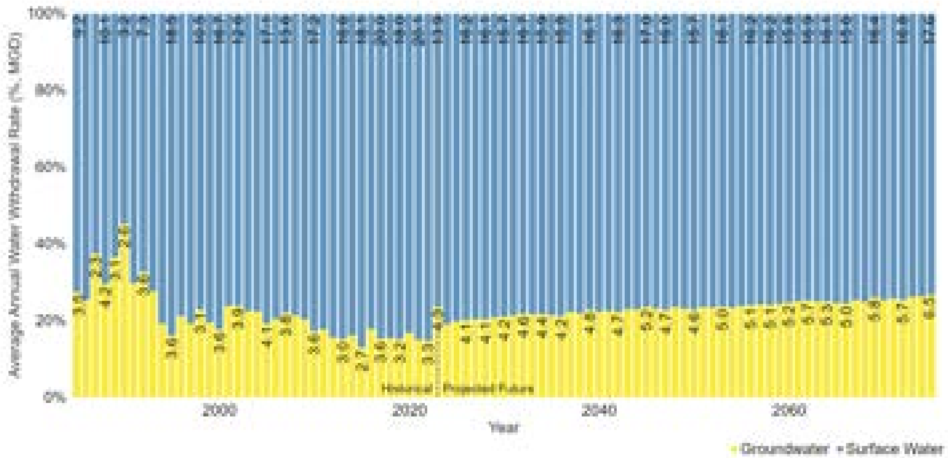
Historical and Projected Future Water Demand by Water Use Sector (MGD)

Historical and Projected Future Water Demand Summaries by County
December 2025



Key:
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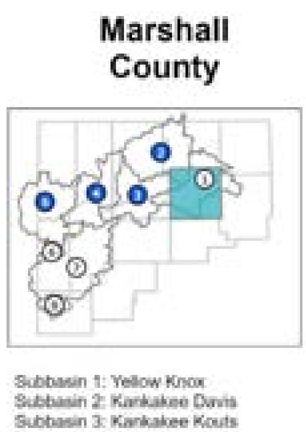
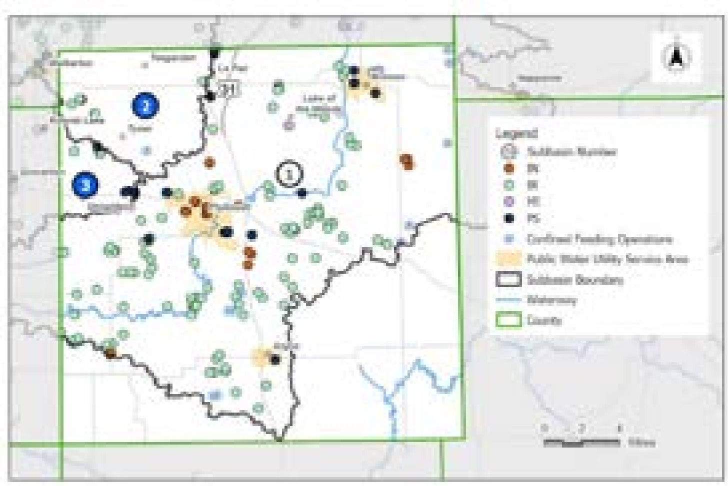
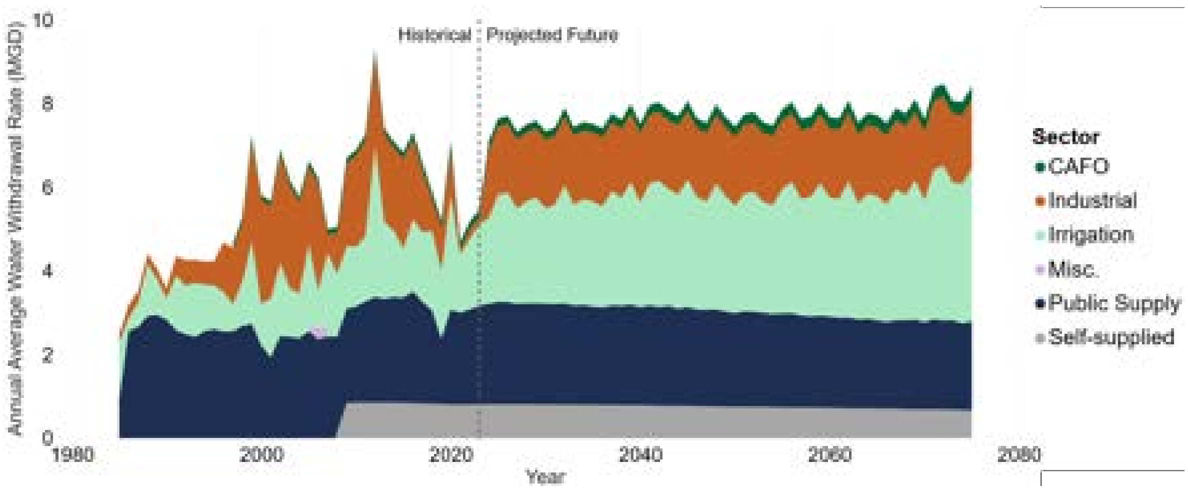
Historical and Projected Future Water Demand by Source Type (MGD)

I.5 Marshall County







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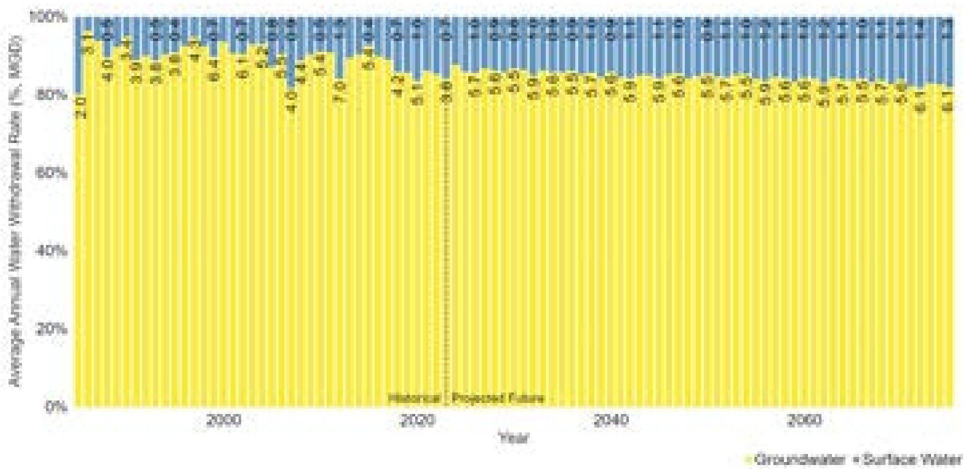
Historical and Projected Future Water Demand by Water Use Sector (MGD)



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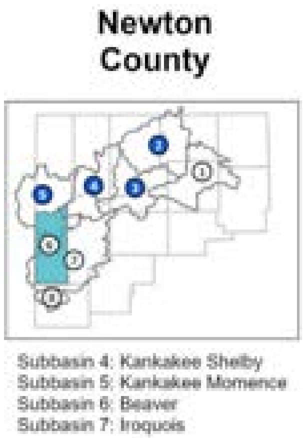
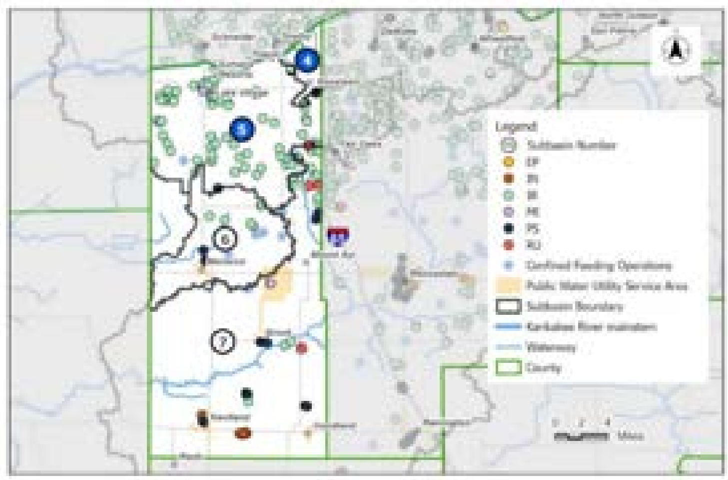
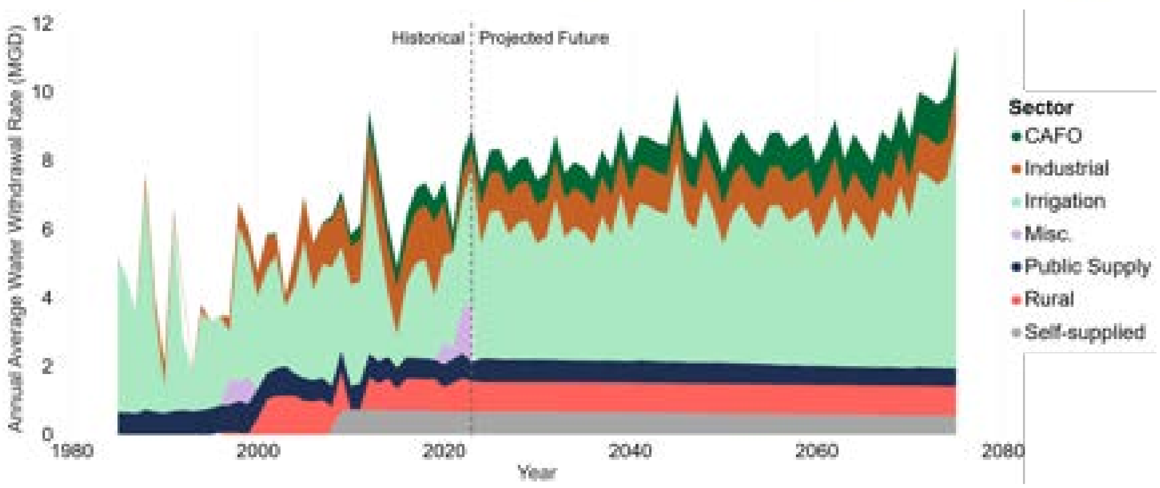
Historical and Projected Future Water Demand by Source Type (MGD)

I.6 Newton County







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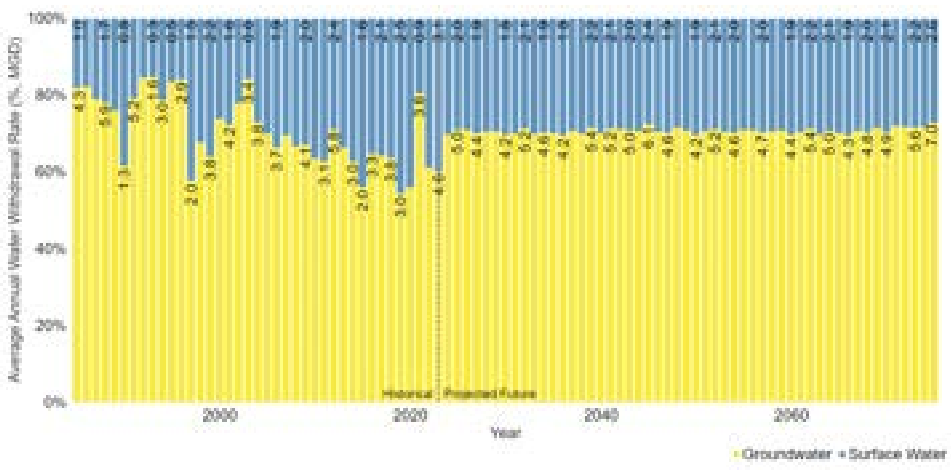
Historical and Projected Future Water Demand by Water Use Sector (MGD)



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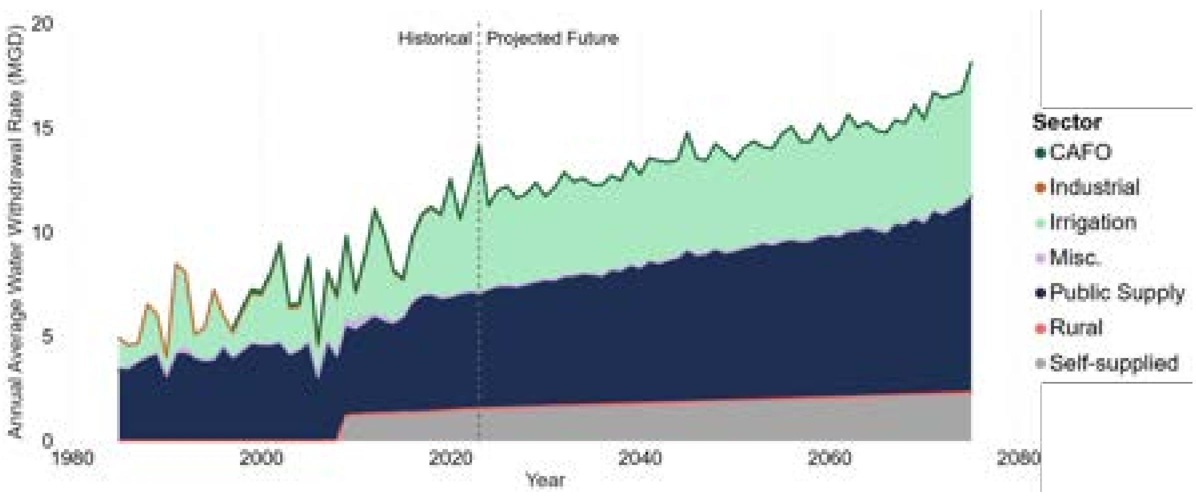
Historical and Projected Future Water Demand by Source Type (MGD)

I.7 Porter County



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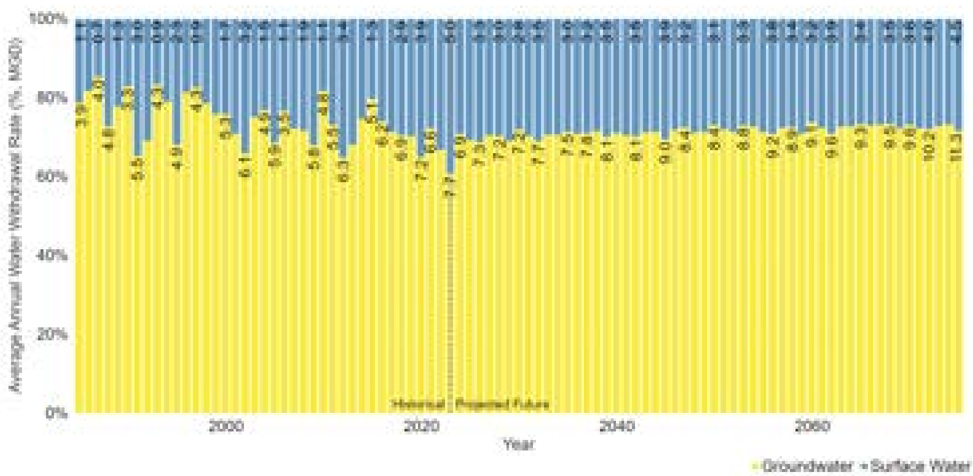
Historical and Projected Future Water Demand by Water Use Sector (MGD)

Historical and Projected Future Water Demand Summaries by County
December 2025



Key:
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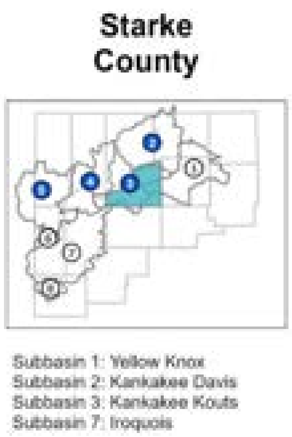
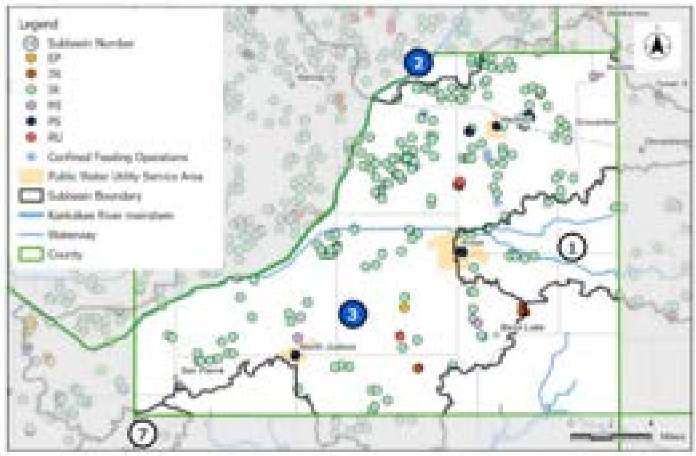
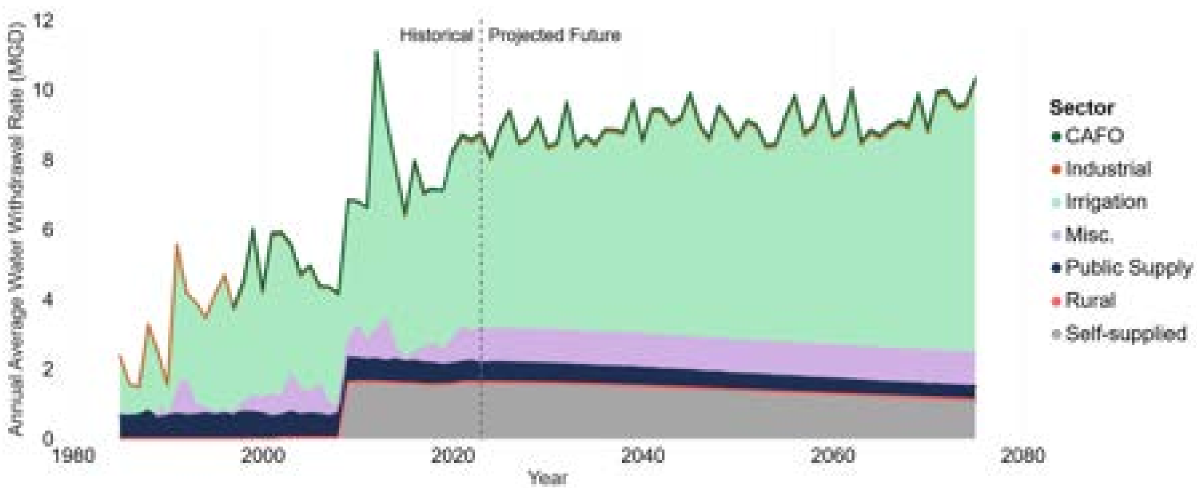
Historical and Projected Future Water Demand by Source Type (MGD)

I.8 Starke County







Key:
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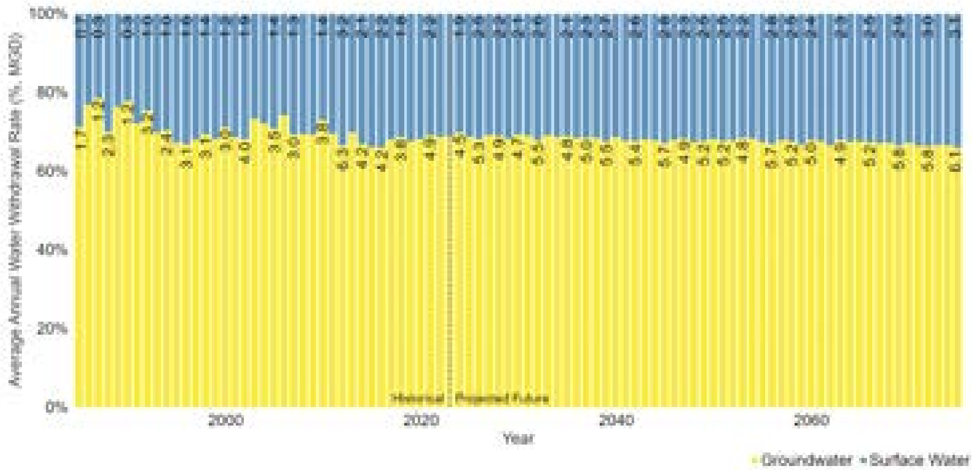
Historical and Projected Future Water Demand by Water Use Sector (MGD)

Historical and Projected Future Water Demand Summaries by County
December 2025



Key:
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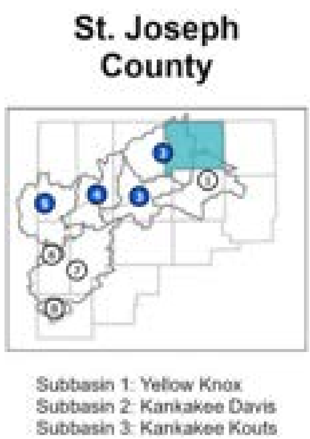
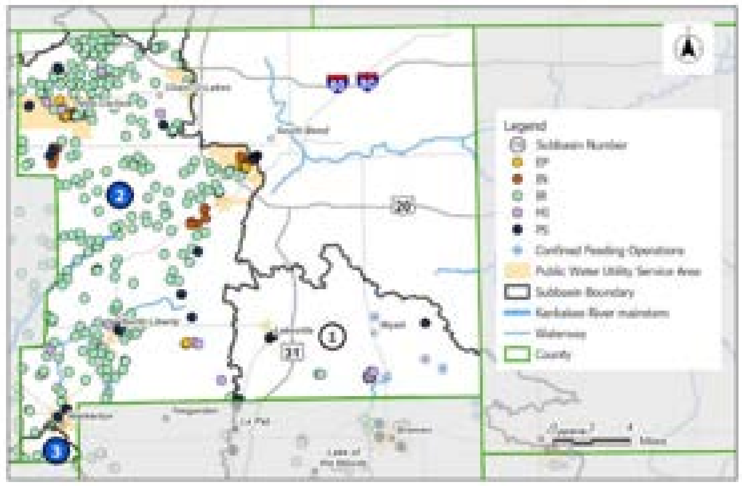
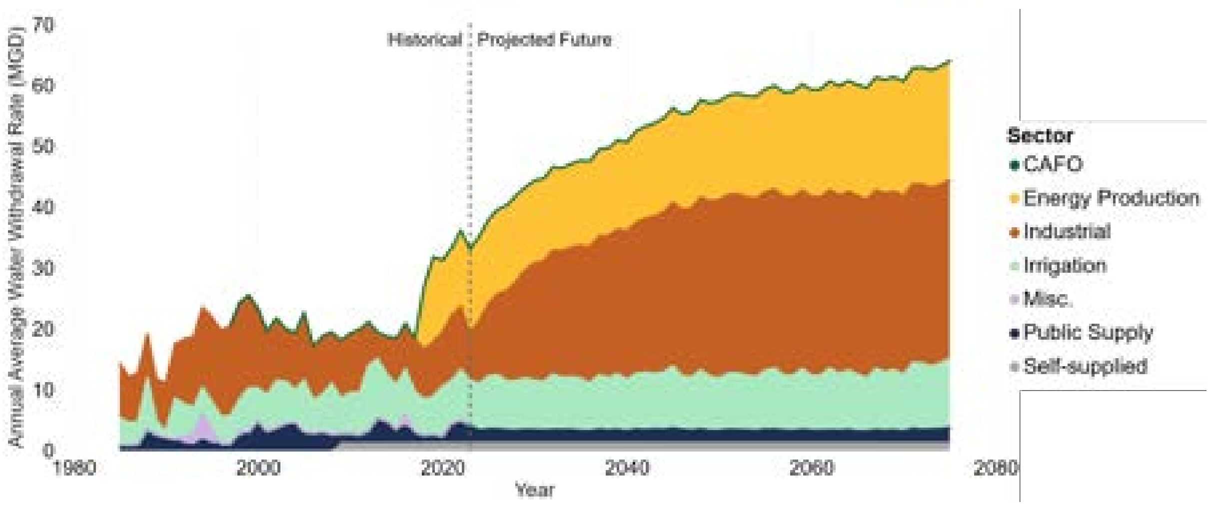
Historical and Projected Future Water Demand by Source Type (MGD)

I.9 St. Joseph County







Key:
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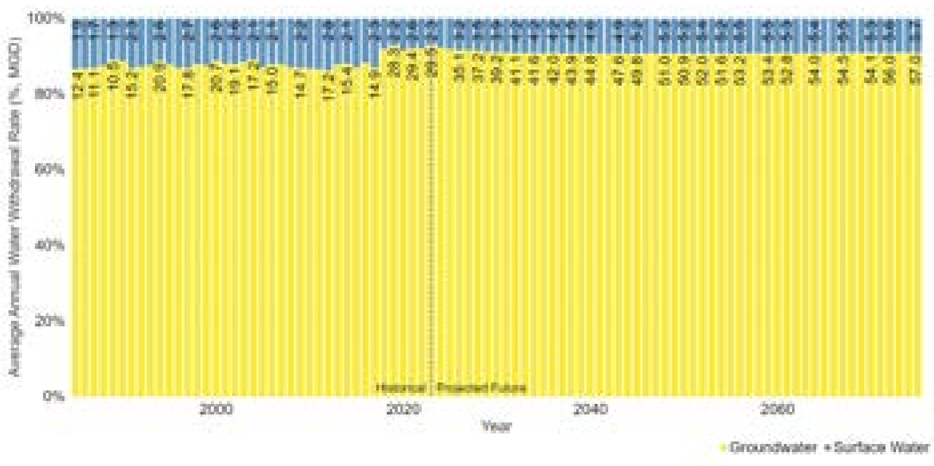
Historical and Projected Future Water Demand by Water Use Sector (MGD)



Key:
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Historical and Projected Future Water Demand by Source Type (MGD)