

2025 **OCWP**
Oklahoma Comprehensive Water Plan

Physical Water Supply Availability

April 2026 / FINAL



OKLAHOMA
Water Resources Board



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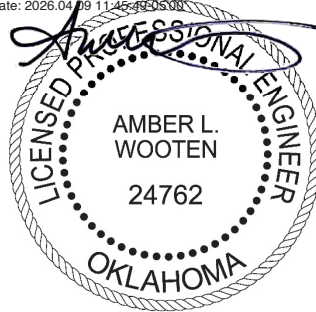
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Contact Info: Carollo Engineers, Inc.
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Abbreviations

AF	acre-feet
AFY	acre-feet per year
AGW	alluvial groundwater
BGW	bedrock groundwater
cfs	cubic feet per second
CI	Crop Irrigation
gpm	gallons per minute
H2O Tool	Oklahoma H2O Tool
ID	identification
No.	number
OCWP	Oklahoma Comprehensive Water Plan
OWRB	Oklahoma Water Resources Board
PS	Public Supply
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

SECTION 1 INTRODUCTION AND BACKGROUND

In 1974, the Oklahoma Legislature enacted 82 O.S. §1086.2(1), which requires that the Oklahoma Water Resources Board (OWRB) decennially develop a strategic guide for managing the state's water resources over the next 50 years. The Oklahoma Comprehensive Water Plan (OCWP) was first published in 1974, with subsequent updates in 1980, 1995, and 2012. The Oklahoma Legislature appropriated funds for the current update due in 2025.

This Physical Water Supply Availability Report summarizes the methodology and results of the technical aspects of the physical water supply availability analysis. The analysis is prepared at the basin level. The following are described in this report.

- Oklahoma H2O Tool (H2O Tool) and Water Supply Availability Methodology
- Oklahoma's Water Resources
- Physical Water Supply Availability Results, including anticipated water shortages
- List of public water systems and communities within each basin (Appendix A)
- 2025 H2O Tool Report (Appendix B)
- Differences Between Surface Water Physical and Legal Availability (Appendix C)

The Planning Basin water shortage forecast is used to characterize any differences between water supply and water demand. Basin-level physical shortage projections are included in Section 4. The basin-level shortages are provided for key planning periods only.

Legal water supply availability analysis is addressed separately and documented in the Legal Availability Analysis Report. More information on the differences and similarities between physical and legal supply availability are discussed in Appendix C.

1.1 Categories of Water Supply

In the OCWP, physical water supply availability is evaluated based on the following water supply sources.

- Surface water, also known as stream water
- Bedrock groundwater (BGW)
- Alluvial groundwater (AGW)

Surface water includes water that flows in streams, rivers, or is stored in lakes. Groundwater is water that exists below the ground surface and is commonly found in aquifers. Aquifers are defined as permeable rock, which can contain or transmit groundwater. Alluvial aquifers are made up of sediments deposited by rivers and are generally filled by infiltration of surface water or precipitation. Bedrock aquifers are generally not associated with rivers and are generally filled with water that percolates into the aquifer from the surface or other overlying aquifers.

1.2 OCWP Planning and Analysis Basins

Water demand and supplies can be evaluated using a variety of boundaries and geographic extents. For example, the sum of all demand and supplies could be analyzed for the entire state, without further subdivision. That level of analysis would not allow local analysis of supply and demand issues. On the other extreme, the analyses could be performed at such a micro-level (e.g., a single residence) that

practical results would not be developed. Thus, balancing the spatial extent, or resolution, of the analyses was considered in developing the approach for the OCWP technical analyses.

Consistent with the 2012 Update to the OCWP, supply analyses were developed on a sub-watershed or "basin" basis using the United States Geological Survey (USGS) stream gage data. The historic supply and future demand comparison has been conducted on a basin basis, requiring the projected water demand to be allocated to the sub-watershed or basin scale.

The statewide water supply availability analysis was performed on a hydrologic basis by subdividing the state into 82 OCWP Planning Basins using USGS 12-digit Hydrologic Unit Code boundaries. The basins used for this analysis were adapted from existing OWRB stream system boundaries and correspond to the same basin boundaries identified in the 2012 OCWP. Where practical, OWRB stream system boundaries were revised to include a USGS stream gage with a long-term, continuous streamflow record at or near the basin outlet (downstream end). Each of the 82 basins has been assigned a name, a unique five-digit basin identification (ID), and a unique numeric identification for graphical representation (basin number). Figure 1 shows the basins used in the supply availability analysis, including basin names and numbers. The basin number, five-digit basin ID, basin name, and basin area (square miles) are tabulated for each basin in Table 1.

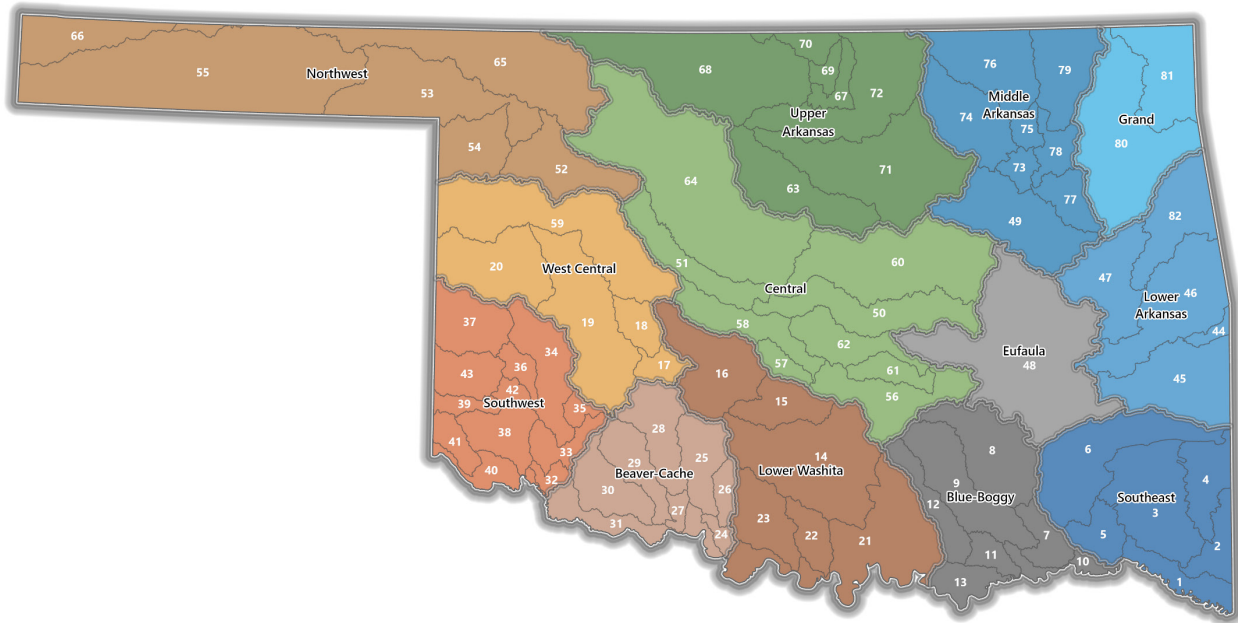


Figure 1 Oklahoma Comprehensive Water Plan Basins

Table 1 Basins

Basin No.	Basin ID	Basin Name	Area (Square Miles)	Planning Region
1	1-1	Red River Mainstem (to Kiamichi River)	410	Southeast
2	1-2	Little River (McCurtain County) - 1	350	Southeast
3	1-2	Little River (McCurtain County) - 2	1,290	Southeast
4	1-2	Little River (McCurtain County) - 3	550	Southeast
5	1-3	Kiamichi River - 1	380	Southeast
6	1-3	Kiamichi River - 2	1,440	Southeast

Basin No.	Basin ID	Basin Name	Area (Square Miles)	Planning Region
7	1-4-1	Muddy Boggy River - 1	350	Blue-Boggy
8	1-4-1	Muddy Boggy River - 2	1,090	Blue-Boggy
9	1-4-2	Clear Boggy Creek	1,000	Blue-Boggy
10	1-5	Red River Mainstem (to Blue River)	220	Blue-Boggy
11	1-6	Blue River - 1	220	Blue-Boggy
12	1-6	Blue River - 2	470	Blue-Boggy
13	1-7	Red River Mainstem (to Washita)	330	Blue-Boggy
14	1-8-1	Lower Washita	1,870	Lower Washita
15	1-8-2	Middle Washita - 1	520	Lower Washita
16	1-8-2	Middle Washita - 2	1,130	Lower Washita
17	1-8-3	Upper Washita - 1	230	West Central
18	1-8-3	Upper Washita - 2	310	West Central
19	1-8-3	Upper Washita - 3	1,590	West Central
20	1-8-4	Washita Headwaters	1,080	West Central
21	1-9	Red River Mainstem (to Walnut Bayou)	1,690	Lower Washita
22	1-10	Walnut Bayou	330	Lower Washita
23	1-11	Mud Creek	650	Lower Washita
24	1-12	Beaver Creek - 1	110	Beaver-Cache
25	1-12	Beaver Creek - 2	560	Beaver-Cache
26	1-12	Beaver Creek - 3	190	Beaver-Cache
27	1-13-1	Cache Creek - 1	110	Beaver-Cache
28	1-13-1	Cache Creek - 2	690	Beaver-Cache
29	1-13-2	Deep Red Creek and West Cache Creek - 1	500	Beaver-Cache
30	1-13-2	Deep Red Creek and West Cache Creek - 2	600	Beaver-Cache
31	1-14	Red River Mainstem (to North Fork of Red)	520	Beaver-Cache
32	1-15-1	Lower North Fork Red River - 1	120	Southwest
33	1-15-1	Lower North Fork Red River - 2	340	Southwest
34	1-15-1	Lower North Fork Red River - 3	800	Southwest
35	1-15-1	Lower North Fork Red River - 4	130	Southwest
36	1-15-2	Upper North Fork Red River - 1	190	Southwest
37	1-15-2	Upper North Fork Red River - 2	680	Southwest
38	1-16	Salt Fork Red River - 1	530	Southwest
39	1-16	Salt Fork Red River - 2	170	Southwest
40	1-17	Prairie Dog Town Fork Red River - 1	280	Southwest
41	1-17	Prairie Dog Town Fork Red River - 2	240	Southwest
42	1-18	Elm Fork Red River - 1	110	Southwest

Basin No.	Basin ID	Basin Name	Area (Square Miles)	Planning Region
43	1-18	Elm Fork Red River - 2	450	Southwest
44	2-1	Poteau River - 1	100	Lower Arkansas
45	2-1	Poteau River - 2	1,250	Lower Arkansas
46	2-2	Lower Arkansas River - 1	1,430	Lower Arkansas
47	2-2	Lower Arkansas River - 2	980	Lower Arkansas
48	2-3	Canadian River (to North Canadian River)	3,220	Eufaula
49	2-4	Middle Arkansas River	1,320	Middle Arkansas
50	2-5-1	Lower North Canadian River	1,060	Central
51	2-5-2	Middle North Canadian River	720	Central
52	2-5-3	Upper North Canadian River - 1	900	Northwest
53	2-5-3	Upper North Canadian River - 2	1,530	Northwest
54	2-5-3	Upper North Canadian River - 3	650	Northwest
55	2-5-4	North Canadian Headwaters	3,630	Northwest
56	2-6-1	Lower Canadian River - 1	940	Central
57	2-6-1	Lower Canadian River - 2	200	Central
58	2-6-2	Middle Canadian River	680	Central
59	2-6-3	Upper Canadian River	2,060	West Central
60	2-7	Deep Fork River	2,010	Central
61	2-8	Little River - 1	290	Central
62	2-8	Little River - 2	600	Central
63	2-9-1	Lower Cimarron River	1,090	Upper Arkansas
64	2-9-2	Middle Cimarron River	3,640	Central
65	2-9-3	Upper Cimarron River	2,020	Northwest
66	2-9-4	Cimarron Headwaters	700	Northwest
67	2-10-1	Lower Salt Fork Arkansas River - 1	230	Upper Arkansas
68	2-10-2	Upper Salt Fork Arkansas River	2,240	Upper Arkansas
69	2-10-1	Lower Salt Fork Arkansas River - 2	150	Upper Arkansas
70	2-10-1	Lower Salt Fork Arkansas River - 3	220	Upper Arkansas
71	2-11	Arkansas River - Cimarron Rivers to Keystone Lake	2,030	Upper Arkansas
72	2-12	Arkansas River Mainstem (to Kansas State Line)	1,490	Upper Arkansas
73	2-13	Bird Creek - 1	180	Middle Arkansas
74	2-13	Bird Creek - 2	960	Middle Arkansas
75	2-14	Caney River - 1	160	Middle Arkansas
76	2-14	Caney River - 2	1,020	Middle Arkansas
77	2-15-1	Verdigris River (to Oologah Dam) - 1	390	Middle Arkansas

Basin No.	Basin ID	Basin Name	Area (Square Miles)	Planning Region
78	2-15-1	Verdigris River (to Oologah Dam) - 2	320	Middle Arkansas
79	2-15-2	Verdigris River (to Kansas State Line)	820	Middle Arkansas
80	2-16	Grand (Neosho) River - 1	2,060	Grand
81	2-16	Grand (Neosho) River - 2	900	Grand
82	2-17	Illinois River	900	Lower Arkansas

Notes:

No. - number

Appendix A includes tables that identify public water systems and communities within each basin. When a community or rural water district spans more than one basin, the entity's name is associated with more than one basin number in the tables.

SECTION 2 OKLAHOMA H2O TOOL AND WATER SUPPLY AVAILABILITY METHODOLOGY

The Oklahoma H2O Tool (H2O Tool) was updated and modernized for the 2025 Update to the OCWP. It is a key tool for determining physical water supply availability and comparing that supply to projected demands. It uses a PCSWMM model framework to quantify physical supply availability, identify areas of potential physical supply limitations, and to more closely examine demand and supplies. Recognizing that both demand and supplies can vary dramatically from one part of the year to another, the analysis was conducted on a monthly time step. Appendix B contains the 2025 H2O Tool report, which provides more information about the modernization of the H2O Tool.

Figure 2 illustrates the basin level mass balance modeled within the H2O Tool. It consists of the following elements.

1. Junctions – Model nodes that link conduits and do not store water.
2. Outfalls – Model nodes that serve as an end point where flow leaves the model.
3. Storages – Model nodes where water is held per a defined storage curve. Outlets and Weirs (defined below) can only originate from a storage node. These elements are utilized in the 2025 Model to represent AGW/BGW/Reservoir storage capacity.
4. Conduits – Model linkages that allow water to flow from one model point to another.
5. Outlets – Model linkages that divert flow from storage nodes using rating curves. These are employed to represent the demand diversions within a planning basin.
6. Weirs – Model element utilized to move flow from storage nodes downstream. In the context of the 2025 Model, weirs are used as a conduit to maintain stream continuity when a storage node is utilized and forces the storage node to free flow to the next downstream node.

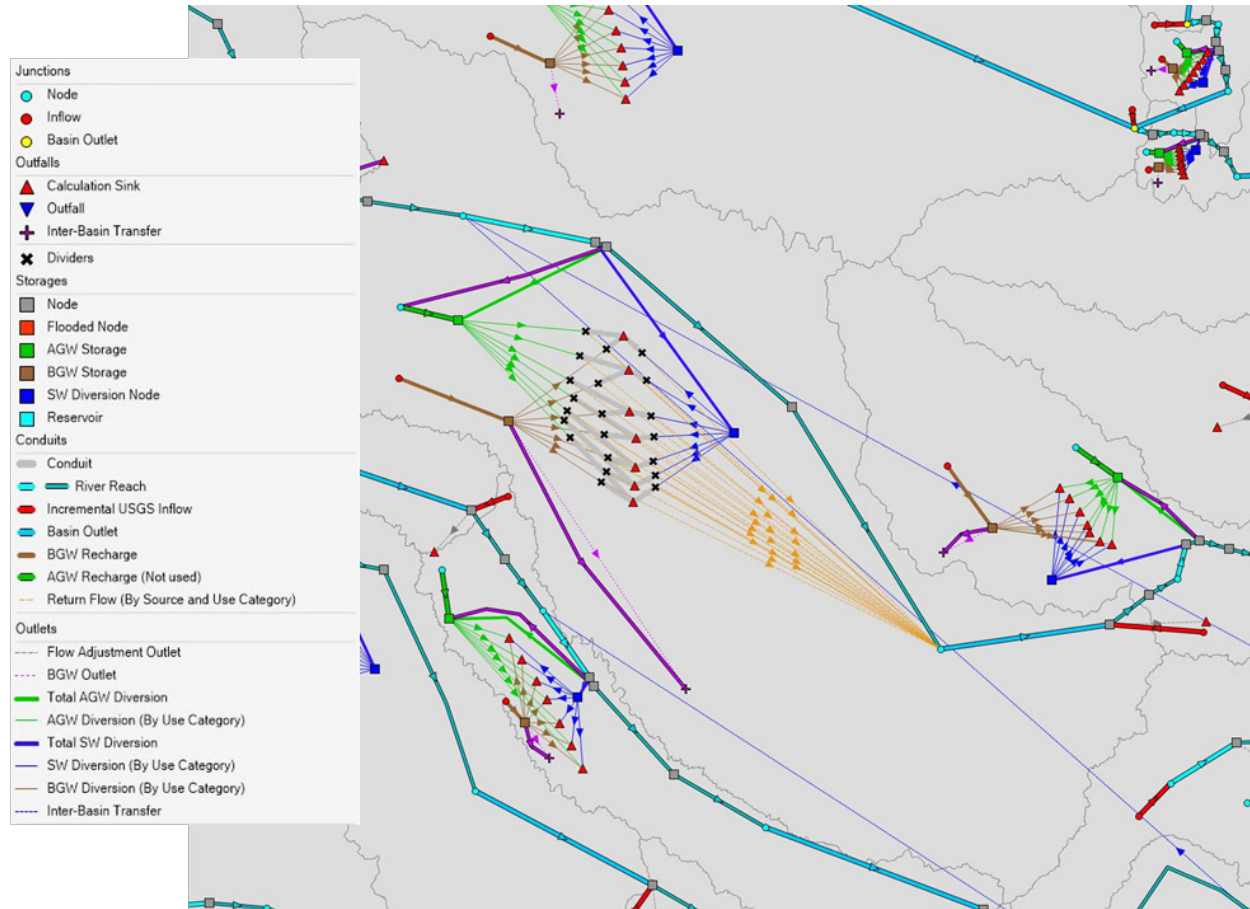


Figure 2 Screenshot of H2O Tool PCSWMM Schematic

The H2O Tool compares physically available supplies to future changes in demand. A key component of this analysis is the assumption that current demand, current diversions, current return flows, and current AGW/surface water interactions are captured in the historical streamflow record (1949 to 2021). Future upstream changes in surface water and AGW demands (increase in demand from 2020 to the future planning year) are reflected in the streamflow available to downstream basins by the H2O Tool. Bedrock aquifer recharge rates are compared to future changes in demand.

The water supply availability analysis represents a statewide screening-level analysis. By its nature, such a statewide analysis requires simplifying assumptions. Examples of some of the primary assumptions in this analysis include the following.

- Water rights or permit obligations are not explicitly considered in the physical supply availability assessment described in this report. Legal water supply availability analysis is addressed separately and documented in the Legal Availability Analysis Report.
- Water quality and other in-stream issues are not considered in the physical supply availability assessment but are being evaluated via other elements of the OCWP.
- Changes in groundwater aquifer volumes and water levels are not explicitly tracked (in other words, the analysis does not predict the water level of an aquifer at any future date).
- Options to meet projected future water shortages are evaluated separately and documented in the Water Management Strategy Assessment Report.

SECTION 3 OKLAHOMA'S WATER RESOURCES

This section summarizes Oklahoma's currently available water resources based on available data for both surface water and groundwater supplies. In addition to surface water and groundwater supplies, return flows and interbasin supplies were also accounted for in the OCWP technical analyses, as each affects the physical supply availability in the Planning Basins. Each of these water supply sources is discussed below.

3.1 Surface Water Supply

The surface water supply includes physically available water in streams, rivers, and lakes to meet demand. The H2O Tool evaluates future increases in demand on physically available surface water. The physically available streamflow is based on recorded USGS stream gage data. The measured streamflow implicitly reflects the following example operating conditions that impact the stream at the time the data are recorded.

- Hydrology
- Water withdrawals and return flows (or use)
- Infrastructure constraints
- Water quality constraints
- Surface water-AGW interactions
- Reservoir operations

Using the full historical record (calendar years 1949 to 2021) balances the likely over-prediction of water in the earlier decades of the historical streamflow dataset for basins that have undergone substantial growth and historic droughts of record. This period of record was used to determine both the size and probability of surface water and AGW shortages.

All of Oklahoma's major river systems receive flow from out-of-state tributary areas. The amount of flow or storage available from out-of-state is regulated based on legal compacts between Oklahoma and surrounding states. A review of compact obligations was performed in the permit availability assessment, which is documented in the Legal Availability Analysis Report. To account for potential compact obligations, the simplifying assumption of the amount of out-of-state water physically coming into Oklahoma was assumed to be reduced by 60 percent (Oklahoma receives 40 percent) is used for physical water analysis. This methodology is consistent with the method that OWRB uses to determine the amount of streamflow available for permitting.

The average annual flows for the water years 1950 through 2020 for each basin are presented in Table 2. The average flows (after existing diversions are taken out of the stream, including interbasin supplies) are shown graphically in Figure 3 for each basin. The surface water supplies follow the strong east-west precipitation gradient in the state and reflect the large quantity of water in the Arkansas River basins.

Table 2 Average Annual Surface Water Supplies for Water Years 1950 through 2020

Basin No.	Basin ID	Basin Name	Average Annual Flow Volume (AFY)	Assumed Upstream Interstate Compact Obligation Average Annual Flow Volume (AFY)
1	10100	Red River Mainstem (To Kiamichi River)	7,733,807	0
2	10201	Little River (McCurtain County) - 1	2,552,771	0
3	10202	Little River (McCurtain County) - 2	1,288,274	0
4	10203	Little River (McCurtain County) - 3	821,463	186,209
5	10301	Kiamichi River - 1	1,653,469	0
6	10302	Kiamichi River - 2	1,305,353	0
7	10411	Muddy Boggy River - 1	1,402,066	0
8	10412	Muddy Boggy River - 2	635,229	0
9	10420	Clear Boggy Creek	564,096	0
10	10500	Red River Mainstem (To Blue River)	5,556,537	0
11	10601	Blue River - 1	341,068	0
12	10602	Blue River - 2	233,522	0
13	10700	Red River Mainstem (To Washita)	3,696,940	0
14	10810	Lower Washita	1,271,229	0
15	10821	Middle Washita - 1	641,119	0
16	10822	Middle Washita - 2	485,452	0
17	10831	Upper Washita - 1	324,249	0
18	10832	Upper Washita - 2	24,917	0
19	10833	Upper Washita - 3	267,518	0
20	10840	Washita Headwaters	43,100	5,848
21	10900	Red River Mainstem (To Walnut Bayou)	3,535,041	0
22	11000	Walnut Bayou	58,958	0
23	11100	Mud Creek	141,059	0
24	11201	Beaver Creek - 1	221,025	0
25	11202	Beaver Creek - 2	171,993	0
26	11203	Beaver Creek - 3	48,072	0
27	11311	Cache Creek - 1	408,408	0
28	11312	Cache Creek - 2	158,758	0
29	11321	Deep Red Creek and West Cache Creek - 1	225,368	0
30	11322	Deep Red Creek and West Cache Creek - 2	123,475	0
31	11400	Red River Mainstem (To North Fork of Red)	1,244,260	0
32	11511	Lower North Fork Red River - 1	249,326	0

Basin No.	Basin ID	Basin Name	Average Annual Flow Volume (AFY)	Assumed Upstream Interstate Compact Obligation Average Annual Flow Volume (AFY)
33	11512	Lower North Fork Red River - 2	241,324	0
34	11513	Lower North Fork Red River - 3	172,618	0
35	11514	Lower North Fork Red River - 4	10,893	0
36	11521	Upper North Fork Red River - 1	18,956	0
37	11522	Upper North Fork Red River - 2	47,427	38,380
38	11601	Salt Fork Red River - 1	124,891	0
39	11602	Salt Fork Red River - 2	25,247	28,284
40	11701	Prairie Dog Town Fork Red River - 1	384,080	0
41	11702	Prairie Dog Town Fork Red River - 2	10,193	1,689
42	11801	Elm Fork Red River - 1	54,389	0
43	11802	Elm Fork Red River - 2	45,897	16,519
44	20101	Poteau River - 1	1,297,229	0
45	20102	Poteau River - 2	1,215,886	263,994
46	20201	Lower Arkansas River - 1	18,330,987	143,564
47	20202	Lower Arkansas River - 2	15,646,871	0
48	20300	Canadian River (To North Canadian River)	4,152,350	0
49	20400	Middle Arkansas River	4,527,173	0
50	20510	Lower North Canadian River	578,661	0
51	20520	Middle North Canadian River	129,936	0
52	20531	Upper North Canadian River - 1	96,785	0
53	20532	Upper North Canadian River - 2	63,210	2,092
54	20533	Upper North Canadian River - 3	18,059	11,680
55	20540	North Canadian Headwaters	21,278	9,977
56	20611	Lower Canadian River - 1	1,094,204	0
57	20612	Lower Canadian River - 2	56,888	0
58	20620	Middle Canadian River	399,617	0
59	20630	Upper Canadian River	181,895	59,499
60	20700	Deep Fork River	650,020	0
61	20801	Little River - 1	253,355	0
62	20802	Little River - 2	125,969	0
63	20910	Lower Cimarron River	1,078,746	0
64	20920	Middle Cimarron River	781,582	0
65	20930	Upper Cimarron River	135,354	37,937

Basin No.	Basin ID	Basin Name	Average Annual Flow Volume (AFY)	Assumed Upstream Interstate Compact Obligation Average Annual Flow Volume (AFY)
66	20940	Cimarron Headwaters	5,360	4,059
67	21011	Lower Salt Fork Arkansas River - 1	788,050	0
68	21020	Upper Salt Fork Arkansas River	471,580	200,500
69	21012	Lower Salt Fork Arkansas River - 2	258,062	0
70	21013	Lower Salt Fork Arkansas River - 3	220,905	246,837
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	3,712,711	0
72	21200	Arkansas River Mainstem (To Kansas State Line)	2,060,425	1,782,384
73	21301	Bird Creek - 1	502,671	0
74	21302	Bird Creek - 2	419,576	0
75	21401	Caney River - 1	757,467	0
76	21402	Caney River - 2	662,941	263,204
77	21511	Verdigris River (To Oologah Dam) - 1	2,602,332	0
78	21512	Verdigris River (To Oologah Dam) - 2	2,415,372	0
79	21520	Verdigris River (To Kansas State Line)	1,173,127	1,088,348
80	21601	Grand (Neosho) River - 1	3,550,656	47,359
81	21602	Grand (Neosho) River - 2	2,809,006	3,413,571
82	21700	Illinois River	841,645	329,045

Notes:

AFY - acre-feet per year

Reservoirs are an important source of water for Oklahoma, providing for water supply, flood protection, hydroelectric power, recreation, and other beneficial uses. Many reservoirs in Oklahoma serve multiple purposes, such as water supply and recreation. Water supply reservoirs capture water when it is available, and store it until needed, traditionally in the late summer and early fall. The Lakes of Oklahoma website (<https://oklahoma.gov/owrb/data-and-maps/lakes-of-oklahoma.html>) provides detailed information on each of the major lakes in the state.

Historic reservoir operations are implicitly accounted for in the streamflow record in the supply availability analysis. Therefore, reservoir storage and operations are not separate inputs of the analysis. For example, Oklahoma City currently pumps raw water from Lake Atoka and McGee Creek Reservoir to Stanley Draper Lake. Lake Atoka and McGee Creek Reservoir are in the Muddy Boggy River basin (Basin 8). The flows recorded in the USGS gage downstream of the Muddy Boggy River basin account for the yields taken from these two reservoirs, because the water was transferred out of the basin upstream of the gage. That is, the historic reservoir yields for Lake Atoka and McGee Creek Reservoir do not have to be subtracted from the surface water supply for Basin 8 because the gage record accounts for the historic withdrawals.

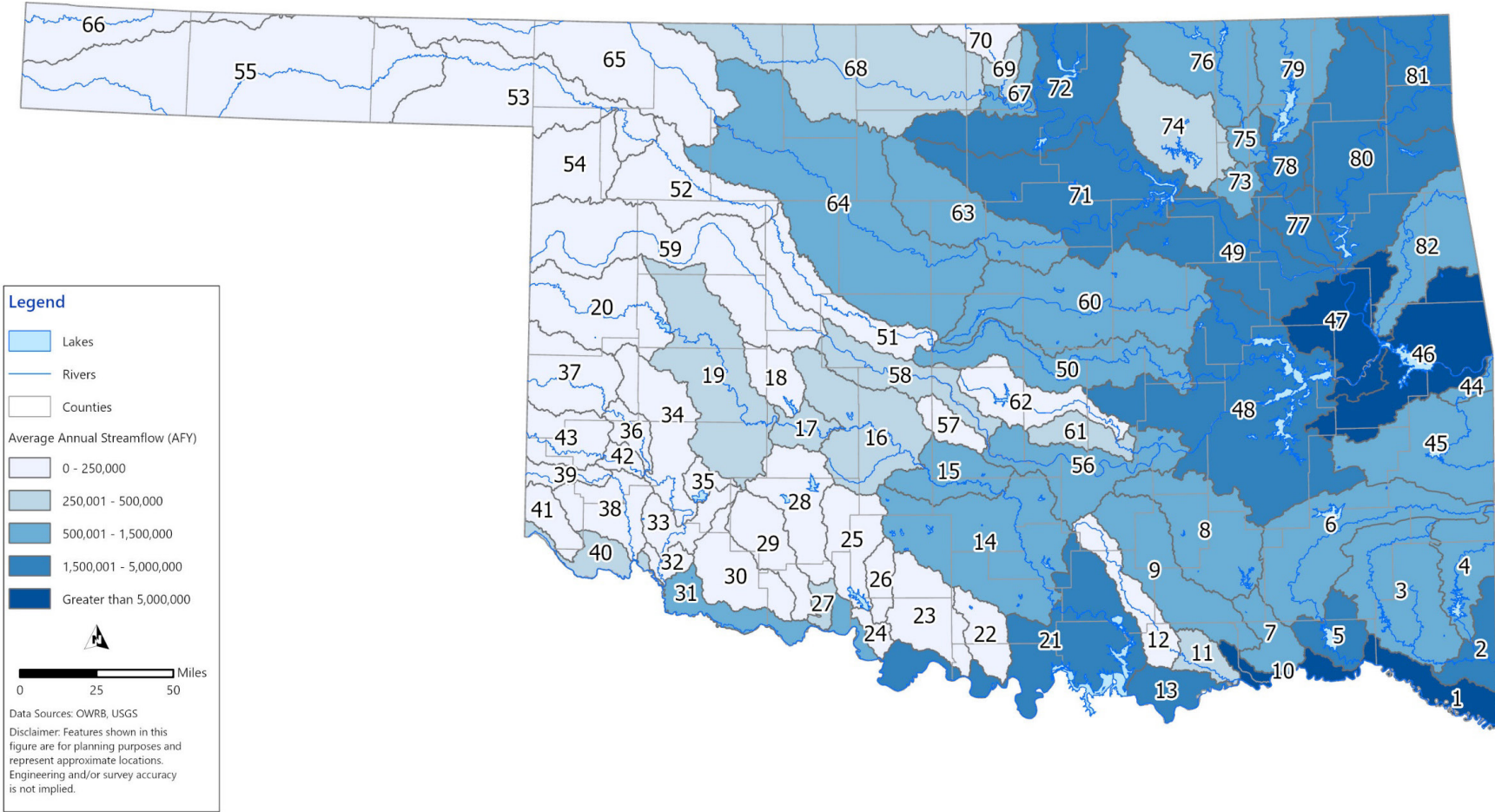


Figure 3 Average Streamflow for Water Years 1950 through 2020

Oklahoma has over 14 million acre-feet (AF) of surface water storage capacity from 147 reservoirs. Permitting data from OWRB estimates over 1.7 million AFY of dependable water supply yield for 73 major reservoirs. Not all the storage and subsequent dependable yield in the state is currently used. Many major reservoirs have yield that is permitted with a schedule of use. In this case, the permit holder has reserved the yield and set a schedule to increase the use of the yield in the future, but it is not currently using the entire permitted yield. Some major reservoirs have unpermitted yields that could be used by a new water user. The yields of many smaller or municipally owned reservoirs are currently fully permitted or the yield is unknown. Reservoirs with a known yield and unused storage, either due to a schedule of use or having unpermitted yield, are presented in Table 3.

The unused reservoir yield from major reservoirs was included in the H2O Tool to account for the substantial water supplies available from these reservoirs. The available yield was used to mitigate surface water gaps in the basin where the reservoir is located. However, any future use of these reservoirs would need to take into consideration existing water rights.

Table 3 Unused Existing Reservoir Yield from Major Reservoirs

Name	Authority	Primary Basin No.	Water Supply Storage (AF)	Water Supply Yield (AFY)	Existing Permits (AFY) ⁽¹⁾	Available Yield in 2020 for New Permits (AFY)
Bellcow Lake	Soil Conservation Service	60	0	4,558 ⁽²⁾	4,144	414
Birch Lake	USACE	74	7,600	3,360	2,800	560
Broken Bow Lake	USACE	4	152,500	58,386	10,780	47,606
Eufaula Lake	USACE	48	79,552	76,451	43,100	33,352
Foss	Bureau of Reclamation	20	0	18,000	17,634	366
Fuqua Lake	City of Duncan	14	21,100	3,427 ⁽²⁾	1,245	2,182
Healdton City Lake	Soil Conservation Service	22	0	3,000 ⁽²⁾	1,473	1,527
Hulah Lake	USACE	76	19,800	13,888	13,886	2
Jean Neustadt	Soil Conservation Service	14	0	2,150	1,267	883
Keystone Lake	USACE	71	20,000	22,400	13,968	8,432
Lone Chimney Lake	Soil Conservation Service	71	0	2,509 ⁽²⁾	2,507	2
McGee Creek Lake	Bureau of Reclamation	8	109,800	71,800	64,608	7,192
Pine Creek Lake	USACE	3	49,400	94,080	33,605	60,475
Sardis Lake (clayton)	USACE	6	297,200	156,800	122,343	34,457
Stroud Lake	Soil Conservation Service	60	0	1,299 ⁽²⁾	1,100	199
Texoma Lake	USACE	21	150,000	168,000	118,001	49,999

Notes:

USACE - United States Army Corps of Engineers

(1) Based on the June 2023 permit database received from OWRB.

(2) Estimated yield.

3.2 Alluvial Groundwater Supply

Major alluvium and terrace aquifers (also referred to as alluvial aquifers in this report) are those that yield, on average, at least 150 gallons per minute (gpm) based on analyses by OWRB. OWRB has identified 11 major alluvial aquifers. Minor AGW aquifers-those yielding less than the major aquifers-are an important local source of water for domestic, stock, and other uses. However, not all minor aquifers have been delineated (i.e., their extent and volume have not been assessed). In the OCWP, these aquifers are referred to as non-delineated minor aquifers.

Oklahoma's major and minor alluvial aquifers are presented in Figure 4. Site-specific information on minor aquifers should be considered before large scale use.

Alluvial and terrace aquifers in the OCWP are assumed to be directly connected to surface water. A surplus of AGW would be displayed as increased baseflow in the adjacent surface water. Conversely, a deficiency of AGW would be displayed as a decrease in baseflow of adjacent surface water. AGW recharge is not considered separately in this analysis since any increases or decreases in AGW storage from recharge or depletion would be exhibited in the surface water increases and decreases.

Aquifer-based data was distributed to the surface water basins for the calculation of available water supplies and is incorporated into Figure 3.

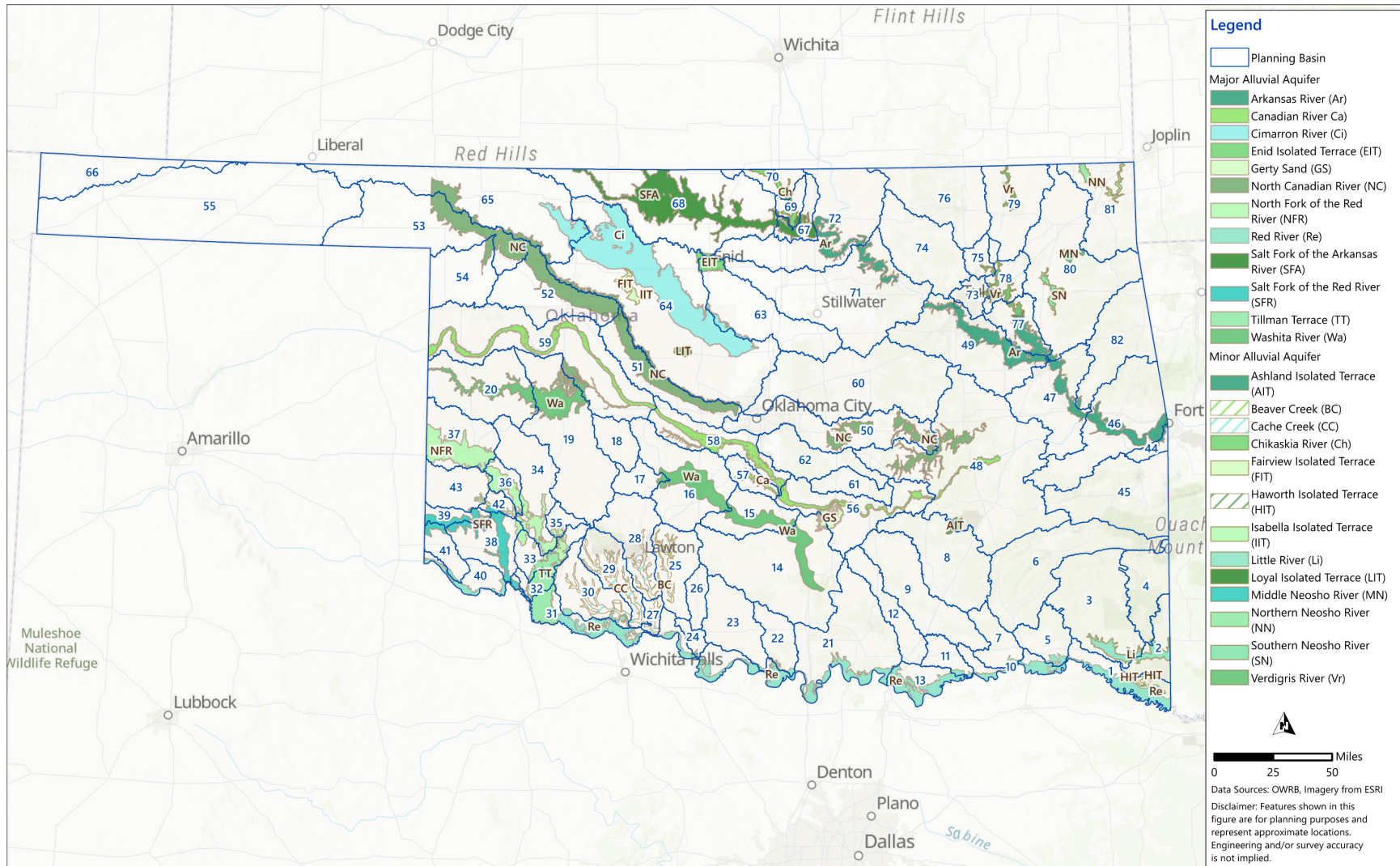


Figure 4 Major and Minor Alluvial Aquifers

3.3 Bedrock Groundwater Supply

Major bedrock aquifers are defined as those that yield an average of 50 gpm or more per well based on analyses by OWRB. OWRB has identified 10 major bedrock aquifers. Minor BGW aquifers, those yielding less than the major aquifers, are an important local source of water for domestic, livestock, and other uses. Some of the more prolific minor bedrock aquifers include the El Reno, Woodbine, and Boone aquifers. However, not all minor aquifers have been delineated (i.e., their extent and volume have not been assessed). In the OCWP, these aquifers are referred to as non-delineated minor aquifers.

Oklahoma's major and minor bedrock aquifers are presented in Figure 5. Site-specific information on minor aquifers should be considered before large scale use. Suitability for long-term supply is typically based on recharge, storage yield, capital and operational costs, and water quality.

Groundwater storage volumes for bedrock aquifers were updated from previous estimates using updated data provided by OWRB, if available. The area of each major or minor aquifer in each planning basin was estimated using the most recent OWRB GIS data for the aquifers. Recent groundwater level data collected by OWRB were used to update the saturated thickness and volume in storage for several aquifers including the Rush Springs, Ogallala-Panhandle, Elk City, and Boone-Roubidoux. If no updated data were available, or if recent data were insufficient to update the aquifer storage estimate, previous estimates of aquifer storage were used. The reported total aquifer storage assumes that the maximum recoverable storage volume is 80 percent of actual groundwater in storage.

The water availability analyses undertaken for the current OCWP update predict if BGW storage depletions exist based on the net of the BGW demand and BGW recharge for each aquifer. Recharge rates for bedrock aquifers were estimated from available literature. Recharge rates by county were available from previous studies for Antlers, Arbuckle-Timbered Hills, Garber-Wellington, Ogallala, and Vamoosa-Ada bedrock aquifers. These recharge rates were assumed to be distributed evenly across the aquifer on an aerial basis if no county-scale estimates were available and were applied at a constant monthly rate throughout the year. The county or aquifer recharge rates were distributed to OCWP Planning Basins based on the fraction of the aquifer in each basin. BGW recharge rates by basin are shown in Table 4. Groundwater supplies are summarized in Table 5.

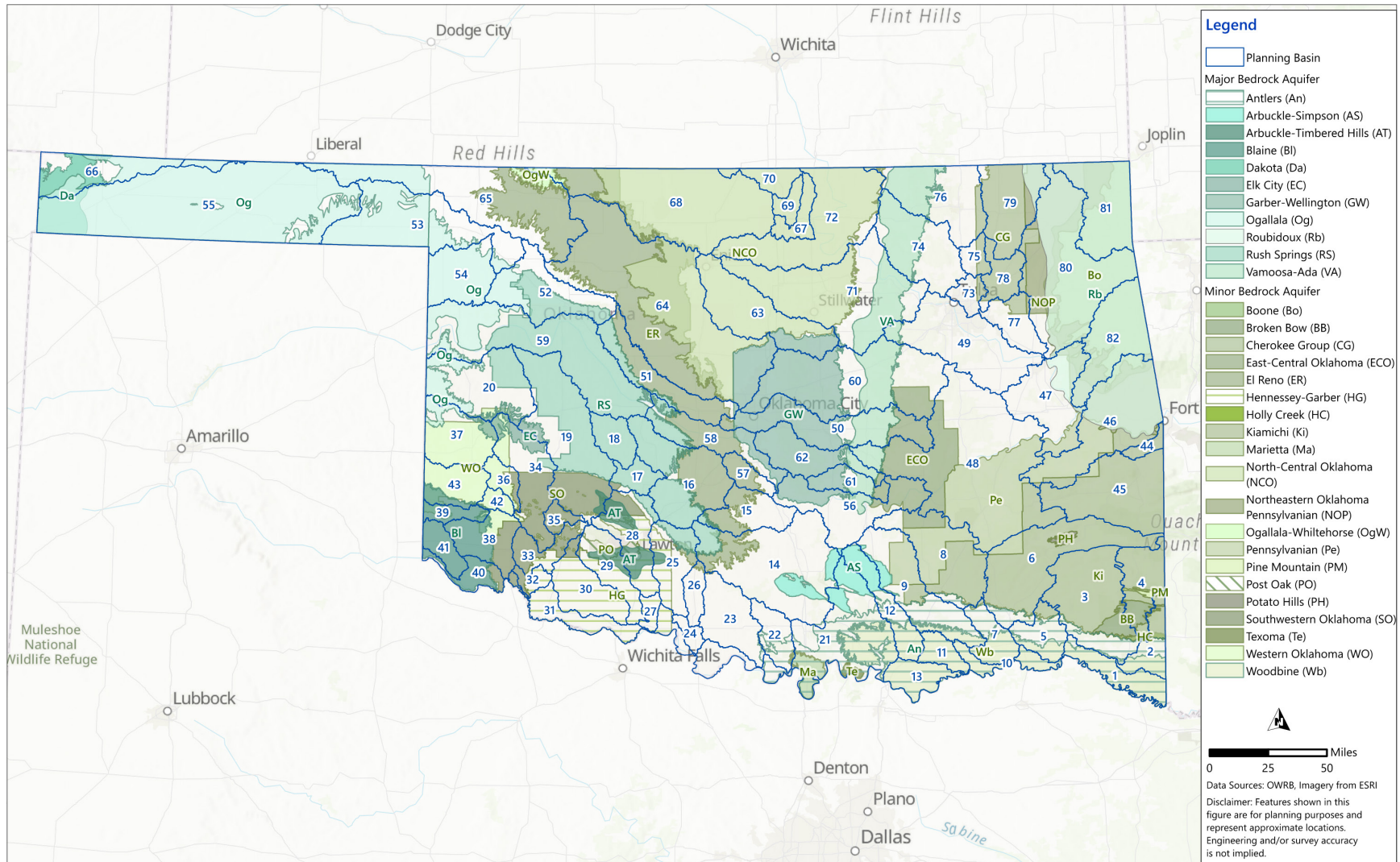


Figure 5 Major and Minor Bedrock Aquifers

Table 4 Recharge Estimates for Bedrock Groundwater by Planning Basin Used in Physical Water Analysis

Planning Basin ID	Bedrock Groundwater Recharge Rate (cfs)	Bedrock Groundwater Recharge Rate (AFY)
1	21	15,216
2	11	8,237
3	13	9,429
4	0	37
5	19	13,500
6	12	8,908
7	24	17,475
8	5	3,787
9	56	40,492
10	9	6,730
11	5	3,515
12	71	51,588
13	7	5,193
14	58	42,008
15	1	964
16	59	42,940
17	25	17,950
18	41	29,537
19	94	68,186
20	30	21,421
21	129	93,583
22	11	8,162
23	1	617
24	0	0
25	10	7,133
26	0	0
27	0	0
28	11	7,978
29	2	1,341
30	0	0
31	0	0
32	0	0
33	0	0
34	29	20,672

Planning Basin ID	Bedrock Groundwater Recharge Rate (cfs)	Bedrock Groundwater Recharge Rate (AFY)
35	0	0
36	0	0
37	15	10,588
38	28	20,439
39	4	3,006
40	21	15,466
41	27	19,233
42	0	0
43	0	0
44	0	37
45	0	0
46	146	105,591
47	48	34,821
48	6	4,130
49	5	3,475
50	68	49,246
51	1	517
52	4	3,113
53	11	8,231
54	13	9,727
55	34	24,596
56	23	16,545
57	0	0
58	21	15,051
59	91	66,215
60	127	91,849
61	20	14,355
62	51	36,948
63	21	15,229
64	35	25,305
65	3	2,328
66	4	3,052
67	0	0
68	0	0
69	0	0
70	0	0

Planning Basin ID	Bedrock Groundwater Recharge Rate (cfs)	Bedrock Groundwater Recharge Rate (AFY)
71	53	38,603
72	3	2,227
73	0	0
74	35	25,282
75	0	0
76	27	19,480
77	0	0
78	0	0
79	22	15,694
80	301	217,874
81	165	119,467
82	165	119,507

Notes:

cfs - cubic feet per second

Table 5 Potential Groundwater Storage Volume by Basin

Primary Basin ID	Alluvium and Terrace Groundwater Storage (AF)	Bedrock Groundwater Storage (AF)	Total Groundwater Storage (AF)
1	199,276	11,438,061	11,637,337
2	88,579	5,960,169	6,048,748
3	109,483	6,379,724	6,489,207
4	3,348	789,646	792,993
5	82,338	5,378,023	5,460,361
6	--	3,918,451	3,918,451
7	53,491	5,863,138	5,916,629
8	19,115	7,948,204	7,967,318
9	--	9,244,694	9,244,694
10	248,021	4,675,434	4,923,456
11	44,933	4,371,562	4,416,495
12	1,155	6,679,717	6,680,873
13	570,254	6,498,076	7,068,330
14	752,740	4,137,338	4,890,079
15	681,824	652,111	1,333,935
16	542,981	3,486,755	4,029,736
17	31,978	825,209	857,187
18	--	1,845,472	1,845,472

Primary Basin ID	Alluvium and Terrace Groundwater Storage (AF)	Bedrock Groundwater Storage (AF)	Total Groundwater Storage (AF)
19	308,067	10,648,515	10,956,582
20	177,875	4,327,039	4,504,914
21	747,603	16,653,228	17,400,831
22	214,043	799,635	1,013,678
23	171,981	67,091	239,072
24	36,508	--	36,508
25	120,679	892,819	1,013,498
26	--	32,893	32,893
27	61,192	236,460	297,652
28	129,854	2,112,319	2,242,173
29	226,955	1,726,047	1,953,002
30	207,342	1,333,701	1,541,043
31	834,169	994,930	1,829,099
32	375,908	257,014	632,922
33	688,392	637,189	1,325,581
34	696,068	2,688,651	3,384,719
35	71,795	196,710	268,505
36	674,981	436,011	1,110,992
37	1,653,630	2,918,785	4,572,415
38	101,775	1,121,340	1,223,115
39	14,359	245,279	259,638
40	1,949	505,446	507,394
41	5,527	464,390	469,917
42	138,466	274,117	412,583
43	100,842	1,067,730	1,168,572
44	12,594	139,938	152,531
45	--	2,204,184	2,204,184
46	160,375	16,431,999	16,592,373
47	87,005	5,148,351	5,235,356
48	507,542	26,509,735	27,017,277
49	344,014	305,517	649,532
50	571,391	15,654,467	16,225,858
51	1,227,260	2,266,499	3,493,759
52	1,777,085	3,853,934	5,631,019
53	1,674,496	16,544,252	18,218,748
54	188,321	7,154,533	7,342,853

Primary Basin ID	Alluvium and Terrace Groundwater Storage (AF)	Bedrock Groundwater Storage (AF)	Total Groundwater Storage (AF)
55	--	48,722,874	48,722,874
56	420,320	7,098,892	7,519,213
57	69,491	415,263	484,753
58	659,658	4,594,332	5,253,990
59	601,534	14,967,495	15,569,030
60	--	19,478,717	19,478,717
61	--	3,617,133	3,617,133
62	--	12,413,472	12,413,472
63	280,607	4,739,674	5,020,282
64	4,077,757	13,917,897	17,995,653
65	1,060,839	9,489,198	10,550,036
66	--	2,167,147	2,167,147
67	125,924	784,715	910,638
68	2,113,881	5,807,898	7,921,779
69	62,690	587,061	649,752
70	13,053	881,607	894,660
71	84,713	3,088,412	3,173,125
72	141,896	2,061,093	2,202,988
73	--	29,411	29,411
74	--	865,872	865,872
75	--	68,780	68,780
76	--	755,509	755,509
77	133,940	65,678	199,618
78	--	281,713	281,713
79	--	1,529,792	1,529,792
80	72,403	25,626,431	25,698,835
81	57,038	16,456,817	16,513,856
82	6,740	16,388,187	16,394,927
Grand Total	27,722,042	453,843,600	481,565,641

3.4 Return Flows

A portion of water withdrawals are not consumed and are ultimately returned to a stream, referred to here as return flow. The H2O Tool allows return flows to occur for surface water and groundwater from each demand sector. The quantity of return flow is based on an assumed percentage of the demand in each sector. For this analysis, return flows were considered for the Public Supply (PS) and Crop Irrigation (CI) demand sectors. In the H2O tool, the return flow percentage is applied to the minimum monthly PS demand (indoor use only) of a given basin and the return flows are based on the full demand for all other

sectors. Return flows are modeled to return to the physically available surface water supply for use in downstream basins.

The return flow percentages for PS demand were estimated based on the discharge method used by the wastewater facilities prevalent in each basin (e.g., surface water discharge, lagoon, land application, or septic system). It was assumed that evaporation facilities generated no return flows; land application facilities generated return flows equal to 50 percent of the lowest month's demand; and surface water discharge facilities generated return flows equal to 95 percent of the lowest month's demand. Return flows from basins with multiple treatment facilities were determined based on the number of facilities for each discharge type, since information on the size of the facilities was not directly available. The resulting return flow percentage is used in the H2O Tool dataset to calculate PS return flow volumes by basin. PS return flows were added to the surface water available in the basin of origin after in basin demands are accounted for so that the return flows are reflected in the surface water leaving the basin and available for downstream basins. The basin PS return flow percentages are presented in Table 6.

Table 6 Return Flow Percentages by Basin and Demand Sector

Basin No.	Basin ID	Basin Name	Public Supply	Self Supplied Residential	Oil & Gas	Self Supplied Industrial	Thermo-electric Power	Livestock	CI
1	10100	Red River Mainstem (To Kiamichi River)	51%	0%	0%	0%	0%	0%	10%
2	10201	Little River (McCurtain County) - 1	57%	0%	0%	0%	0%	0%	10%
3	10202	Little River (McCurtain County) - 2	63%	0%	0%	0%	0%	0%	10%
4	10203	Little River (McCurtain County) - 3	95%	0%	0%	0%	0%	0%	10%
5	10301	Kiamichi River - 1	95%	0%	0%	0%	0%	0%	10%
6	10302	Kiamichi River - 2	95%	0%	0%	0%	0%	0%	10%
7	10411	Muddy Boggy River - 1	95%	0%	0%	0%	0%	0%	10%
8	10412	Muddy Boggy River - 2	81%	0%	0%	0%	0%	0%	10%
9	10420	Clear Boggy Creek	56%	0%	0%	0%	0%	0%	10%
10	10500	Red River Mainstem (To Blue River)	63%	0%	0%	0%	0%	0%	10%
11	10601	Blue River - 1	48%	0%	0%	0%	0%	0%	10%
12	10602	Blue River - 2	48%	0%	0%	0%	0%	0%	10%
13	10700	Red River Mainstem (To Washita)	95%	0%	0%	0%	0%	0%	10%

Basin No.	Basin ID	Basin Name	Public Supply	Self Supplied Residential	Oil & Gas	Self Supplied Industrial	Thermo-electric Power	Livestock	CI
14	10810	Lower Washita	41%	0%	0%	0%	0%	0%	10%
15	10821	Middle Washita - 1	95%	0%	0%	0%	0%	0%	10%
16	10822	Middle Washita - 2	59%	0%	0%	0%	0%	0%	10%
17	10831	Upper Washita - 1	95%	0%	0%	0%	0%	0%	10%
18	10832	Upper Washita - 2	0%	0%	0%	0%	0%	0%	10%
19	10833	Upper Washita - 3	46%	0%	0%	0%	0%	0%	10%
20	10840	Washita Headwaters	48%	0%	0%	0%	0%	0%	10%
21	10900	Red River Mainstem (To Walnut Bayou)	52%	0%	0%	0%	0%	0%	10%
22	11000	Walnut Bayou	84%	0%	0%	0%	0%	0%	10%
23	11100	Mud Creek	41%	0%	0%	0%	0%	0%	10%
24	11201	Beaver Creek - 1	16%	0%	0%	0%	0%	0%	10%
25	11202	Beaver Creek - 2	5%	0%	0%	0%	0%	0%	10%
26	11203	Beaver Creek - 3	84%	0%	0%	0%	0%	0%	10%
27	11311	Cache Creek - 1	0%	0%	0%	0%	0%	0%	10%
28	11312	Cache Creek - 2	33%	0%	0%	0%	0%	0%	10%
29	11321	Deep Red Creek and West Cache Creek - 1	35%	0%	0%	0%	0%	0%	10%
30	11322	Deep Red Creek and West Cache Creek - 2	27%	0%	0%	0%	0%	0%	10%
31	11400	Red River Mainstem (To North Fork of Red)	52%	0%	0%	0%	0%	0%	10%
32	11511	Lower North Fork Red River - 1	0%	0%	0%	0%	0%	0%	10%
33	11512	Lower North Fork Red River - 2	43%	0%	0%	0%	0%	0%	10%
34	11513	Lower North Fork Red River - 3	19%	0%	0%	0%	0%	0%	10%
35	11514	Lower North Fork Red River - 4	0%	0%	0%	0%	0%	0%	10%
36	11521	Upper North Fork Red River - 1	71%	0%	0%	0%	0%	0%	10%

Basin No.	Basin ID	Basin Name	Public Supply	Self Supplied Residential	Oil & Gas	Self Supplied Industrial	Thermo-electric Power	Livestock	CI
37	11522	Upper North Fork Red River - 2	26%	0%	0%	0%	0%	0%	10%
38	11601	Salt Fork Red River - 1	48%	0%	0%	0%	0%	0%	10%
39	11602	Salt Fork Red River - 2	0%	0%	0%	0%	0%	0%	10%
40	11701	Prairie Dog Town Fork Red River - 1	0%	0%	0%	0%	0%	0%	10%
41	11702	Prairie Dog Town Fork Red River - 2	63%	0%	0%	0%	0%	0%	10%
42	11801	Elm Fork Red River - 1	95%	0%	0%	0%	0%	0%	10%
43	11802	Elm Fork Red River - 2	0%	0%	0%	0%	0%	0%	10%
44	20101	Poteau River - 1	95%	0%	0%	0%	0%	0%	10%
45	20102	Poteau River - 2	93%	0%	0%	0%	0%	0%	10%
46	20201	Lower Arkansas River - 1	84%	0%	0%	0%	0%	0%	10%
47	20202	Lower Arkansas River - 2	63%	0%	0%	0%	0%	0%	10%
48	20300	Canadian River (To North Canadian River)	64%	0%	0%	0%	0%	0%	10%
49	20400	Middle Arkansas River	42%	0%	0%	0%	0%	0%	10%
50	20510	Lower North Canadian River	35%	0%	0%	0%	0%	0%	10%
51	20520	Middle North Canadian River	22%	0%	0%	0%	0%	0%	10%
52	20531	Upper North Canadian River - 1	5%	0%	0%	0%	0%	0%	10%
53	20532	Upper North Canadian River - 2	15%	0%	0%	0%	0%	0%	10%
54	20533	Upper North Canadian River - 3	0%	0%	0%	0%	0%	0%	10%
55	20540	North Canadian Headwaters	3%	0%	0%	0%	0%	0%	10%
56	20611	Lower Canadian River - 1	23%	0%	0%	0%	0%	0%	10%

Basin No.	Basin ID	Basin Name	Public Supply	Self Supplied Residential	Oil & Gas	Self Supplied Industrial	Thermo-electric Power	Livestock	CI
57	20612	Lower Canadian River - 2	15%	0%	0%	0%	0%	0%	10%
58	20620	Middle Canadian River	31%	0%	0%	0%	0%	0%	10%
59	20630	Upper Canadian River	17%	0%	0%	0%	0%	0%	10%
60	20700	Deep Fork River	15%	0%	0%	0%	0%	0%	10%
61	20801	Little River - 1	79%	0%	0%	0%	0%	0%	10%
62	20802	Little River - 2	5%	0%	0%	0%	0%	0%	10%
63	20910	Lower Cimarron River	59%	0%	0%	0%	0%	0%	10%
64	20920	Middle Cimarron River	29%	0%	0%	0%	0%	0%	10%
65	20930	Upper Cimarron River	22%	0%	0%	0%	0%	0%	10%
66	20940	Cimarron Headwaters	0%	0%	0%	0%	0%	0%	10%
67	21011	Lower Salt Fork Arkansas River - 1	25%	0%	0%	0%	0%	0%	10%
68	21020	Upper Salt Fork Arkansas River	22%	0%	0%	0%	0%	0%	10%
69	21012	Lower Salt Fork Arkansas River - 2	24%	0%	0%	0%	0%	0%	10%
70	21013	Lower Salt Fork Arkansas River - 3	0%	0%	0%	0%	0%	0%	10%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	55%	0%	0%	0%	0%	0%	10%
72	21200	Arkansas River Mainstem (To Kansas State Line)	50%	0%	0%	0%	0%	0%	10%
73	21301	Bird Creek - 1	39%	0%	0%	0%	0%	0%	10%
74	21302	Bird Creek - 2	32%	0%	0%	0%	0%	0%	10%
75	21401	Caney River - 1	14%	0%	0%	0%	0%	0%	10%
76	21402	Caney River - 2	21%	0%	0%	0%	0%	0%	10%
77	21511	Verdigris River (To Oologah Dam) - 1	74%	0%	0%	0%	0%	0%	10%

Basin No.	Basin ID	Basin Name	Public Supply	Self Supplied Residential	Oil & Gas	Self Supplied Industrial	Thermo-electric Power	Livestock	CI
78	21512	Verdigris River (To Oologah Dam) - 2	60%	0%	0%	0%	0%	0%	10%
79	21520	Verdigris River (To Kansas State Line)	89%	0%	0%	0%	0%	0%	10%
80	21601	Grand (Neosho) River - 1	76%	0%	0%	0%	0%	0%	10%
81	21602	Grand (Neosho) River - 2	89%	0%	0%	0%	0%	0%	10%
82	21700	Illinois River	59%	0%	0%	0%	0%	0%	10%

Based on a review of available literature, CI return flows were estimated for state-wide analyses at 10 percent of the total demand. The return flow represents the portion of the demand that is not evaporated, transpired, or lost to bedrock groundwater.

The thermoelectric demand sector uses consumptive demands as described in the Water Demand Forecast report available on OWRB's Water Planning website (<https://oklahoma.gov/owrb/water-planning.html>).

3.5 Future Interbasin Supplies

Future interbasin supplies (water withdrawn in one basin and used in another basin) were accounted for as a supply to the receiving basin and as a demand on the basin of origin. Existing interbasin supplies are implicitly represented in the streamflow record; therefore, only the incremental increase in interbasin supplies was used in the H2O Tool. Incremental future interbasin supply transfers were determined from available OWRB permitting and GIS information. Incremental interbasin supplies were estimated by subtracting the future demand from the 2020 demand. Future interbasin transfer flows were assumed to be limited to the permitted amount of existing interbasin transfers or the receiving basin's projected increase in demand, whichever is less. Table 7 summarizes the maximum amount (permit volume) of water available to be transferred into the basin. The actual amount of water transferred depends on the streamflow available in any given year.

Table 7 Interbasin Supplies by Basin

Permit No.	Permit Holder	Source Basin	Use Basin
19050005	Anadarko, City of	17	16, 17
19510128	Fort Cobb Reservoir Master Conservancy District	18	16, 17
19690030	Frederick, City of	30	31
19670560	International Paper	3	1
19670671	Mountain Park Master Conservancy District	35	33, 38
19260006	Altus, City of	36	33, 38
19880007	Southwest Soil & Water Conservation District	41 and 40	N/A

Permit No.	Permit Holder	Source Basin	Use Basin
19390055	Oklahoma City, City of	51	50, 51, 58, 60, 62, 64
19820119	Oklahoma City, City of	51	50, 51, 58, 60, 62, 64
20110009	Cimarex Energy Co	51	51, 58, 59, 64
20190047	Tri-City Construction, Inc.	58	16
20190048	Tri-City Construction, Inc.	58	16
20190050	Tri-City Construction, Inc.	58	16
20160017	Shelton, Robert L	64	63, 64
20160030	Ovintiv USA, Inc.	64	63, 64
20170001	Five - G - Water	64	51, 58, 63, 64
19640884	Chelsea, Town of	79	80
19760001	Rogers Co Rural Water District #4	79	75, 76, 78, 79
19760094	Rogers Co Rural Water District #3	79	73, 75, 78, 79, 80
19770162	Claremore, City of	79	78
19780063R	Broken Arrow, City of	79	49, 73, 77, 78
20130038	Washington Co Rural Water District #3	79	73, 74, 75
19540517	Tulsa Metropolitan Utility Auth	79	49, 73, 77, 78
19570115	Collinsville, City of	79	75
19650363	Waurika Lake Project Master Conservancy District	25	24, 25, 26, 28, 31
19830041	Waurika Lake Project Master Conservancy District	25	24, 25, 26, 28, 31
19550061	Duncan, City of	14	25, 26
19550278	Duncan, City of	14	25, 26
19620028	Duncan, City of	14	25, 26
19650046	Ardmore, City of	14	14, 21
19650047	Ardmore, City of	14	14, 21
19680181	Duncan, City of	14	25, 26
19680182	Duncan, City of	14	25, 26
19710468	Lindsay, City of	14	15
19810093	South Central Oklahoma Water Association	14	14, 15, 16, 23, 24, 25, 26
19890003	Duncan, City of	14	25, 26
20140076	Duncan, City of	14	25, 26
20180046	Ovintiv Mid-Continent, Inc.	14	14, 15, 23, 25, 26
20140002	Continental Resources, Inc.	15	14, 15, 16, 23, 25, 26
19810021	Holdenville, City of	56	48, 56
19760011	Holdenville, City of	56	48, 56
20170034	Laze, LLC	57	15, 56, 57
20180085	Bluefin Water Solutions, LLC	57	15, 56, 57

Permit No.	Permit Holder	Source Basin	Use Basin
20180094	Snell, Robert Clay	57	15, 56, 57, 58, 62
20190008	Bluefin Water Solutions, LLC	57	15, 56, 57
20190010	Bluefin Water Solutions, LLC	57	15, 56, 57
20190024	Bluefin Water Solutions, LLC	57	14, 15, 16, 56, 57
19650637	Central Oklahoma Master Conservancy District	62	50, 58, 62
20100001	Norman, City of	62	58, 62
19760057	Pottawatomie Co Development Authority	50	50, 62
19740175	Edmond, City of	60	60, 64
19840039	Okemah, City of	60	50, 60
20110066	Edmond, City of	60	60, 64
20140037	Pierce, Earl Allen	63	63, 64, 68, 71, 72
20170051	Oklahoma Energy Acquisitions LP	63	63, 64
20190054	Coe, Matthew	63	60, 63, 64, 71
19340060	Ponca City, City of	72	67, 72
19690327	Newkirk, City of	72	67
19720491	Stillwater, City of	72	71
19740390	Osage Tribe of Indians	72	72, 74, 76
19810180	City of Enid	72	63, 64, 72
19870031	Tonkawa, City of	72	67, 68
19930034	Ponca City, City of	72	67, 72
19930035	Ponca City, City of	72	67, 72
20030001	Perkins PWA	72	63
20140047	City of Enid	72	63, 64, 72
19810193	Phillips 66 Company	67	67, 72
19660293	Sand Springs, City of	74	49
19740120	Sapulpa, City of	74	49
19760013	Osage Co RWD #15	74	74
19760049	Rogers Co Rural Water District #4	74	75, 76, 78, 79
19770169	Washington Co Rural Water District #3	74	73, 74, 75
19740120A	Sand Springs, City of	74	49
20030042	Washington Co Rural Water District #3	75	73, 74, 75
20130009	Fugate, John Bret	73	73, 74
19640789	Creek Co Rural Water District #1	49	49, 60
19660568	Haskell County Water Corporation	48	45, 46, 47, 48
19810098	Checotah, City of	48	47
20000018	Juniper Water Company, LLC	48	8

Permit No.	Permit Holder	Source Basin	Use Basin
20000040	Juniper Water Company, LLC	48	8
20060057	Checotah, City of	48	47
20070017	Oklahoma City, City of	6	50, 51, 58, 60, 62, 64
19540613	Oklahoma City, City of	8	50, 51, 58, 60, 62, 64
19680042	Midwest City, City of	8	50
19680104	Ada, City of	8	9, 56
19730176	Moore, City of	8	58, 62
19800048	Oklahoma City, City of	8	50, 51, 58, 60, 62, 64
19730282B	County Commissioners of Atoka Co	8	7, 9, 10
20020014	Hefley, Gay	7	7, 10
19590157	Ada, City of	9	9, 56
19800107	Ada, City of	9	9, 56
19770025	Bryan County RWS & SWM #2	12	12, 21
20210015	Adams, Gary Chad and Kimberly K	10	5, 10
19720249	Durant City Utility Authority	13	12, 13
19660337	McCurtain Co Rural Water District #1	2	1, 2, 3
19550764	Idabel Public Works Authority	3	1, 2, 3
19800132	Valliant, City of	3	1, 3
19820137	Idabel Public Works Authority	3	1, 2, 3
19820105	Broken Bow Public Works Authority	4	3, 4
19860015	Broken Bow Public Works Authority	4	3, 4
19910001	Latimer Co Rural Water District #1	45	45, 48
20140014	Stigler, City of	46	47
19630131	Broken Arrow, City of	77	49, 73, 77, 78
19780063	Broken Arrow, City of	77	49, 73, 77, 78
19800184	Coweta, City of	77	49, 77
19910022	Wagoner Co Rural Water District #4	77	49, 77
20000035	Wagoner Co Rural Water District #4	77	49, 77
20040011	Wagoner Co Rural Water District #5	77	49, 77
20110032	Phillips Farms LLC	77	77, 80
20200008	Ten Point Farms LLC	77	49, 77
19800006	Washington Co Rural Water District #3	78	73, 74, 75
19880006	Rogers Co Rural Water District #3	78	73, 75, 78, 79, 80
19900001	Rogers Co Rural Water District #5	78	73, 77, 78
20020005	Rogers Co Rural Water District #5	78	73, 77, 78
19700139	Sallisaw, City of	82	46

Permit No.	Permit Holder	Source Basin	Use Basin
19710110	Muskogee, City of	82	47, 49
19790060	Broken Arrow, City of	82	49, 73, 77, 78
19790107	Sallisaw, City of	82	46
19800029	East Central Okla Water Authority	82	47, 82
19890052	Gore Public Works Authority	82	47, 82
20030028	Tenkiller Utilities Authority	82	46, 49, 80, 82
19820020A	Stick Ross Mountain Water Co, Inc.	82	47, 80, 82
19220033	Tulsa Metropolitan Utility Authority	80	49, 73, 77, 78
19320030	Muskogee, City of	82	47, 49
19320034	Wagoner, City of	80	77
19350064	Fort Gibson, Town of	80	47
19760120	Fort Gibson, Town of	80	47
19320032	Vinita, City of	81	80
19260006	Lugert Altus Irrigation District	36	33, 38

SECTION 4 PHYSICAL WATER SUPPLY AVAILABILITY RESULTS

The primary objectives of the physical supply availability analysis are to characterize statewide physical water supply availability through the 2075 planning horizon, compare these supply projections with demand projections, and quantify anticipated gaps in physical supply. This section describes the basis of the analyses, the results of the analyses, and known limitations of the methods and results.

4.1 Basis of Physical Water Supply Availability

The H2O Tool provides the ability to analyze any of a number of scenarios and potential future conditions. The following conditions were used to assess the baseline physical supply availability.

- The return flows from a given basin are delivered to the next downstream basin.
- The change in upstream demand affects the supply availability downstream. For example, return flows generated in a basin will continue to flow downstream until the supply is depleted.
- Supplies in BGW aquifers are not hydrologically connected to surface water.
- Existing interbasin supplies were used to satisfy the receiving basin's incremental demand (2030 to 2075) up to the permitted transfer capacity or the 2075 demand in the receiving basin, whichever is less.
- Future demand is supplied by water from the basin that generates the demand (i.e., the analysis characterized the gap that would be expected to occur if all new demand was satisfied with local sources and existing interbasin supplies).
- All effects of well pumping remain in the basin where a well is located.

Within each planning basin, a mass balance of the incremental surface water supplies, AGW supplies, and BGW supplies is evaluated with the basins' projected demands for a planning period. The following three fundamental equations of the 2025 Model were employed to calculate surface water supply gaps and AGW and BGW aquifer depletions

$$\text{SW Monthly Gap} = \text{SW Gage Data} + \text{SW Transfers into Basin} - \text{SW Transfers Out of Basin} - \Delta \text{SW Demand} - \Delta \text{Reservoir Volume} + \text{Return Flows}$$

$$\text{AGW Monthly Storage Depletions} = \text{AGW recharge from SW (1:1 rate)} - \Delta \text{AGW Demand}$$

$$\text{BGW Monthly Storage Depletions} = (\text{BGW Annual Average Recharge}/12 - \text{Existing BGW Pumping}) - \Delta \text{BGW Demand}$$

$$\text{Annual Gap or Depletion} = \text{Sum of Monthly Gaps or Depletions}$$

Where "Δ Demand" terms refer to incremental demand (future – current) for the planning decade. SW = surface water. Annual gap or depletion values reflect only months with deficits and do not offset shortages with surplus from other months.

For the above equations, a value less than zero represents a surface water gap or a AGW or BGW aquifer depletion. For the surface water gap equation, a value greater than zero represents a surface water surplus. The AGW and BGW storage depletion equations are valid when demand is greater than recharge, and equal to zero when demand is less than recharge.

The OCWP looks at monthly and annual maximum surface water gaps and groundwater depletions. The maximum monthly gap is the largest gap for a given month over the period of record. The maximum annual gap is the largest sum of monthly gaps for a given year. For the 2030 planning horizon, the change in demand (2030 demand minus 2020 demand) is subtracted from the available supply (historical hydrology) to estimate the gap or depletion. Similarly, for the 2075 planning horizon, the change in demand (2075 demand minus 2020 demand) is subtracted from the available supply (historical hydrology) to estimate the gap or depletion.

AGW and BGW values are referred to as storage depletions rather than gaps because each aquifer has a certain amount of available storage that may be used before there is no remaining supply. A BGW storage depletion is assumed to occur if the demand exceeds the aquifer recharge rate, and an AGW storage depletion is assumed to occur if the AGW demand exceeds the available streamflow after the surface water demand has been subtracted.

None of the analyses presented herein are intended to indicate the legal availability of water under Oklahoma's existing water administrative system. Rather, these analyses focus on the physical availability of surface water and groundwater supplies. Analyses of the amounts of water that could be permitted for use, by basin, are documented separately.

4.2 Physical Water Supply Availability Results

Recognizing that conditions vary substantially from one area to another in any given year, the entire period of record for streamflows from water years 1950 through 2020 was used to examine the anticipated probability of surface water gaps.

AGW aquifers have a hydrologic connection with the overlying streams and rivers. This connection means that AGW storage depletions can reduce surface water flows. The interaction of AGW storage depletions and surface water flows is complex and changes over time depending on the location and rate of AGW storage depletions and on the surface water flows themselves. Even so, AGW demand from well pumping eventually is supplied by the flow in streams or from recharged water that would have discharged to streams. This analysis incorporates the AGW-surface water connection by attributing all AGW demand to streamflow.

BGW aquifers in Oklahoma, for the most part, do not have a hydrologic connection to overlying surface water. BGW aquifers are replenished slowly by recharge from surface infiltration and from adjacent aquifers. This analysis evaluates BGW storage depletions using projected BGW demand in comparison to the estimates of annual incremental recharge to major BGW aquifers.

The potential for gaps and storage depletions was analyzed for future demand projections, by basin, for planning years 2030, 2035, 2045, 2060, and 2075. Both the magnitude and the probability of supply gaps and storage depletions are important considerations in water supply planning. For instance, many communities or water users would take steps to mitigate shortages if they were anticipated to be high in both magnitude and probability. However, investments in infrastructure to mitigate a low-probability, high-magnitude shortage may not be economically feasible, depending on local conditions and priorities. Conversely, a high-probability, low-magnitude shortage (e.g., less than 500 AFY) might be addressed by demand management measures. Potential solutions for addressing anticipated supply needs are addressed in the Water Management Strategy Assessment report.

The resulting surface water gaps are presented graphically for the planning years 2030 and 2075 demand in Figures 6 through 11. Those figures depict the minimum, median, and maximum surface water gaps that would be anticipated considering the 71-year period of hydrologic record when evaluating supply availability for the 2030 and 2075 incremental demand in each basin.

Figures 12 and 13 illustrate the potential frequency of having a surface water gap of any magnitude in each basin for the 2030 and 2075 baseline demand conditions, respectively.

Similarly, Figures 14 through 19 illustrate the minimum, median, and maximum AGW storage depletions that would be anticipated for the 2030 and 2075 demand when compared to the 71-year period of hydrology, and Figures 20 and 21 illustrate the anticipated probability of AGW storage depletions for the 2030 and 2075 demand.

Figures 22 and 23 illustrate the BGW storage depletions for the 2030 and 2075 incremental demand scenarios based on the incremental recharge rate, respectively.

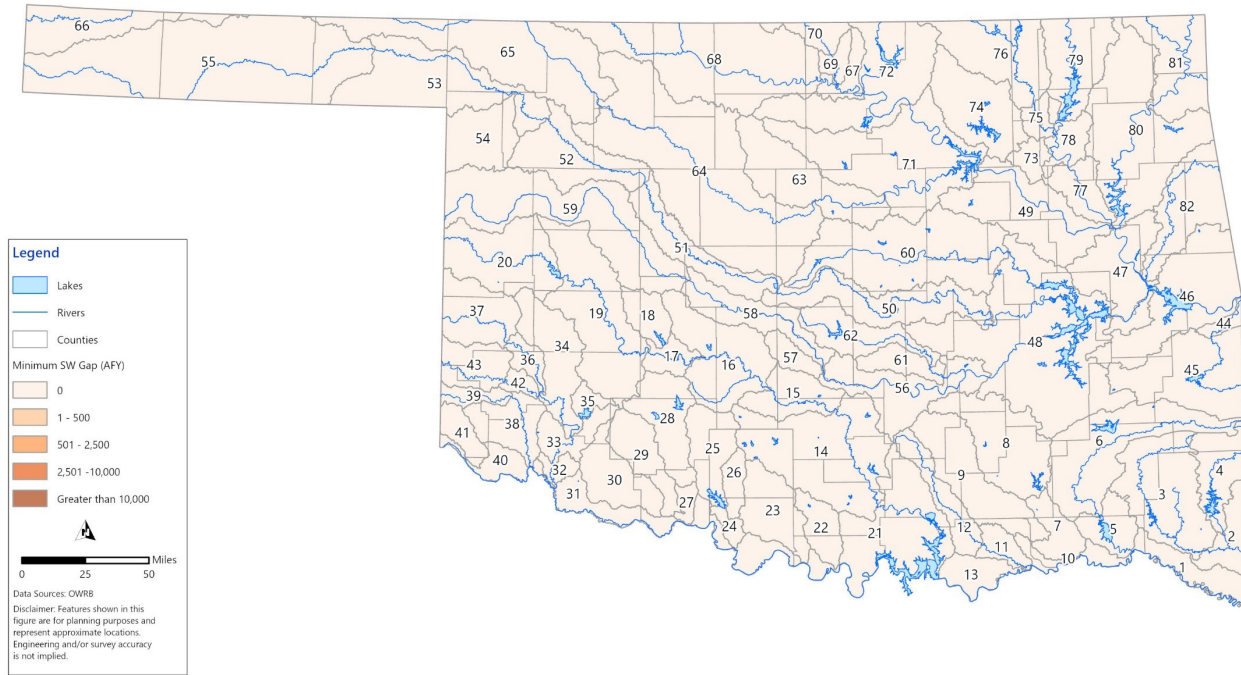


Figure 6 Minimum Annual Surface Water Supply Availability Gaps for 1950 through 2020 Historical Hydrology and 2030 Demands

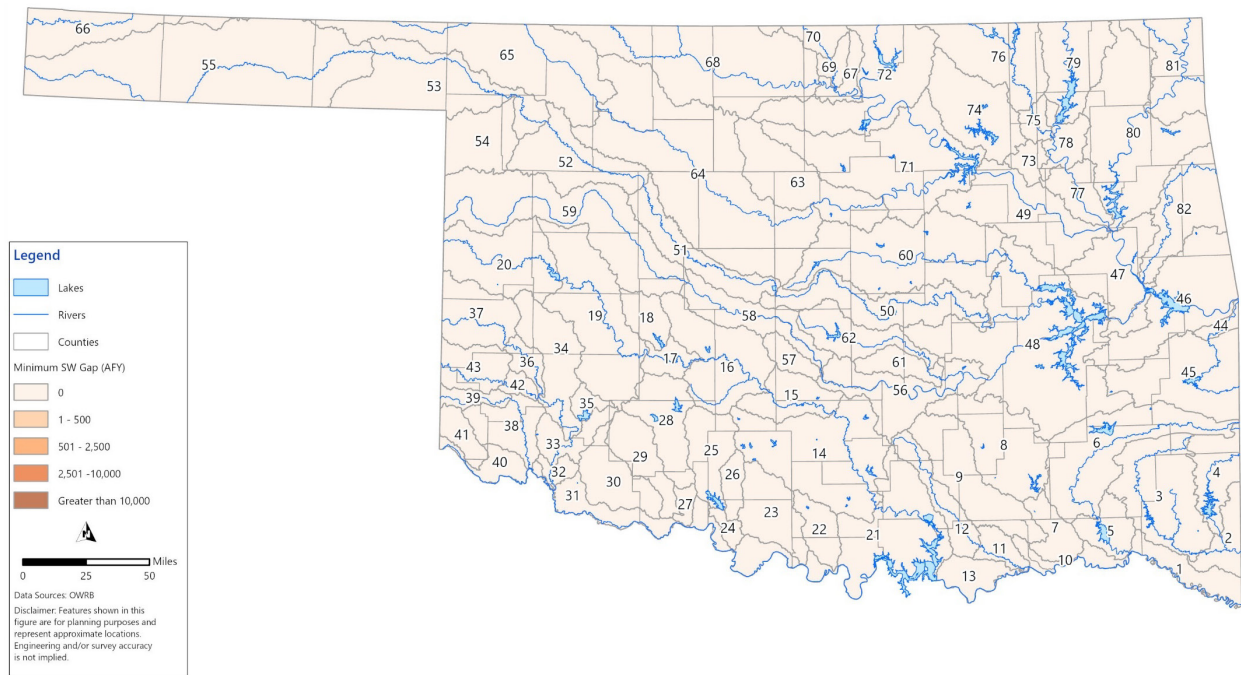


Figure 7 Minimum Annual Surface Water Supply Availability Gaps for 1950 through 2020 Historical Hydrology and 2075 Demands

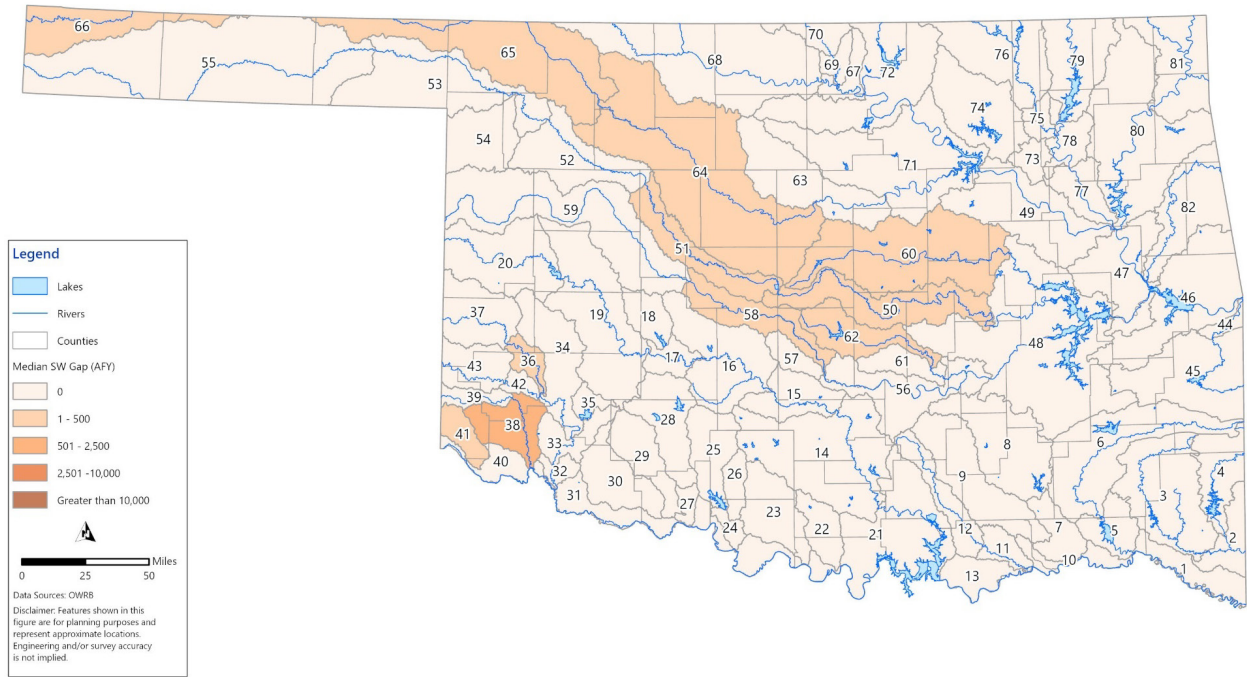


Figure 8 Median Annual Surface Water Supply Availability Gaps for 1950 through 2020 Historical Hydrology and 2030 Demands

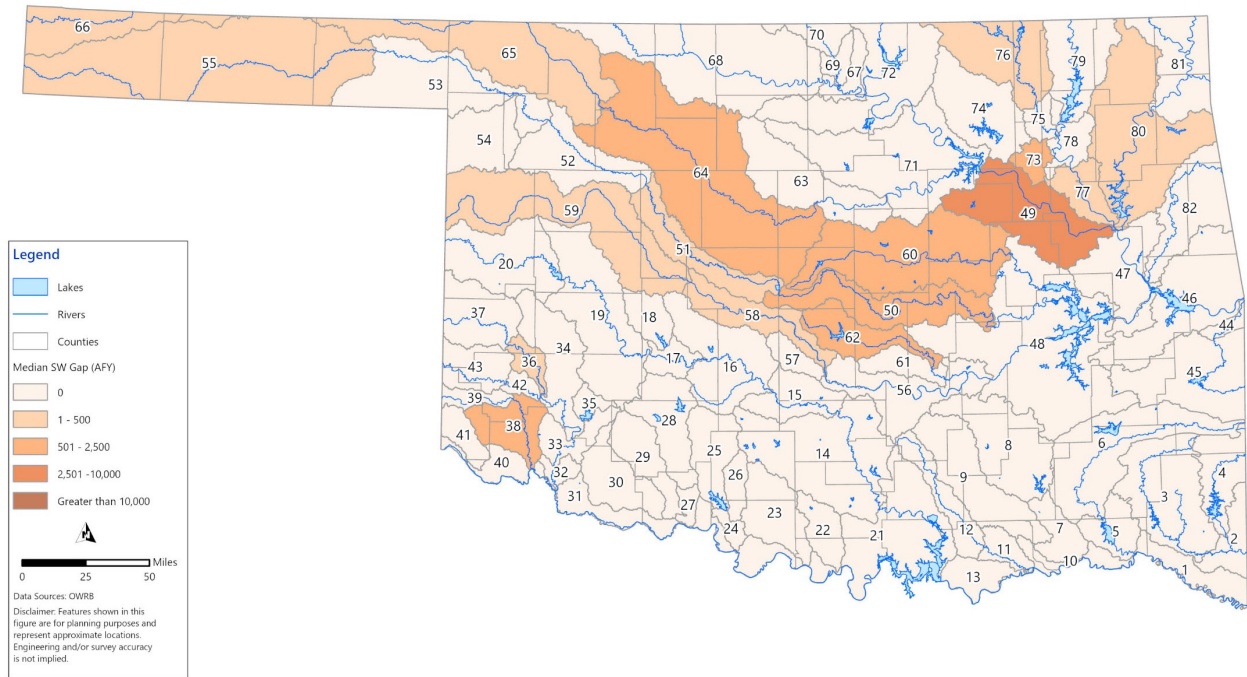


Figure 9 Median Annual Surface Water Supply Availability Gaps for 1950 through 2020 Historical Hydrology and 2075 Demands

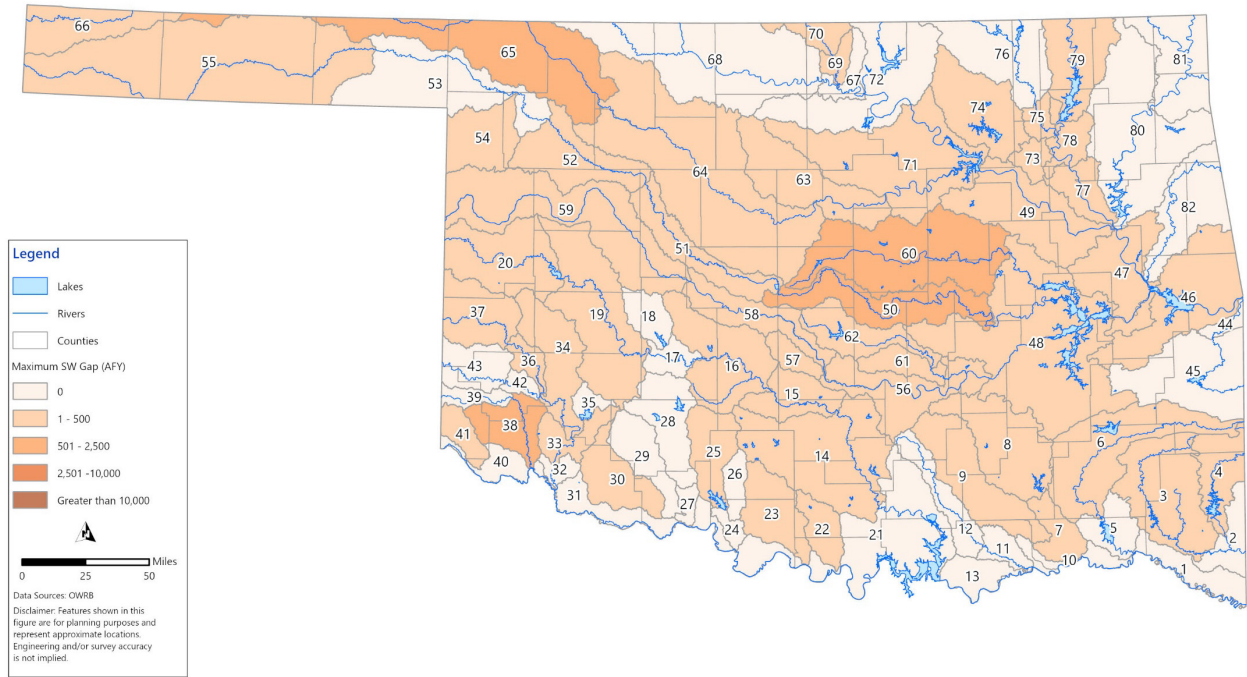


Figure 10 Maximum Annual Surface Water Supply Availability Gap for 1950 through 2020 Historical Hydrology and 2030 Demands

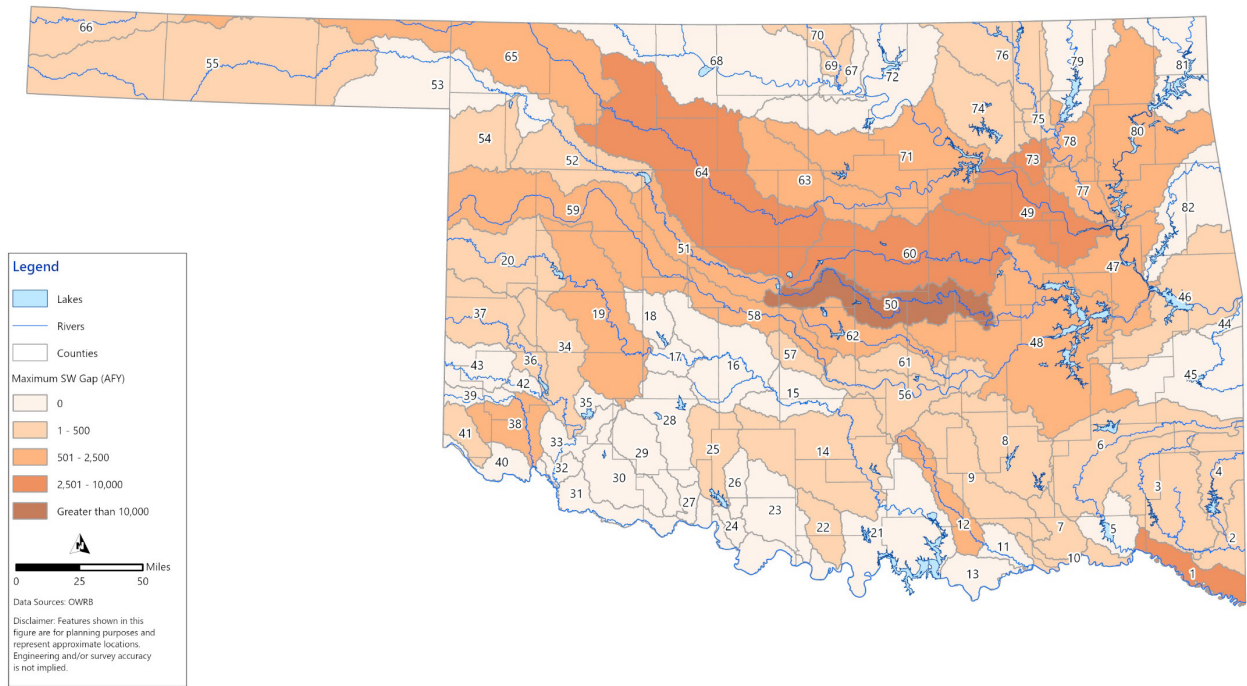


Figure 11 Maximum Annual Surface Water Supply Availability Gap for 1950 through 2020 Historical Hydrology and 2075 Demands

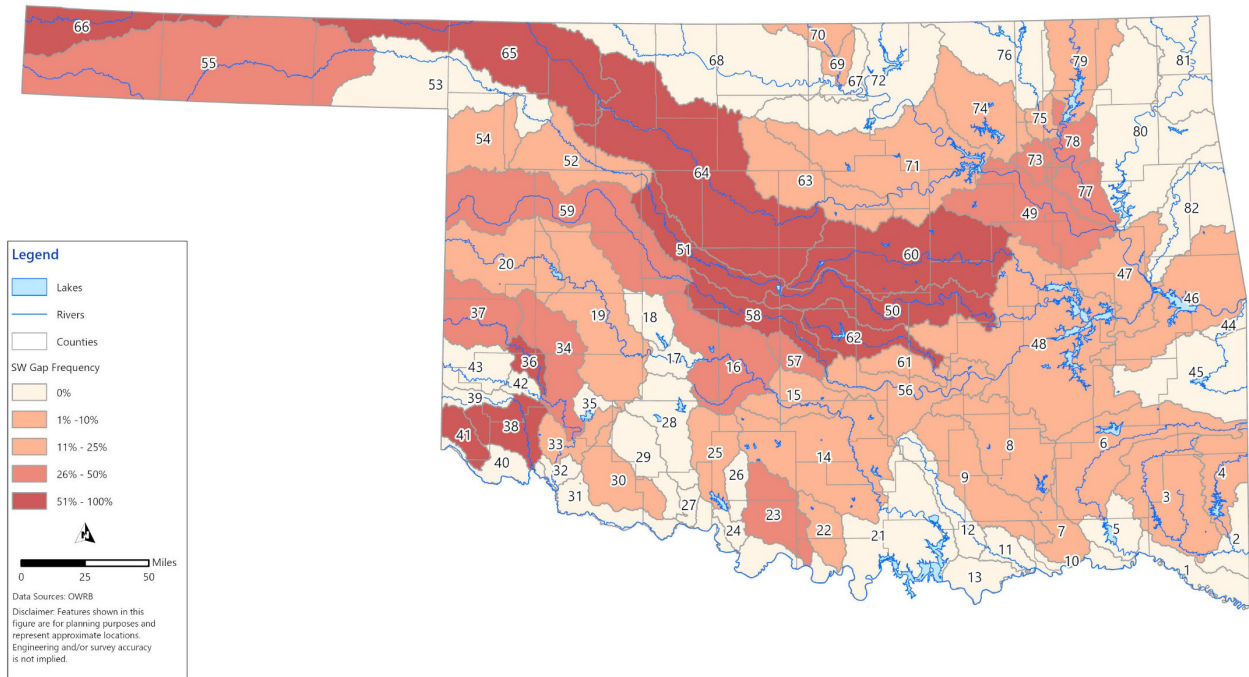


Figure 12 Frequency of Annual Surface Water Supply Gaps for 2030 Demands

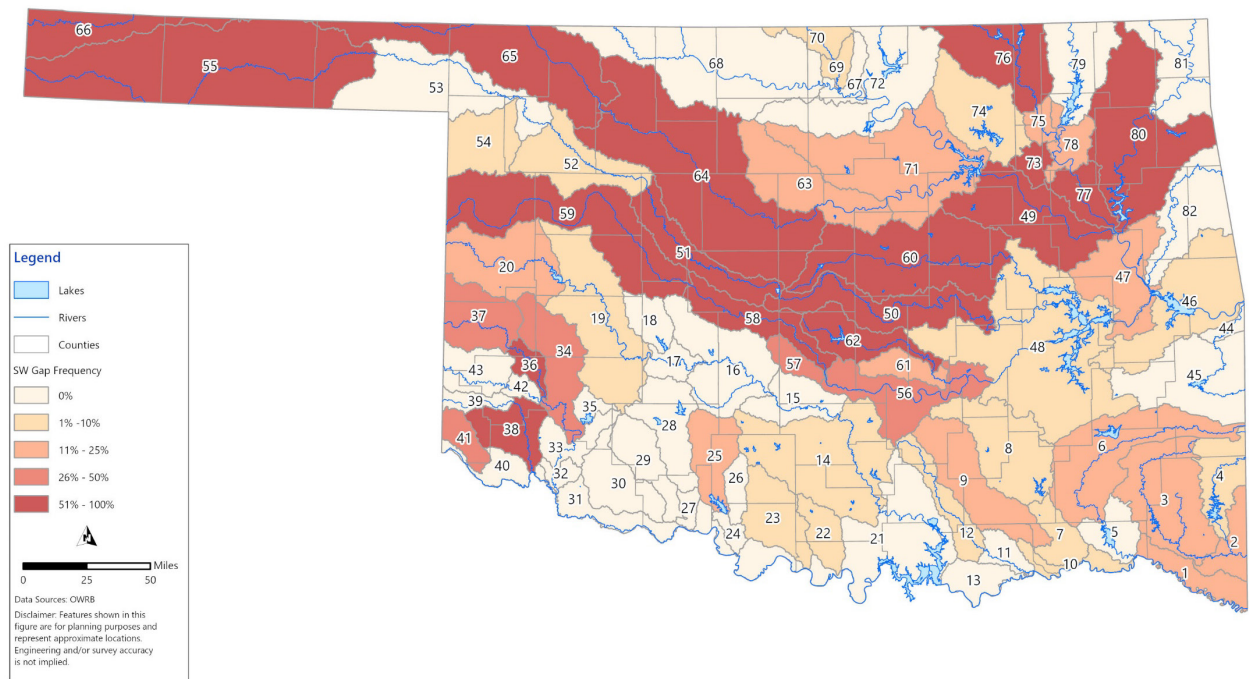


Figure 13 Frequency of Annual Surface Water Supply Gaps for 2075 Demands

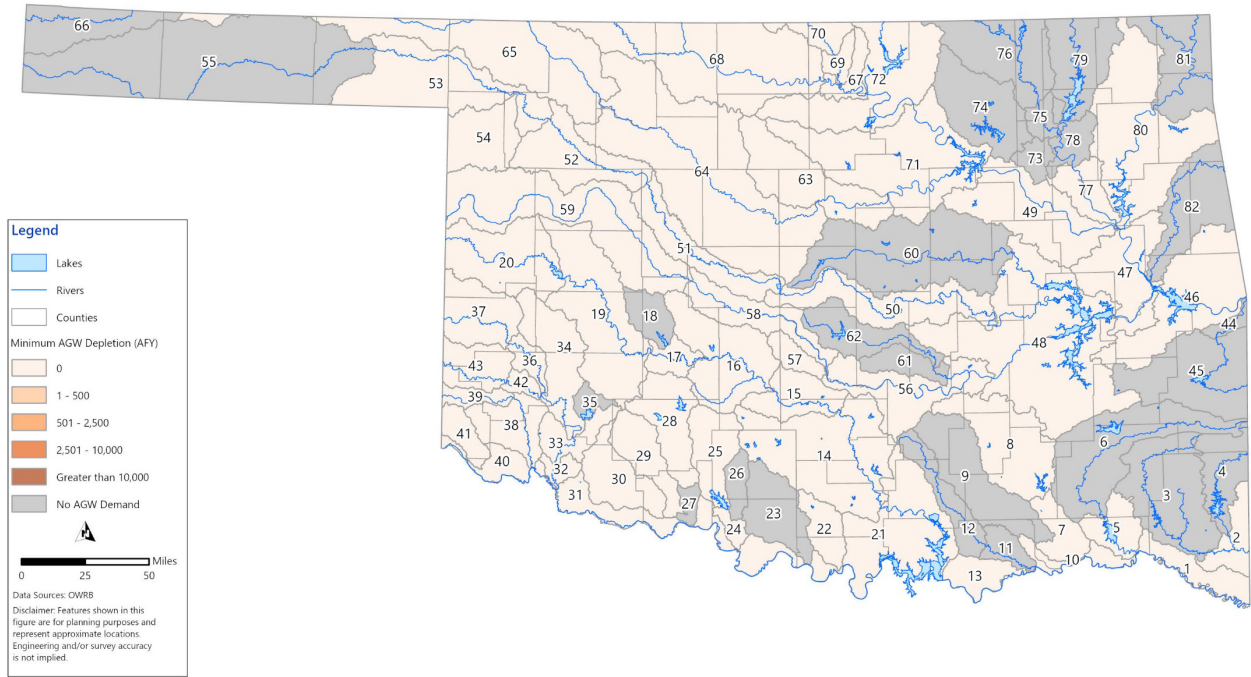


Figure 14 Minimum Annual Alluvial Groundwater Storage Depletions for 1950 through 2020 Historical Hydrology and 2030 Demands

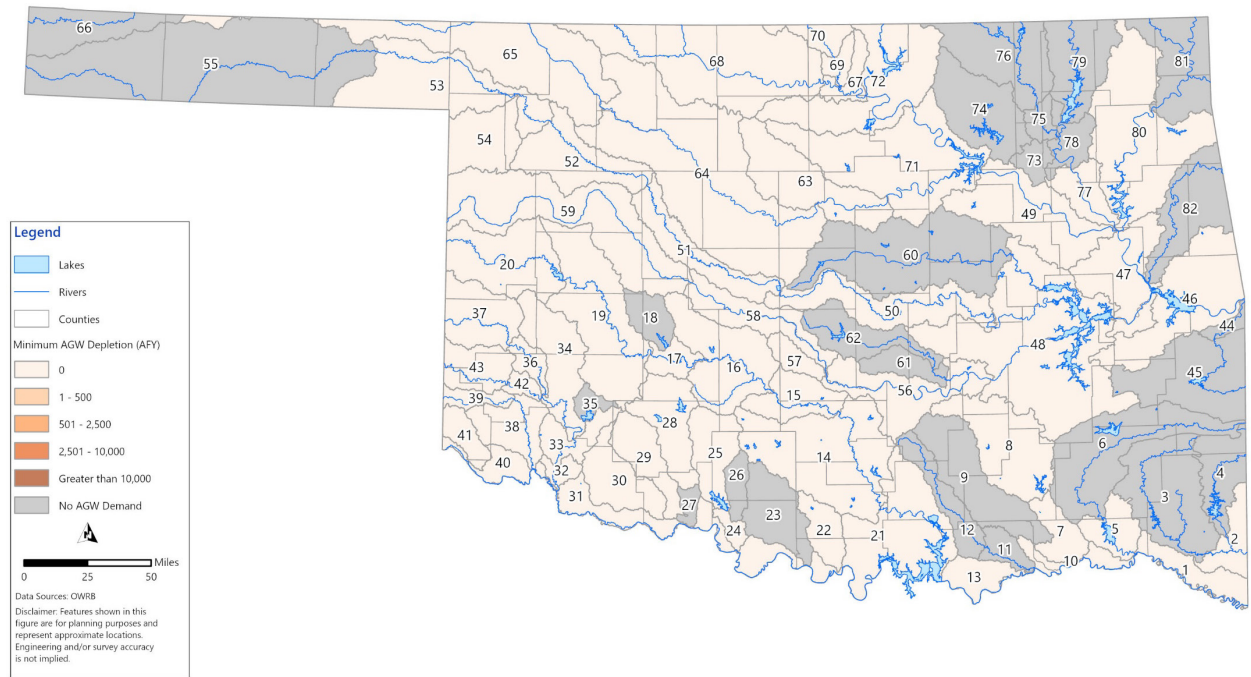


Figure 15 Minimum Annual Alluvial Groundwater Storage Depletions for 1950 through 2020 Historical Hydrology and 2075 Demands

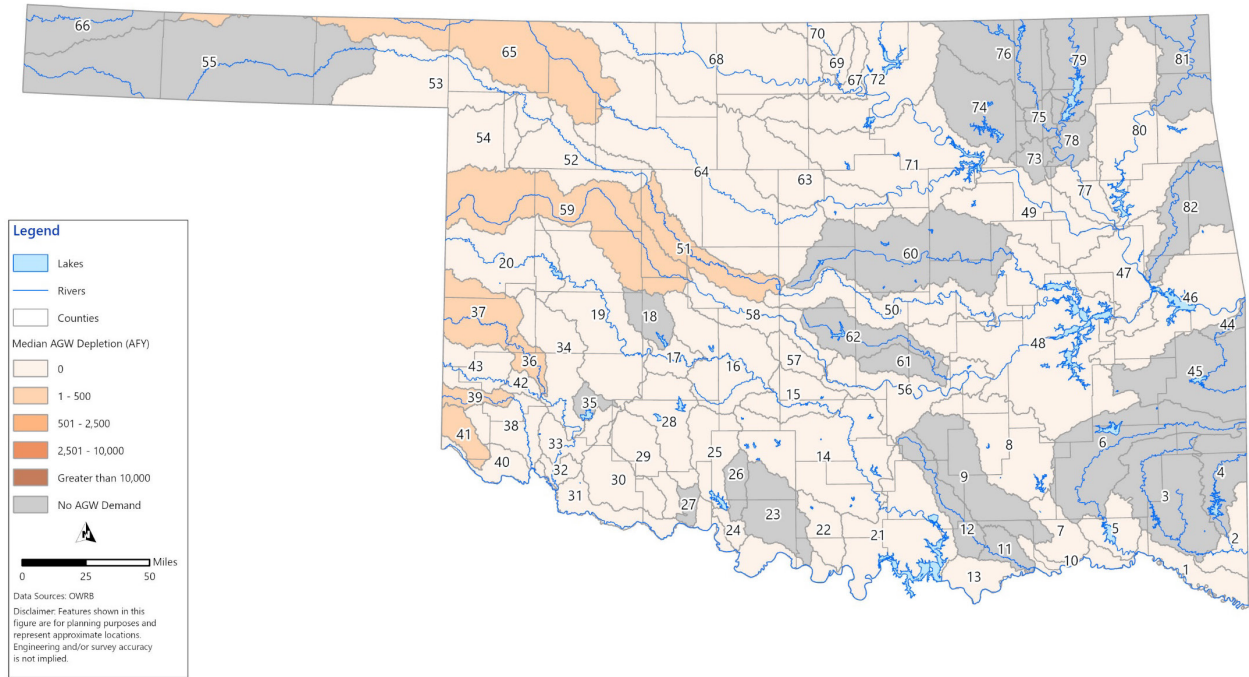


Figure 16 Median Annual Alluvial Groundwater Storage Depletions for 1950 through 2020 Historical Hydrology and 2030 Demands

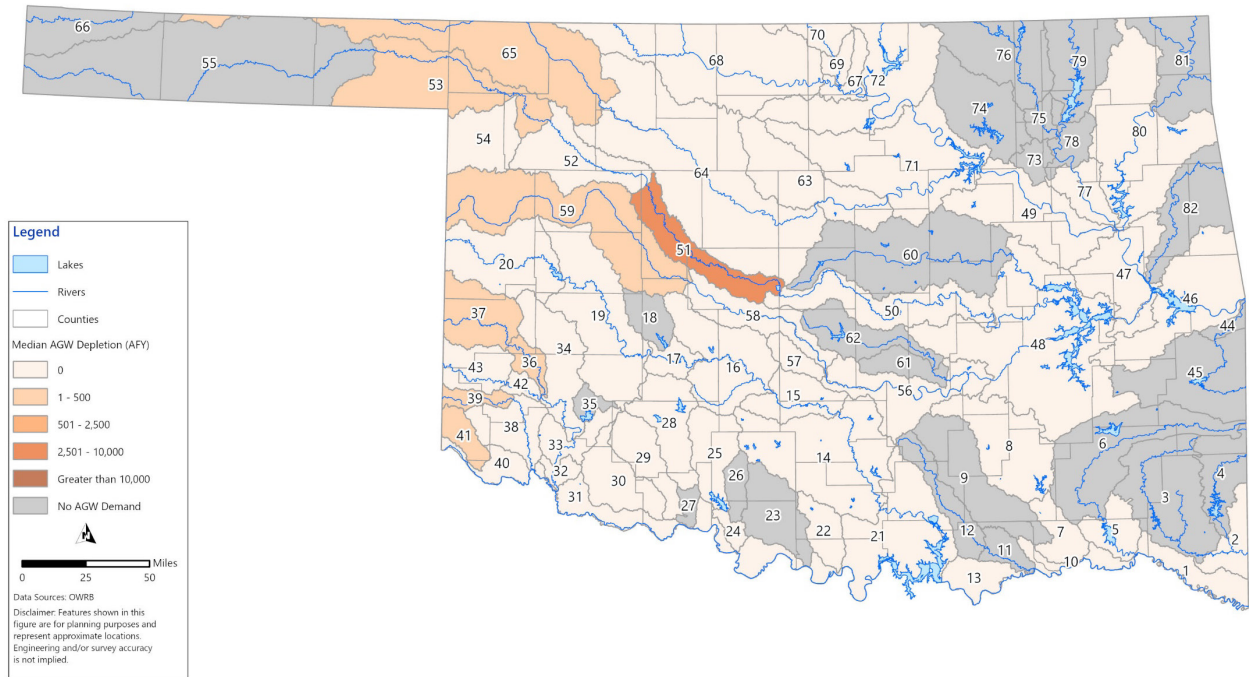


Figure 17 Median Annual Alluvial Groundwater Storage Depletions for 1950 through 2020 Historical Hydrology and 2075 Demands

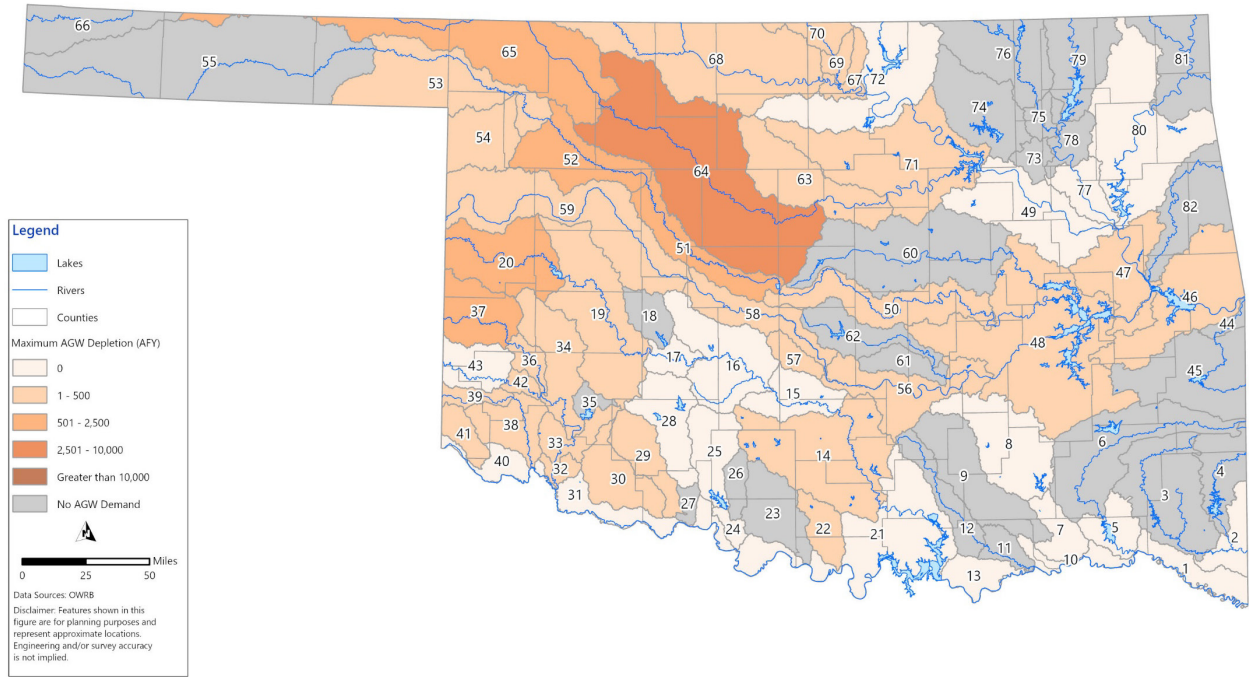


Figure 18 Maximum Annual Alluvial Groundwater Storage Depletions for 1950 through 2020 Historical Hydrology and 2030 Demands

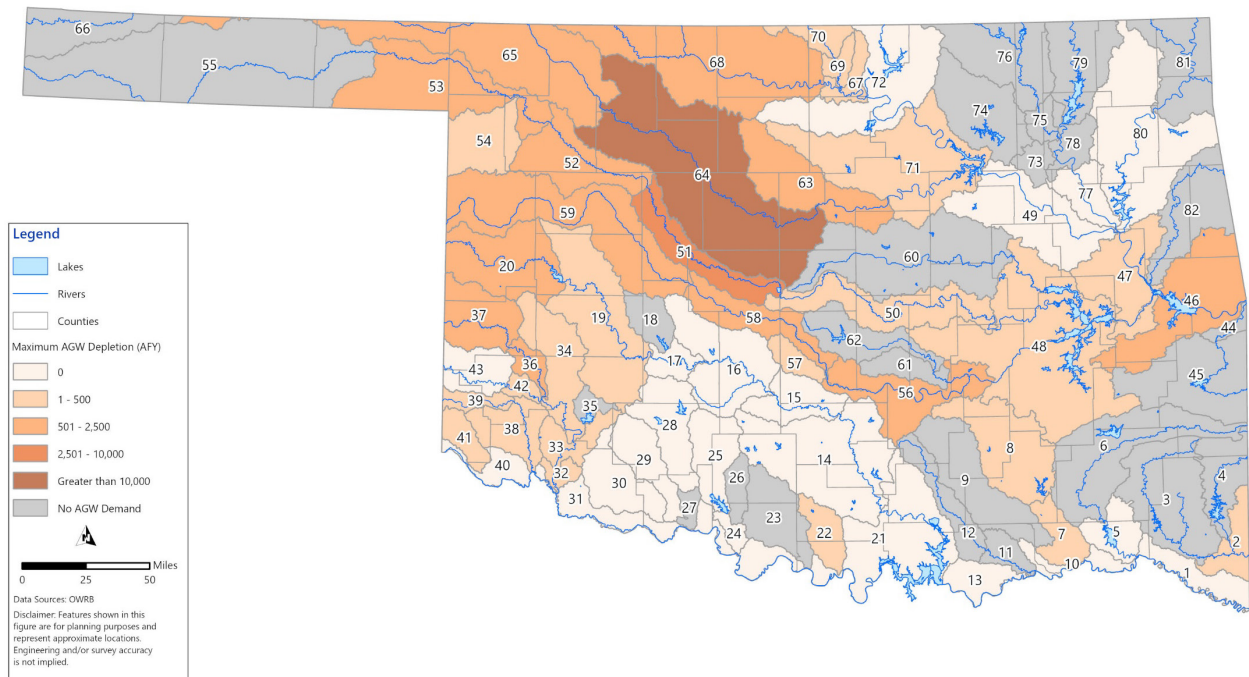


Figure 19 Maximum Annual Alluvial Groundwater Storage Depletions for 1950 through 2020 Historical Hydrology and 2075 Demands

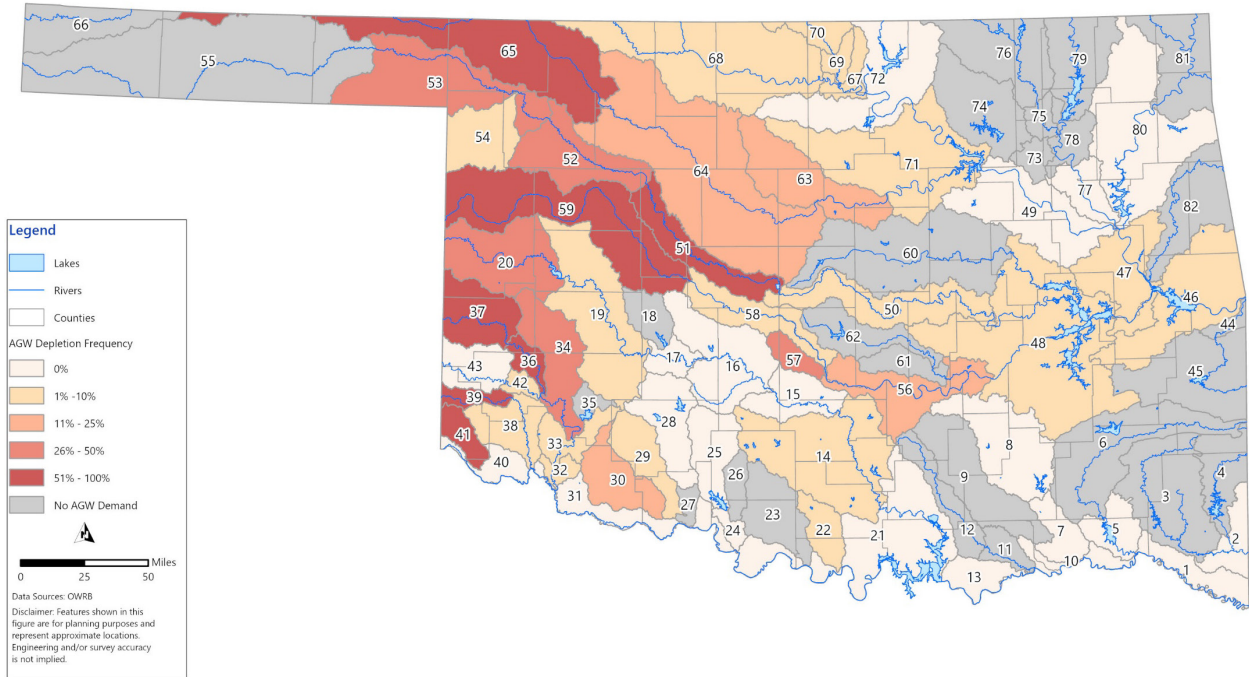


Figure 20 Probability of Annual Alluvial Groundwater Storage Depletions for 2030 Demands

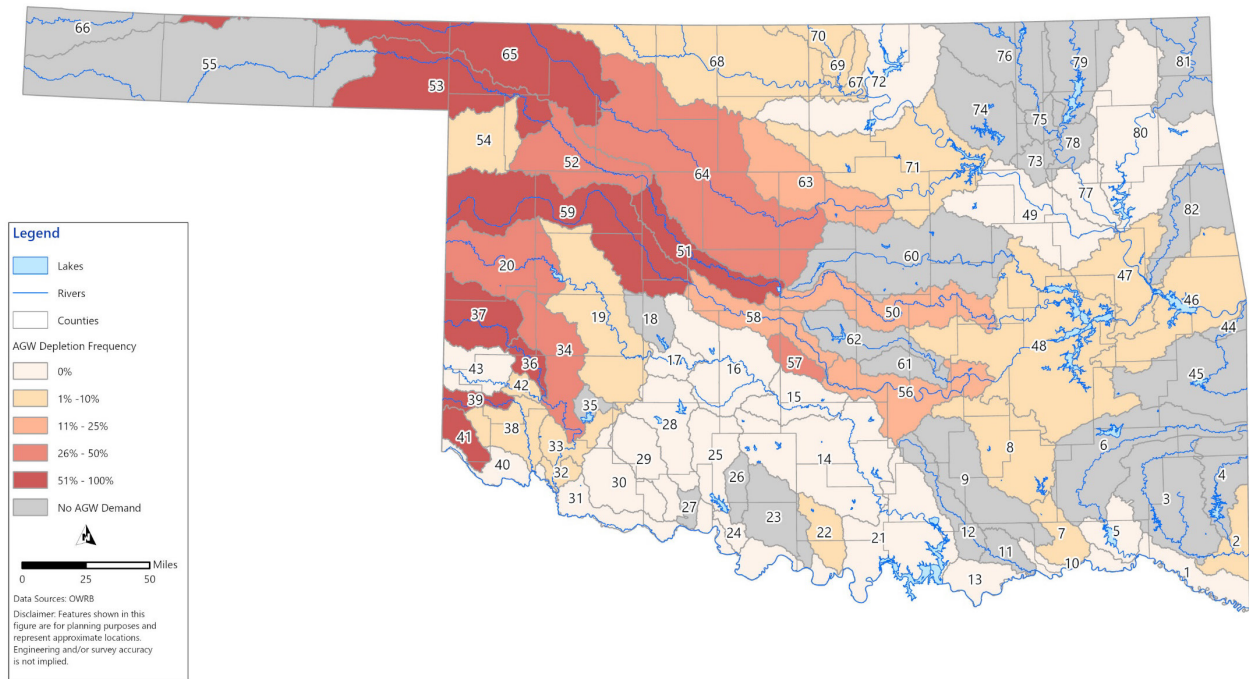


Figure 21 Probability of Annual Alluvial Groundwater Storage Depletions for 2075 Demands

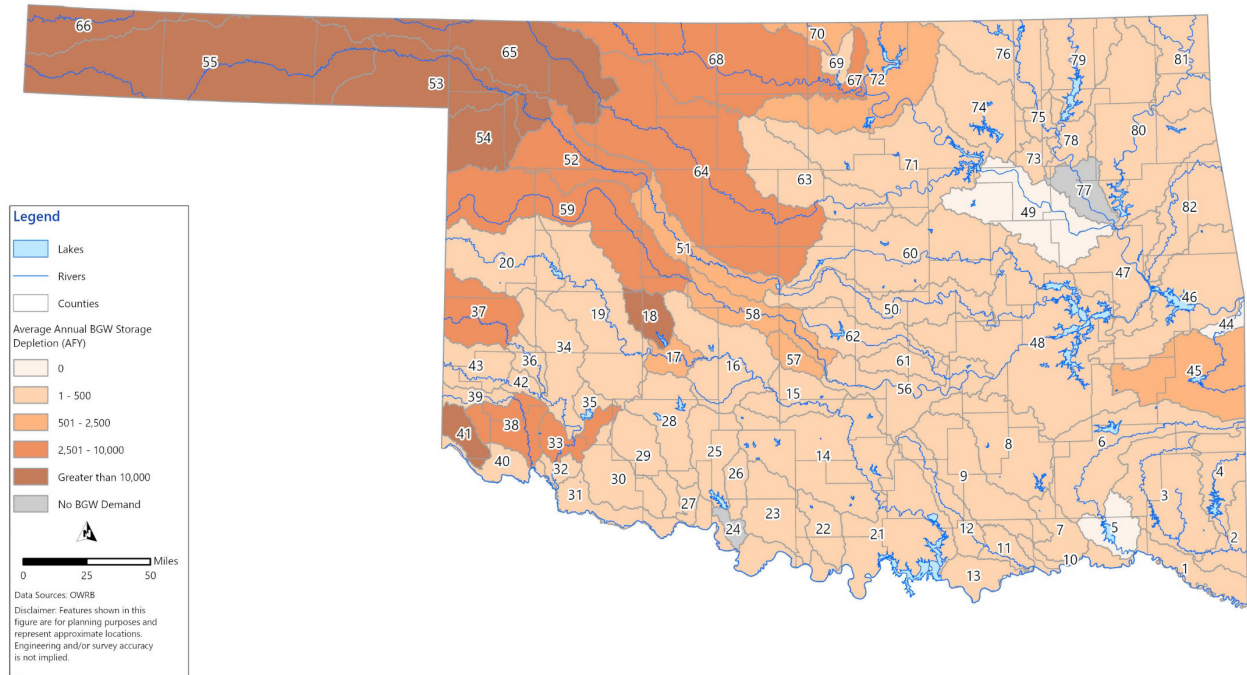


Figure 22 Bedrock Groundwater Storage Depletions in Excess of Annual Average Recharge for 2030 Demands

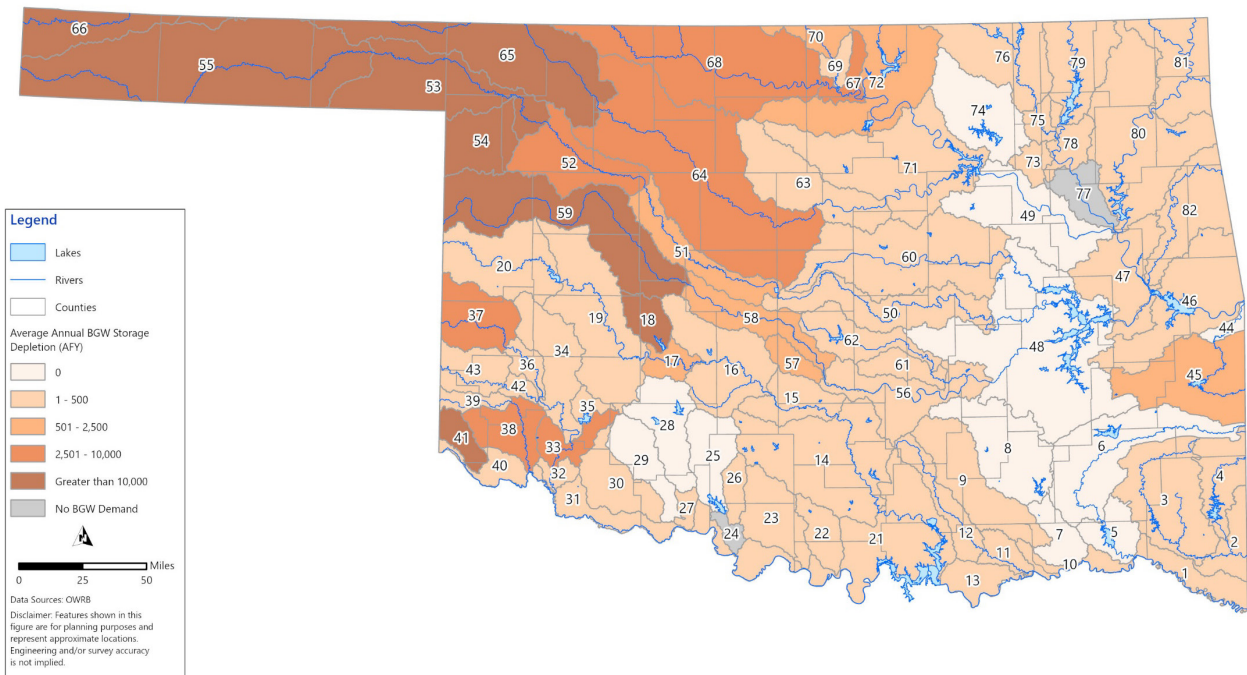


Figure 23 Bedrock Groundwater Storage Depletions in Excess of Annual Average Recharge for 2075 Demands

The projections of maximum surface water gaps and groundwater storage depletions, based on historical hydrology from water years 1950 through 2020 and the 2030 through 2075 incremental demand are summarized in Tables 8, 9, and 10.

Table 8 Maximum Annual Surface Water Supply Gaps for the Demand Projections for 1950 through 2020 Historical Hydrology (AFY)

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075
1	10100	Red River Mainstem (To Kiamichi River)	0	11	520	1,644	2,656
2	10201	Little River (McCurtain County) - 1	0	5	25	48	64
3	10202	Little River (McCurtain County) - 2	70	92	145	193	333
4	10203	Little River (McCurtain County) - 3	22	24	26	43	64
5	10301	Kiamichi River - 1	0	0	0	0	0
6	10302	Kiamichi River - 2	4	5	5	5	5
7	10411	Muddy Boggy River - 1	9	26	59	119	158
8	10412	Muddy Boggy River - 2	47	2	160	269	378
9	10420	Clear Boggy Creek	312	318	328	354	395
10	10500	Red River Mainstem (To Blue River)	0	2	7	107	265
11	10601	Blue River - 1	0	0	0	0	0
12	10602	Blue River - 2	0	31	99	247	667
13	10700	Red River Mainstem (To Washita)	0	0	0	0	0
14	10810	Lower Washita	24	6	1	1	1
15	10821	Middle Washita - 1	2	0	0	0	0
16	10822	Middle Washita - 2	2	1	0	0	0
17	10831	Upper Washita - 1	0	0	0	0	0
18	10832	Upper Washita - 2	0	0	0	0	0
19	10833	Upper Washita - 3	405	435	470	548	601
20	10840	Washita Headwaters	112	111	100	89	80
21	10900	Red River Mainstem (To Walnut Bayou)	0	0	0	0	0
22	11000	Walnut Bayou	24	28	25	46	55
23	11100	Mud Creek	18	17	10	4	0
24	11201	Beaver Creek - 1	0	0	0	0	0
25	11202	Beaver Creek - 2	374	360	333	317	292
26	11203	Beaver Creek - 3	0	0	0	0	0
27	11311	Cache Creek - 1	0	0	0	0	0
28	11312	Cache Creek - 2	0	0	0	0	0
29	11321	Deep Red Creek and West Cache Creek - 1	0	0	0	0	0
30	11322	Deep Red Creek and West Cache Creek - 2	16	6	0	0	0
31	11400	Red River Mainstem (To North Fork of Red)	0	0	0	0	0

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075
32	11511	Lower North Fork Red River - 1	0	0	0	0	0
33	11512	Lower North Fork Red River - 2	2	2	1	0	0
34	11513	Lower North Fork Red River - 3	187	249	315	310	303
35	11514	Lower North Fork Red River - 4	0	0	0	0	0
36	11521	Upper North Fork Red River - 1	3	5	7	7	7
37	11522	Upper North Fork Red River - 2	18	21	19	15	12
38	11601	Salt Fork Red River - 1	810	813	803	803	793
39	11602	Salt Fork Red River - 2	0	0	0	0	0
40	11701	Prairie Dog Town Fork Red River - 1	0	0	0	0	0
41	11702	Prairie Dog Town Fork Red River - 2	7	7	5	3	1
42	11801	Elm Fork Red River - 1	0	0	0	0	0
43	11802	Elm Fork Red River - 2	0	0	0	0	0
44	20101	Poteau River - 1	0	0	0	0	0
45	20102	Poteau River - 2	0	0	0	0	0
46	20201	Lower Arkansas River - 1	1	37	0	293	421
47	20202	Lower Arkansas River - 2	29	0	40	325	640
48	20300	Canadian River (To North Canadian River)	26	56	245	300	503
49	20400	Middle Arkansas River	204	645	2,647	6,013	9,628
50	20510	Lower North Canadian River	1,060	1,728	3,133	5,681	11,377
51	20520	Middle North Canadian River	157	241	414	655	834
52	20531	Upper North Canadian River - 1	8	8	6	6	6
53	20532	Upper North Canadian River - 2	0	0	0	0	0
54	20533	Upper North Canadian River - 3	1	1	1	1	1
55	20540	North Canadian Headwaters	4	5	9	12	14
56	20611	Lower Canadian River - 1	134	175	306	272	270
57	20612	Lower Canadian River - 2	110	109	109	108	109
58	20620	Middle Canadian River	49	92	197	441	689
59	20630	Upper Canadian River	147	200	286	482	632
60	20700	Deep Fork River	996	1,641	3,015	5,503	8,015
61	20801	Little River - 1	3	4	6	11	15
62	20802	Little River - 2	232	381	705	1,409	2,394
63	20910	Lower Cimarron River	120	163	272	473	807
64	20920	Middle Cimarron River	393	684	1,422	2,782	4,590
65	20930	Upper Cimarron River	1,033	1,034	1,039	1,044	1,047
66	20940	Cimarron Headwaters	95	95	95	95	95
67	21011	Lower Salt Fork Arkansas River - 1	0	0	0	0	0

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075
68	21020	Upper Salt Fork Arkansas River	0	0	0	0	0
69	21012	Lower Salt Fork Arkansas River - 2	116	107	91	72	55
70	21013	Lower Salt Fork Arkansas River - 3	212	212	210	208	207
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	475	520	236	494	896
72	21200	Arkansas River Mainstem (To Kansas State Line)	0	0	0	0	0
73	21301	Bird Creek - 1	89	398	1,727	3,629	5,362
74	21302	Bird Creek - 2	125	132	141	173	219
75	21401	Caney River - 1	2	10	26	84	126
76	21402	Caney River - 2	0	2	15	47	117
77	21511	Verdigris River (To Oologah Dam) - 1	18	32	132	266	547
78	21512	Verdigris River (To Oologah Dam) - 2	8	12	13	222	546
79	21520	Verdigris River (To Kansas State Line)	10	9	1	0	0
80	21601	Grand (Neosho) River - 1	0	184	396	1,159	1,745
81	21602	Grand (Neosho) River - 2	0	0	0	0	0
82	21700	Illinois River	0	0	0	0	0

Table 9 Maximum Annual Alluvial Groundwater Supply Depletion for the Demand Projections for 1950 through 2020 Historical Hydrology (AFY)

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075	No AGW Demands in Basin
1	10100	Red River Mainstem (To Kiamichi River)	0	0	0	0	0	
2	10201	Little River (McCurtain County) - 1	0	0	0	1	1	
3	10202	Little River (McCurtain County) - 2	0	0	0	0	0	X
4	10203	Little River (McCurtain County) - 3	0	0	0	0	0	X
5	10301	Kiamichi River - 1	0	0	0	0	0	
6	10302	Kiamichi River - 2	0	0	0	0	0	X
7	10411	Muddy Boggy River - 1	0	1	1	2	3	
8	10412	Muddy Boggy River - 2	0	0	3	3	3	
9	10420	Clear Boggy Creek	0	0	0	0	0	X
10	10500	Red River Mainstem (To Blue River)	0	0	0	0	0	
11	10601	Blue River - 1	0	0	0	0	0	X
12	10602	Blue River - 2	0	0	0	0	0	X
13	10700	Red River Mainstem (To Washita)	0	0	0	0	0	
14	10810	Lower Washita	7	7	0	0	0	

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075	No AGW Demands in Basin
15	10821	Middle Washita - 1	0	0	0	0	0	
16	10822	Middle Washita - 2	0	0	0	0	0	
17	10831	Upper Washita - 1	0	0	0	0	0	
18	10832	Upper Washita - 2	0	0	0	0	0	X
19	10833	Upper Washita - 3	238	243	249	261	270	
20	10840	Washita Headwaters	524	524	526	531	534	
21	10900	Red River Mainstem (To Walnut Bayou)	0	0	0	0	0	
22	11000	Walnut Bayou	9	9	9	9	9	
23	11100	Mud Creek	0	0	0	0	0	X
24	11201	Beaver Creek - 1	0	0	0	0	0	
25	11202	Beaver Creek - 2	0	0	0	0	0	
26	11203	Beaver Creek - 3	0	0	0	0	0	X
27	11311	Cache Creek - 1	0	0	0	0	0	X
28	11312	Cache Creek - 2	0	0	0	0	0	
29	11321	Deep Red Creek and West Cache Creek - 1	3	0	0	0	0	
30	11322	Deep Red Creek and West Cache Creek - 2	8	7	0	0	0	
31	11400	Red River Mainstem (To North Fork of Red)	0	0	0	0	0	
32	11511	Lower North Fork Red River - 1	202	202	202	151	54	
33	11512	Lower North Fork Red River - 2	226	248	125	56	3	
34	11513	Lower North Fork Red River - 3	137	151	163	164	157	
35	11514	Lower North Fork Red River - 4	0	0	0	0	0	X
36	11521	Upper North Fork Red River - 1	370	445	498	503	504	
37	11522	Upper North Fork Red River - 2	559	616	613	652	657	
38	11601	Salt Fork Red River - 1	74	68	68	49	41	
39	11602	Salt Fork Red River - 2	83	88	88	88	88	
40	11701	Prairie Dog Town Fork Red River - 1	0	0	0	0	0	
41	11702	Prairie Dog Town Fork Red River - 2	77	79	78	78	78	
42	11801	Elm Fork Red River - 1	49	55	55	55	55	
43	11802	Elm Fork Red River - 2	0	5	0	0	0	
44	20101	Poteau River - 1	0	0	0	0	0	X
45	20102	Poteau River - 2	0	0	0	0	0	X
46	20201	Lower Arkansas River - 1	4	32	0	578	581	

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075	No AGW Demands in Basin
47	20202	Lower Arkansas River - 2	4	0	0	0	22	
48	20300	Canadian River (To North Canadian River)	98	97	219	221	224	
49	20400	Middle Arkansas River	0	0	0	0	0	
50	20510	Lower North Canadian River	10	15	98	183	312	
51	20520	Middle North Canadian River	1,120	1,768	3,089	5,179	6,959	
52	20531	Upper North Canadian River - 1	784	823	699	665	733	
53	20532	Upper North Canadian River - 2	497	761	1,236	1,867	2,146	
54	20533	Upper North Canadian River - 3	2	2	2	2	2	
55	20540	North Canadian Headwaters	0	0	0	0	0	X
56	20611	Lower Canadian River - 1	369	495	799	827	852	
57	20612	Lower Canadian River - 2	7	9	20	38	60	
58	20620	Middle Canadian River	1	3	178	493	774	
59	20630	Upper Canadian River	397	538	822	1,298	1,831	
60	20700	Deep Fork River	0	0	0	0	0	X
61	20801	Little River - 1	0	0	0	0	0	X
62	20802	Little River - 2	0	0	0	0	0	X
63	20910	Lower Cimarron River	133	191	319	550	815	
64	20920	Middle Cimarron River	5,966	6,926	8,800	11,482	14,248	
65	20930	Upper Cimarron River	558	757	1,120	1,536	1,721	
66	20940	Cimarron Headwaters	0	0	0	0	0	X
67	21011	Lower Salt Fork Arkansas River - 1	283	260	160	119	60	
68	21020	Upper Salt Fork Arkansas River	97	143	219	388	536	
69	21012	Lower Salt Fork Arkansas River - 2	8	8	8	7	7	
70	21013	Lower Salt Fork Arkansas River - 3	105	105	105	105	105	
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	17	24	1	15	23	
72	21200	Arkansas River Mainstem (To Kansas State Line)	0	0	0	0	0	
73	21301	Bird Creek - 1	0	0	0	0	0	X
74	21302	Bird Creek - 2	0	0	0	0	0	X
75	21401	Caney River - 1	0	0	0	0	0	X
76	21402	Caney River - 2	0	0	0	0	0	X
77	21511	Verdigris River (To Oologah Dam) - 1	0	0	0	0	0	
78	21512	Verdigris River (To Oologah Dam) - 2	0	0	0	0	0	X

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075	No AGW Demands in Basin
79	21520	Verdigris River (To Kansas State Line)	0	0	0	0	0	X
80	21601	Grand (Neosho) River - 1	0	0	0	0	0	
81	21602	Grand (Neosho) River - 2	0	0	0	0	0	X
82	21700	Illinois River	0	0	0	0	0	X

Table 10 Average Annual Bedrock Groundwater Depletions for the Demand Projections (AFY)

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075	No BGW Demands in Basin
1	10100	Red River Mainstem (To Kiamichi River)	14	23	24	26	27	
2	10201	Little River (McCurtain County) - 1	1	1	1	1	1	
3	10202	Little River (McCurtain County) - 2	1	1	1	1	2	
4	10203	Little River (McCurtain County) - 3	88	92	100	114	127	
5	10301	Kiamichi River - 1	0	0	0	0	0	
6	10302	Kiamichi River - 2	2	1	1	1	0	
7	10411	Muddy Boggy River - 1	1	1	0	0	0	
8	10412	Muddy Boggy River - 2	3	3	1	0	0	
9	10420	Clear Boggy Creek	13	13	13	12	11	
10	10500	Red River Mainstem (To Blue River)	3	2	2	2	3	
11	10601	Blue River - 1	2	2	2	2	2	
12	10602	Blue River - 2	12	12	12	12	13	
13	10700	Red River Mainstem (To Washita)	74	108	176	207	209	
14	10810	Lower Washita	47	47	45	41	36	
15	10821	Middle Washita - 1	43	35	28	27	29	
16	10822	Middle Washita - 2	87	87	60	23	7	
17	10831	Upper Washita - 1	1,783	1,821	1,828	1,828	1,829	
18	10832	Upper Washita - 2	30,235	30,551	30,539	30,522	30,508	
19	10833	Upper Washita - 3	139	138	134	129	125	
20	10840	Washita Headwaters	35	35	34	33	31	
21	10900	Red River Mainstem (To Walnut Bayou)	25	26	25	24	24	
22	11000	Walnut Bayou	10	10	10	9	8	
23	11100	Mud Creek	19	18	16	12	10	
24	11201	Beaver Creek - 1	0	0	0	0	0	X

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075	No BGW Demands in Basin
25	11202	Beaver Creek - 2	5	3	1	0	0	
26	11203	Beaver Creek - 3	388	383	374	363	351	
27	11311	Cache Creek - 1	113	107	96	80	64	
28	11312	Cache Creek - 2	6	3	0	0	0	
29	11321	Deep Red Creek and West Cache Creek - 1	1	0	0	0	0	
30	11322	Deep Red Creek and West Cache Creek - 2	312	310	305	300	294	
31	11400	Red River Mainstem (To North Fork of Red)	314	313	313	312	311	
32	11511	Lower North Fork Red River - 1	294	294	294	293	293	
33	11512	Lower North Fork Red River - 2	2,556	2,560	2,562	2,556	2,548	
34	11513	Lower North Fork Red River - 3	27	27	19	23	14	
35	11514	Lower North Fork Red River - 4	207	213	221	221	221	
36	11521	Upper North Fork Red River - 1	287	290	291	291	291	
37	11522	Upper North Fork Red River - 2	4,277	4,309	4,307	4,319	4,320	
38	11601	Salt Fork Red River - 1	6,479	6,484	6,473	6,458	6,447	
39	11602	Salt Fork Red River - 2	1	1	1	1	1	
40	11701	Prairie Dog Town Fork Red River - 1	93	94	93	91	90	
41	11702	Prairie Dog Town Fork Red River - 2	39,051	39,076	39,049	39,004	38,966	
42	11801	Elm Fork Red River - 1	403	403	402	400	397	
43	11802	Elm Fork Red River - 2	149	150	149	150	149	
44	20101	Poteau River - 1	0	0	0	0	0	
45	20102	Poteau River - 2	1,528	1,737	1,848	1,837	1,829	
46	20201	Lower Arkansas River - 1	21	24	26	21	18	
47	20202	Lower Arkansas River - 2	4	4	4	3	2	
48	20300	Canadian River (To North Canadian River)	20	9	5	2	0	
49	20400	Middle Arkansas River	0	0	0	0	0	
50	20510	Lower North Canadian River	96	99	105	117	127	
51	20520	Middle North Canadian River	1,314	1,426	1,668	2,058	2,390	
52	20531	Upper North Canadian River - 1	2,840	2,869	2,943	3,064	3,185	
53	20532	Upper North Canadian River - 2	37,119	38,419	40,774	43,452	44,620	
54	20533	Upper North Canadian River - 3	10,611	10,611	10,606	10,612	10,608	
55	20540	North Canadian Headwaters	422,563	423,861	426,128	428,605	429,749	
56	20611	Lower Canadian River - 1	3	3	4	4	4	

Basin No.	Basin ID	Basin Name	2030	2035	2045	2060	2075	No BGW Demands in Basin
57	20612	Lower Canadian River - 2	1,432	1,439	1,465	1,510	1,564	
58	20620	Middle Canadian River	557	611	825	1,319	1,749	
59	20630	Upper Canadian River	6,879	7,633	9,142	11,938	14,868	
60	20700	Deep Fork River	60	59	101	141	176	
61	20801	Little River - 1	12	13	12	12	12	
62	20802	Little River - 2	60	61	64	67	71	
63	20910	Lower Cimarron River	19	19	15	12	11	
64	20920	Middle Cimarron River	3,206	3,380	3,706	4,260	4,864	
65	20930	Upper Cimarron River	41,611	42,355	43,673	45,195	45,878	
66	20940	Cimarron Headwaters	18,481	18,480	18,469	18,455	18,445	
67	21011	Lower Salt Fork Arkansas River - 1	4,070	3,995	3,847	3,683	3,480	
68	21020	Upper Salt Fork Arkansas River	3,146	3,177	3,256	3,454	3,615	
69	21012	Lower Salt Fork Arkansas River - 2	356	346	327	307	281	
70	21013	Lower Salt Fork Arkansas River - 3	722	720	718	715	711	
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	47	49	50	52	57	
72	21200	Arkansas River Mainstem (To Kansas State Line)	1,536	1,485	1,402	1,341	1,282	
73	21301	Bird Creek - 1	177	180	186	197	206	
74	21302	Bird Creek - 2	8	3	2	1	0	
75	21401	Caney River - 1	142	143	145	148	151	
76	21402	Caney River - 2	7	5	3	2	2	
77	21511	Verdigris River (To Oologah Dam) - 1	0	0	0	0	0	X
78	21512	Verdigris River (To Oologah Dam) - 2	321	324	328	334	341	
79	21520	Verdigris River (To Kansas State Line)	3	3	3	4	3	
80	21601	Grand (Neosho) River - 1	24	21	14	10	8	
81	21602	Grand (Neosho) River - 2	52	51	38	29	18	
82	21700	Illinois River	17	17	16	16	15	

An estimate of the surface water flow at each of the 82 OCWP surface water gages in 2075 is presented in terms of the annual average flow and the minimum annual flow in Figures 24 and 25, respectively. These projections are based on flow data for the 71-year period of record at each OCWP stream gage location and the projected surface water use in each basin in 2075. The minimum streamflow shown for each basin is an estimate of the minimum flow for that basin under any of the 71 years of historical hydrologic data, and as such, the minimum flows shown in Figure 25 would likely not occur for all 82 basins in any single future calendar year. Surface water gaps are calculated based on a monthly comparison of surface water demand to gaged flow. Therefore, gaps may occur in any basin, including those for which minimum annual flows are projected to be greater than zero.

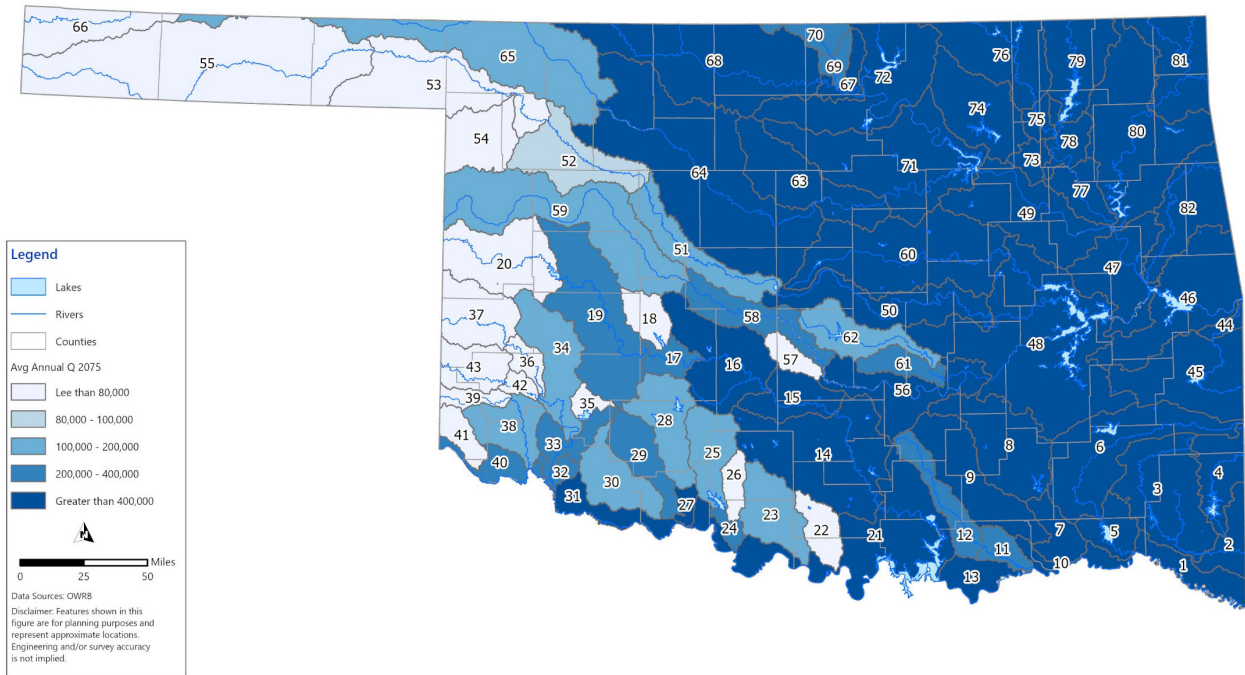


Figure 24 Estimated Average Annual Streamflow in 2075

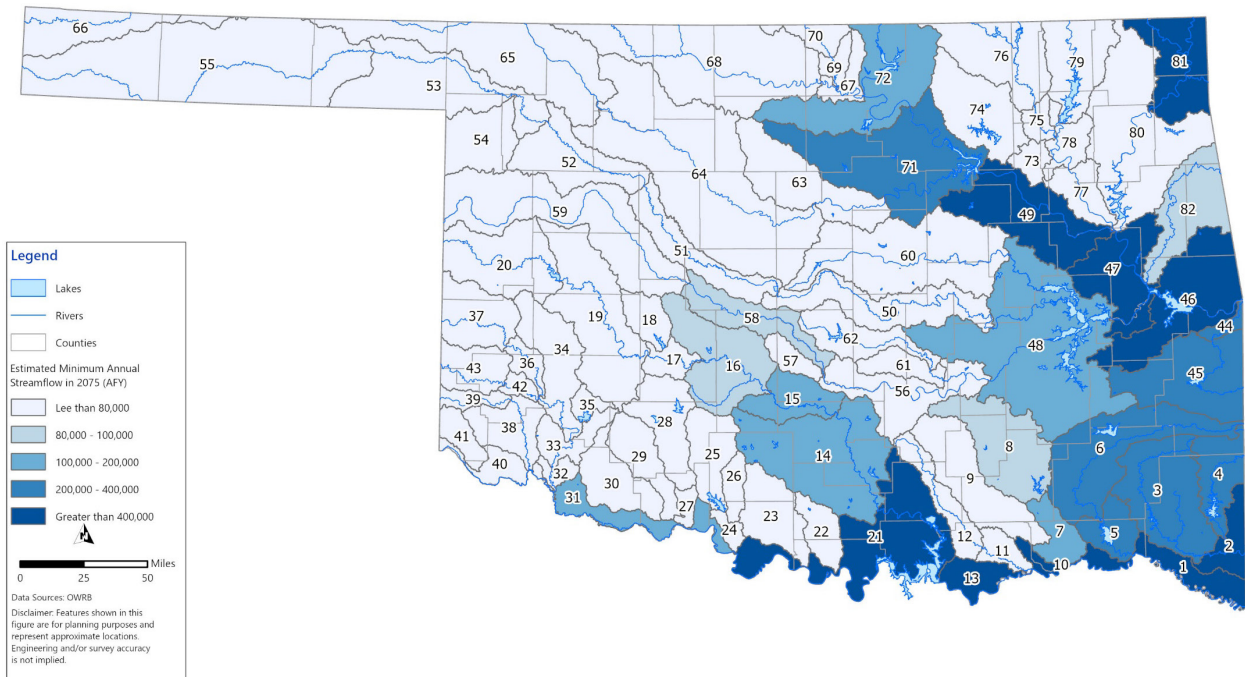


Figure 25 Estimated Minimum Annual Streamflow in 2075

4.3 Limitations and Uncertainties in the Water Availability Analyses

There are several known limitations and uncertainties associated with the current model methodology and input data. The following are key known limitations.

- Localized surface water gaps or groundwater storage depletions may not be evident at the basin level, such that the magnitude and/or probability of localized shortages might be greater than those shown via this analysis for each OCWP basin.
- Future proportions of surface water and groundwater used to satisfy future demand for a given basin and water use sector may differ from current proportions.
- Grand River Dam Authority contracts are implicitly included in the input dataset using surface water diversion amounts identified in the OWRB Water Rights database (OWRB 2024).
- The statistical method used to estimate flows where actual data are missing is not constrained to a minimum flow value; therefore, periods of zero flow may be created when actual flows may have occurred.
- Drawing down the water in a reservoir may influence the timing or quantity of gaps, especially when the majority of consumptive use occurs upstream of the stream gage.
- The simplifying assumption that upstream states were assumed to use 60 percent of all available flow into Oklahoma based on OWRB's permitting protocol, which is adapted from interstate compact obligations between Oklahoma and its neighboring states.
- Downstream interstate compact obligations were assumed to not constrain availability and are analyzed separately as part of the legal availability analysis.

SECTION 5 RELATED TECHNICAL STUDIES

Related and ongoing technical studies complement the physical water supply availability analysis described in this report. These include potential constraints, challenges, and opportunities associated with:

- Permitting and interstate compacts, sometimes referred to as the permitting availability of water.
- Water quality factors characterized as potential future constraints on the use of specific supplies for the various water demand sectors.
- Assessing the efficacy (via a scoring system) of various water management strategies at mitigating anticipated water demand shortages forecasted.

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APPENDIX A

PUBLIC WATER SYSTEMS AND COMMUNITIES WITHIN EACH BASIN

Appendix A includes tables that identify public water systems and communities within each basin. When a community or rural water district spans more than one basin, the entity's name is associated with more than one basin number in the tables. The percentages were used to assign permit values to basins. For example, Tulsa Permit No. 19540517 use is split between Basins 49 (42%), 73 (52%), 77 (2%), and 78 (4%). The percentage of permit use is based on the percentage of service area within each basin.

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
1	Choctaw RWD #2	95%
1	Garvin	30%
1	Haworth	100%
1	Idabel	22%
1	McCurtain Co RWD #1	57%
1	McCurtain Co RWD #2	49%
1	McCurtain Co RWD #7	95%
1	Valliant	15%
2	Broken Bow	0%
2	Idabel	24%
2	McCurtain Co RWD #1	42%
2	McCurtain Co RWD #7	1%
2	McCurtain Co RWD #8 (Mt Fork Water)	25%
3	Broken Bow	100%
3	Choctaw RWD #2	5%
3	Garvin	70%
3	Idabel	54%
3	McCurtain Co RWD #1	1%
3	McCurtain Co RWD #2	51%
3	McCurtain Co RWD #5 (Hochatown)	55%
3	McCurtain Co RWD #7	3%
3	McCurtain Co RWD #8 (Mt Fork Water)	72%
3	Pushmataha Co RWD #3	9%
3	Pushmataha Co RWD #5 (Nashoba)	97%
3	Valliant	85%
3	Wright City	100%
4	Leflore Co RWD #15	0%
4	Leflore Co RWD #17	22%
4	McCurtain Co RWD #5 (Hochatown)	45%
4	McCurtain Co RWD #8 (Mt Fork Water)	3%
5	Choctaw Co RWD #1	10%
5	Choctaw Co RWSG & SWMD #3	100%
5	Fort Towson	100%
5	Hugo	58%
5	Pushmataha Co RWD #3	14%
6	Antlers	100%
6	Atoka Co RWS & SWMD #4	1%
6	Clayton	100%
6	Latimer Co RWD #2	100%
6	Latimer RWD #3	9%
6	Leflore Co RWD #15	14%
6	Leflore Co RWD #17	78%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
6	Leflore Co RWD #3	100%
6	Oklahoma City	0%
6	Pushmataha Co RWD #1	100%
6	Pushmataha Co RWD #2 (Albion)	100%
6	Pushmataha Co RWD #3	71%
6	Pushmataha Co RWD #5 (Nashoba)	3%
6	Stringtown	10%
6	Talihina	100%
7	Atoka Co RWS & SWMD #4	11%
7	Boswell	82%
7	Choctaw Co RWD #1	23%
7	Oklahoma City	2%
7	Pushmataha Co RWD #3	6%
7	Soper	100%
8	Ada	0%
8	Allen	70%
8	Atoka	100%
8	Atoka Co RWD #1 (Wardville)	100%
8	Atoka Co RWD #2	29%
8	Atoka Co RWS & SWMD #4	28%
8	Centrahoma	31%
8	Clarita Olney Water Co Inc	18%
8	Coal Co RWD #5	100%
8	Coalgate	100%
8	Hughes Co RWD #2	37%
8	Hughes Co RWD #6 (Gerty)	42%
8	Kiowa	100%
8	Lehigh	100%
8	Oklahoma City	7%
8	Phillips RWD #1	100%
8	Pontotoc Co RWD #1 (Homer)	96%
8	Pontotoc Co RWD #7	50%
8	Roundhill RWD #4	100%
8	Stringtown	90%
9	Ada	29%
9	Atoka Co RWD #2	71%
9	Atoka Co RWD #3 (Caney)	100%
9	Atoka Co RWS & SWMD #4	60%
9	Boswell	18%
9	Bromide	100%
9	Bryan Co RWD #6	14%
9	Caddo	64%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
9	Centrahoma	69%
9	Clarita Olney Water Co Inc	82%
9	Johnston Co RWD #3	0%
9	Johnston Co RWS & SWMD #4	58%
9	Oklahoma City	3%
9	Pontotoc Co RWD #1 (Homer)	1%
9	Pontotoc Co RWD #6 (Fittstown)	89%
9	Pontotoc Co RWD #7	30%
9	Pontotoc Co RWD #8	3%
9	Pontotoc Co RWD #9	100%
9	Stonewall	100%
9	Tupelo	100%
9	Wapanucka	100%
10	Bryan Co RWD #7	27%
10	Choctaw Co RWD #1	68%
10	Hugo	42%
11	Bokchito	100%
11	Bryan Co RW & SD #5	15%
11	Bryan Co RWD #6	86%
11	Bryan Co RWD #7	73%
11	Caddo	36%
12	Ada	1%
12	Bryan Co RW & SD #5	11%
12	Bryan Co RWS & SWMD #2	53%
12	Durant	100%
12	Johnston Co RWD #3	29%
12	Johnston Co RWS & SWMD #4	42%
12	Kenefic	100%
12	Milburn	89%
12	Murray Co RWD #1	1%
12	Pontotoc Co RWD #6 (Fittstown)	11%
12	Pontotoc Co RWD #8	11%
12	Roff	100%
13	Achille	100%
13	Bryan Co RW & SD #5	65%
13	Bryan Co RWD #9	100%
13	Calera	100%
13	Colbert	100%
14	Ardmore	70%
14	Buckhorn RWD	59%
14	Byars	87%
14	Davis	100%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
14	Dougherty	100%
14	Elmore City	100%
14	Elmore City RW Corp	97%
14	Garvin Co RWD #1	94%
14	Garvin Co RWD #2	17%
14	Garvin Co RWD #4	81%
14	Garvin Co RWD #6 (Wells)	100%
14	Grady Co RWD #7 (Ninnekah)	0%
14	Jefferson Co Cons RWD #1	1%
14	Lone Grove	22%
14	Marlow	58%
14	McClain Co RWD #8	4%
14	Murray Co RWD #1	78%
14	Pauls Valley	100%
14	Ratliff City	100%
14	Rush Springs	100%
14	Southern Okla Water Corp	28%
14	Stephens Co RW & SD #1	76%
14	Stephens Co RWD #5	53%
14	Sulphur	100%
14	West Davis RWD	100%
14	Western Carter Co Water Corp	81%
14	Wynnewood	100%
15	Alex	21%
15	Dibble	69%
15	Elmore City RW Corp	3%
15	Garvin Co RWD #1	2%
15	Garvin Co RWD #2	83%
15	Garvin Co RWD #4	19%
15	Grady Co RWD #3	100%
15	Grady Co RWD #7 (Ninnekah)	3%
15	Lindsay	100%
15	Maysville	100%
15	McClain Co RWD #8	70%
15	Paoli	100%
15	Purcell	30%
15	Wayne	31%
16	Alex	79%
16	Anadarko	74%
16	Binger	100%
16	Caddo Co RWD #1 (Lookeba)	100%
16	Caddo Co RWD #3	17%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
16	Cement	100%
16	Chickasha	100%
16	Cyril	100%
16	Dibble	1%
16	Gracemont	100%
16	Grady Co RWD #1	100%
16	Grady Co RWD #2	100%
16	Grady Co RWD #6	81%
16	Grady Co RWD #7 (Ninnekah)	97%
16	Hinton	36%
16	Norge Water Co.	100%
16	Verden	100%
17	Anadarko	26%
17	Caddo Co RWD #3	16%
17	Fort Cobb	100%
18	Corn	63%
18	Eakly	100%
18	Washita Co RWD #2	18%
19	Arapaho	100%
19	Beckham Co RWD #1	13%
19	Beckham Co RWD #3	1%
19	Bessie	100%
19	Burns Flat	39%
19	Butler	100%
19	Caddo Co RWD #3	30%
19	Canute	47%
19	Carnegie	100%
19	Clinton	100%
19	Corn	37%
19	Custer City	34%
19	Custer Co RWD #3	64%
19	Dill City	6%
19	Foss	100%
19	Foss Reservoir MCD	76%
19	Frontier Development Authority	35%
19	Gotebo	100%
19	Hobart	22%
19	Leedey	36%
19	Mountain View	100%
19	New Cordell	94%
19	Roger Mills RWD #2 (Red Star)	4%
19	Washita Co RWD #2	79%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
20	Beckham Co RWD #3	43%
20	Cheyenne	100%
20	Foss Reservoir MCD	24%
20	Frontier Development Authority	65%
20	Hammon	100%
20	Leedey	64%
20	Roger Mills RWD #2 (Red Star)	69%
20	Roger Mills RWS & SWMD #1	100%
20	Roger Mills RWS & SWMD #3	100%
21	Ardmore	30%
21	Bryan Co RW & SD #5	9%
21	Bryan Co RWS & SWMD #2	47%
21	Buckhorn RWD	41%
21	Jefferson Co Cons RWD #1	10%
21	Johnston Co RWD #3	71%
21	Kingston	100%
21	Leon RWD #1 (Love County)	100%
21	Lone Grove	37%
21	Madill	100%
21	Mannsville	100%
21	Marietta	100%
21	Marshall Co Water Corp	100%
21	Milburn	11%
21	Mill Creek	100%
21	Murray Co RWD #1	9%
21	Oakland	100%
21	Ravia	100%
21	Ryan	12%
21	Southern Okla Water Corp	59%
21	Terral	100%
21	Thackerville	100%
21	Tishomingo	100%
22	Healdton	100%
22	Jefferson Co Cons RWD #1	13%
22	Lone Grove	41%
22	Southern Okla Water Corp	14%
22	Western Carter Co Water Corp	18%
22	Wilson	100%
23	Comanche	32%
23	Cornish	100%
23	Healdton	0%
23	Jefferson Co Cons RWD #1	45%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
23	Ringling	100%
23	Stephens Co RW & SD #1	24%
23	Stephens Co RWD #4 (Loco)	100%
23	Stephens Co RWD #5	11%
23	Western Carter Co Water Corp	1%
24	Cotton Co RWD #2	0%
24	Jefferson Co Cons RWD #1	8%
24	Ryan	88%
24	Waurika	49%
25	Caddo Co RWD #3	5%
25	Comanche Co RWD #3	50%
25	Cotton Co RWD #2	8%
25	Duncan	41%
25	Elgin	87%
25	Fletcher	63%
25	Jefferson Co Cons RWD #1	8%
25	Lawton	35%
25	Marlow	42%
25	Stephens Co RWD #5	27%
25	Sterling	100%
26	Comanche	68%
26	Duncan	59%
26	Jefferson Co Cons RWD #1	10%
26	Lawton	12%
26	Stephens Co RWD #3 (Meridian)	100%
26	Stephens Co RWD #5	9%
26	Waurika	51%
27	Comanche Co RWD #3	1%
27	Cotton Co RWD #2	19%
27	Temple	34%
27	Tillman Co RWD #1	3%
27	Walters	30%
28	Apache	100%
28	Caddo Co RWD #3	22%
28	Comanche Co RWD #3	46%
28	Comanche Co RWD #4	0%
28	Cotton Co RWD #2	13%
28	Elgin	13%
28	Fletcher	37%
28	Geronimo	100%
28	Lawton	51%
28	Medicine Park	100%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
28	Walters	38%
29	Cache	100%
29	Chattanooga	71%
29	Comanche Co RWD #3	2%
29	Comanche Co RWD #4	59%
29	Cotton Co RWD #2	35%
29	Faxon	100%
29	Grandfield	1%
29	Indiahoma	100%
29	Lawton	1%
29	Tillman Co RWD #1	11%
29	Walters	32%
30	Chattanooga	29%
30	Comanche Co RWD #4	30%
30	Cotton Co RWD #1	0%
30	Cotton Co RWD #2	11%
30	Davidson	1%
30	Frederick	46%
30	Grandfield	22%
30	Hollister	100%
30	Manitou	100%
30	Mountain Park MCD	11%
30	Tillman Co RWD #1	66%
30	Tipton	1%
31	Cotton Co RWD #1	100%
31	Cotton Co RWD #2	15%
31	Davidson	99%
31	Devol	100%
31	Frederick	36%
31	Grandfield	77%
31	Jefferson Co Cons RWD #1	4%
31	Temple	66%
31	Tillman Co RWD #1	20%
31	Tipton	28%
32	Altus	1%
32	Frederick	18%
32	Jackson Co Water Corp	8%
32	Tipton	71%
33	Altus	44%
33	Blair	1%
33	Caddo Co RWD #3	1%
33	Comanche Co RWD #4	12%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
33	Headrick	78%
33	Jackson Co Water Corp	40%
33	Mountain Park	100%
33	Mountain Park MCD	35%
33	Snyder	100%
34	Altus	22%
34	Beckham Co RWD #1	63%
34	Beckham Co RWD #3	27%
34	Blair	1%
34	Burns Flat	61%
34	Caddo Co RWD #3	2%
34	Canute	53%
34	Dill City	94%
34	Elk City	100%
34	Headrick	22%
34	Hobart	78%
34	Jackson Co Water Corp	12%
34	Lone Wolf	100%
34	Mountain Park MCD	50%
34	New Cordell	6%
34	Rocky	100%
34	Sentinel	100%
35	Altus	0%
35	Caddo Co RWD #3	6%
35	Mountain Park MCD	4%
35	Roosevelt	100%
35	Snyder	0%
36	Beckham Co RWD #1	17%
36	Carter	1%
36	Granite	45%
36	Kiowa Co RWS & SWMD #1	100%
36	Mangum	31%
36	Thirsty Water Corp	7%
36	Willow	89%
37	Beckham Co RWD #1	8%
37	Beckham Co RWD #2	87%
37	Beckham Co RWD #3	28%
37	Carter	99%
37	Elk City	0%
37	Erick	100%
37	Sayre	100%
37	Thirsty Water Corp	0%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
38	Altus	25%
38	Beckham Co RWD #1	0%
38	Blair	67%
38	Duke	100%
38	Duke Central Vue Water	89%
38	Gould	15%
38	Harmon Electric	98%
38	Harmon Water Corp	26%
38	Hollis	0%
38	Jackson Co Water Corp	39%
38	Mangum	6%
38	Martha	100%
38	Olustee	100%
39	Duke Central Vue Water	4%
39	Harmon Electric	1%
39	Harmon Water Corp	3%
39	Hollis	8%
39	Reed	40%
40	Altus	8%
40	Duke Central Vue Water	7%
40	Eldorado	100%
40	Harmon Water Corp	17%
40	Jackson Co Water Corp	1%
41	Gould	85%
41	Harmon Water Corp	55%
41	Hollis	92%
42	Blair	32%
42	Granite	55%
42	Harmon Electric	1%
42	Mangum	64%
42	Reed	8%
42	Thirsty Water Corp	4%
43	Beckham Co RWD #2	13%
43	Reed	52%
43	Thirsty Water Corp	89%
43	Willow	11%
44	Arkoma	98%
44	Leflore Co RWD #14	17%
44	Leflore Co RWD #2	91%
44	Panama	100%
44	Poteau	6%
44	Sequoyah Co RWD #7	0%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
44	Spiro	20%
44	Spiro East RWS	42%
45	Bokoshe	100%
45	Cameron	100%
45	Consolidated RWD #1 Leflore Co	100%
45	Haskell Co Water Company	1%
45	Heavener	100%
45	Latimer Co RWD #1	31%
45	Latimer Co RWD #4	100%
45	Latimer RWD #3	91%
45	Leflore Co RWD #1	100%
45	Leflore Co RWD #14	52%
45	Leflore Co RWD #15	86%
45	Leflore Co RWD #2	9%
45	Leflore Co RWD #5	100%
45	McCurtain	91%
45	Poteau	94%
45	Red Oak	100%
45	Wilburton	90%
45	Wister	100%
46	Adair Co RWD #1 (Cherry Tree)	100%
46	Adair Co RWD #2	15%
46	Adair Co RWD #3	0%
46	Adair Co RWD #4	35%
46	Gans	100%
46	Haskell Co Water Company	61%
46	Keota	100%
46	Latimer Co RWD #4	0%
46	Lee Creek RWD	100%
46	Leflore Co RWD #14	31%
46	McCurtain	9%
46	Muldrow	100%
46	Pittsburg Co RWD #14	8%
46	Quinton	100%
46	Roland	100%
46	Sallisaw	100%
46	Sequoyah Co RWD #3	100%
46	Sequoyah Co RWD #4	100%
46	Sequoyah Co RWD #5	46%
46	Sequoyah Co RWD #7	100%
46	Sequoyah Co Water Assoc	85%
46	Spiro	80%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
46	Spiro East RWS	58%
46	Stilwell	97%
46	Vian	100%
47	Braggs	100%
47	Checotah	75%
47	Cherokee Co RWD #1 (Ft Gibson)	37%
47	Cherokee Co RWD #2 (Keys)	17%
47	Cherokee Co RWD #3	1%
47	East Central Okla Water Authority	100%
47	Fort Gibson	86%
47	Gore	29%
47	Haskell	0%
47	Haskell Co Water Company	26%
47	McIntosh Co RWD #3 (Victor)	92%
47	McIntosh Co RWD #5	73%
47	McIntosh Co RWS & SWMD #2 (Onapa)	24%
47	Muskogee	100%
47	Muskogee Co RWD #1 (Oktaha)	99%
47	Muskogee Co RWD #2 (Gooseneck)	100%
47	Muskogee Co RWD #3	11%
47	Muskogee Co RWD #4	100%
47	Muskogee Co RWD #5	100%
47	Muskogee Co RWD #6	40%
47	Muskogee Co RWD #7	95%
47	Okay	10%
47	Porum	87%
47	Sequoyah Co RWD #5	13%
47	Sequoyah Co Water Assoc	3%
47	Stick Ross Mt Water Co.	85%
47	Stigler	100%
47	Warner	100%
48	Adamson RWD #8	100%
48	Beggs	93%
48	Bowlegs Lima Water	65%
48	Checotah	25%
48	Dewar	100%
48	Dustin	100%
48	Eufaula	100%
48	Haileyville	100%
48	Hanna	100%
48	Hartshorne	100%
48	Haskell Co Water Company	12%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
48	Henryetta	100%
48	Holdenville	31%
48	Hughes Co RWD #1	94%
48	Hughes Co RWD #2	63%
48	Hughes Co RWD #3	93%
48	Hughes Co RWD #5	71%
48	Hughes Co RWD #6 (Gerty)	23%
48	Indianola RWD #18	100%
48	Krebs	100%
48	Kusa RWD #3	100%
48	Latimer Co RWD #1	69%
48	Longtown RW & S District #1 Pittsburg Co	100%
48	McAlester	100%
48	McIntosh Co RWD #13 (Wells)	100%
48	McIntosh Co RWD #3 (Victor)	8%
48	McIntosh Co RWD #4 (Hitchita)	100%
48	McIntosh Co RWD #5	27%
48	McIntosh Co RWD #6 (Vivian)	100%
48	McIntosh Co RWD #8 (Texanna)	100%
48	McIntosh Co RWS & SWMD #2 (Onapa)	76%
48	McIntosh Co RWS & SWMD #9	100%
48	Morris	100%
48	Muskogee Co RWD #3	62%
48	Okfuskee Co RWD #2	7%
48	Okfuskee Co RWD #3	42%
48	Okmulgee	100%
48	Okmulgee Co RWD #1	100%
48	Okmulgee Co RWD #2 (Preston)	37%
48	Okmulgee Co RWD #20	25%
48	Okmulgee Co RWD #21	100%
48	Okmulgee Co RWD #4	100%
48	Okmulgee Co RWD #5 (Bryant RWD #5)	100%
48	Okmulgee Co RWD #6 (Hectorville RWD #6)	8%
48	Okmulgee Co RWD #7 (Nuyaka)	57%
48	Pittsburg	100%
48	Pittsburg Co PWA (Crowder)	100%
48	Pittsburg Co RWD #14	92%
48	Pittsburg Co RWD #16	100%
48	Pittsburg Co RWD #4 (Canadian)	100%
48	Pittsburg Co RWD #5	100%
48	Pittsburg Co RWD #6 (Alderson)	100%
48	Pittsburg Co RWD #7 (Haywood)	100%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
48	Pittsburg Co RWD #9 (McAlester)	100%
48	Porum	13%
48	Pottawatomie Co RWD #2 (Tri County)	15%
48	Savanna	100%
48	Seminole	100%
48	Seminole Co RW & SWMD #3	57%
48	Seminole Co RWD #1	100%
48	Seminole Co RWD #2	100%
48	Seminole Co RWD #5	100%
48	Weleetka	100%
48	Wetumka	98%
48	Wewoka	100%
48	Wilburton	10%
49	Bixby	100%
49	Boynton	100%
49	Broken Arrow	89%
49	Consolidated RWD #3 Creek Co	100%
49	Coweta	1%
49	Creek Co RWD #1	90%
49	Creek Co RWD #10	29%
49	Creek Co RWD #2	100%
49	Creek Co RWD #4	100%
49	Creek Co RWD #7	100%
49	Glenpool	100%
49	Haskell	100%
49	Jenks	100%
49	Mannford	1%
49	Muskogee	0%
49	Muskogee Co RWD #1 (Oktaha)	1%
49	Muskogee Co RWD #10	100%
49	Muskogee Co RWD #3	27%
49	Muskogee Co RWD #6	60%
49	Muskogee Co RWD #9	100%
49	Okay	26%
49	Okmulgee Co RWD #2 (Preston)	63%
49	Okmulgee Co RWD #20	75%
49	Okmulgee Co RWD #6 (Hectorville RWD #6)	85%
49	Porter	52%
49	Red Bird	89%
49	Sand Springs	66%
49	Sapulpa	100%
49	Sapulpa Rural Water Company	100%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
49	Taft	100%
49	Tallahassee	9%
49	Tulsa	42%
49	Wagoner Co RWD #4	46%
49	Wagoner Co RWD #5	44%
50	Bethany	40%
50	Choctaw	100%
50	Del City	100%
50	Harrah	100%
50	Hughes Co RWD #1	6%
50	Jones	99%
50	McIntosh Co RWD #13 (Wells)	0%
50	McLoud	100%
50	Meeker	12%
50	Midwest City	100%
50	Moore	1%
50	Mustang	40%
50	Okemah	64%
50	Okfuskee Co RWD #1 (Boley)	97%
50	Okfuskee Co RWD #2	56%
50	Okfuskee Co RWD #3	7%
50	Oklahoma City	23%
50	Paden	5%
50	Pottawatomie Co Development Authority	53%
50	Pottawatomie Co RWD #2 (Tri County)	69%
50	Prague	69%
50	Seminole Co RW & SWMD #3	43%
50	Shawnee	99%
50	Spencer	100%
50	Tecumseh	67%
50	Wetumka	2%
50	Yukon	66%
51	Bethany	46%
51	Calumet	100%
51	Canadian Co RWD #1	59%
51	Canadian Co RWD #4	38%
51	Canadian Co Water Authority	56%
51	Canton	100%
51	El Reno	100%
51	Geary	56%
51	Greenfield	100%
51	Hitchcock	3%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
51	Longdale	100%
51	Major Co RWD #1	0%
51	North Blaine Water	1%
51	Okarche RWD	8%
51	Oklahoma City	6%
51	Union City	10%
51	Watonga	100%
51	Yukon	30%
52	Dewey Co RWD #3	65%
52	Fairview	16%
52	Major Co RWD #1	5%
52	Mooreland	100%
52	North Blaine Water	0%
52	Quinlan Community RWD #1	13%
52	Seiling	100%
52	Sharon	100%
52	Vici	91%
52	Woodward Co RWD #1	3%
52	Woodward Co RWD #2	47%
53	Beaver	96%
53	Forgan	32%
53	Fort Supply	100%
53	Harper Co Water Corp	3%
53	Laverne	100%
53	Woodward	100%
53	Woodward Co RWD #2	43%
54	Fargo	100%
54	Gage	100%
54	Shattuck	100%
54	Woodward Co RWD #2	10%
55	Beaver	4%
55	Beaver Co RWD #1 (Turpin)	100%
55	Boise City	100%
55	Forgan	9%
55	Goodwell	100%
55	Guymon	100%
55	Hardesty	100%
55	Hooker	100%
55	Keyes	100%
55	Optima	100%
55	Texas Co RWD #1	100%
55	Texhoma	94%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
55	Tyrone	100%
56	Ada	70%
56	Allen	30%
56	Asher	100%
56	Byars	13%
56	Calvin	100%
56	Francis	100%
56	Garvin Co RWD #1	4%
56	Garvin Co RWD #6 (Wells)	0%
56	Holdenville	69%
56	Hughes Co RWD #2	0%
56	Hughes Co RWD #3	7%
56	Hughes Co RWD #4	100%
56	Hughes Co RWD #5	29%
56	Hughes Co RWD #6 (Gerty)	35%
56	Konawa	100%
56	Lexington	75%
56	McClain Co RWD #8	26%
56	Murray Co RWD #1	12%
56	Oklahoma City	6%
56	Pontotoc Co RWD #1 (Homer)	3%
56	Pontotoc Co RWD #7	20%
56	Pontotoc Co RWD #8	86%
56	Pottawatomie Co RWD #3	100%
56	Purcell	19%
56	Sasakwa RWD	79%
56	Stratford	100%
56	Wanette	100%
56	Wayne	69%
57	Blanchard	100%
57	Cole	100%
57	Dibble	30%
57	Goldsby	40%
57	Newcastle	10%
57	Purcell	41%
57	Washington	100%
58	Canadian Co RWD #1	41%
58	Canadian Co Water Authority	44%
58	Geary	29%
58	Goldsby	60%
58	Grady Co RWD #6	19%
58	Lexington	25%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
58	Minco	100%
58	Moore	6%
58	Mustang	60%
58	Newcastle	90%
58	Noble	86%
58	Norman	62%
58	Oklahoma City	9%
58	Purcell	10%
58	Tuttle	100%
58	Union City	90%
58	Yukon	4%
59	Arnett	100%
59	Bridgeport	100%
59	Camargo RWD #2	100%
59	Custer City	66%
59	Custer Co RWD #3	36%
59	Dewey Co RWD #1	100%
59	Dewey Co RWD #3	35%
59	Geary	15%
59	Hinton	64%
59	Hydro	100%
59	Roger Mills RWD #2 (Red Star)	27%
59	Taloga	100%
59	Thomas	100%
59	Vici	9%
59	Washita Co RWD #2	3%
59	Weatherford	100%
60	Beggs	7%
60	Bethany	0%
60	Bristow	100%
60	Carney	74%
60	Chandler	100%
60	Creek Co RWD #1	10%
60	Davenport	100%
60	Depew	100%
60	Edmond	58%
60	Guthrie	3%
60	Jones	1%
60	Kendrick	100%
60	Lincoln Co RWD #1	100%
60	Lincoln Co RWD #2	100%
60	Lincoln Co RWD #3	100%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
60	Lincoln Co RWD #4	32%
60	Logan Co RWD #1	22%
60	Luther	100%
60	Meeker	88%
60	Meridian Water Supply	100%
60	Nichols Hills	90%
60	Okemah	36%
60	Okfuskee Co RWD #1 (Boley)	3%
60	Okfuskee Co RWD #2	37%
60	Okfuskee Co RWD #3	51%
60	Oklahoma City	11%
60	Okmulgee Co RWD #6 (Hectorville RWD #6)	7%
60	Okmulgee Co RWD #7 (Nuyaka)	43%
60	Paden	95%
60	Pottawatomie Co RWD #2 (Tri County)	1%
60	Prague	31%
60	Shawnee	1%
60	Slick	100%
60	Stroud	100%
60	Tryon	3%
60	Wellston	100%
61	Bowlegs Lima Water	7%
61	Maud	58%
61	Oklahoma City	4%
61	Pottawatomie Co Development Authority	0%
61	Sasakwa PWA	100%
61	Sasakwa RWD	21%
61	St Louis RWD	100%
62	Bowlegs Lima Water	27%
62	Brooksville	100%
62	Choctaw	0%
62	Maud	42%
62	Midwest City	0%
62	Moore	93%
62	Noble	14%
62	Norman	38%
62	Oklahoma City	19%
62	Pottawatomie Co Development Authority	46%
62	Pottawatomie Co RWD #2 (Tri County)	15%
62	Tecumseh	33%
63	Carney	26%
63	Covington	90%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
63	Coyle	100%
63	Crescent	10%
63	Douglas	100%
63	Enid	9%
63	Fairmont	2%
63	Garfield Co RWD #1 (Krem-Hill)	0%
63	Garfield Co RWD #5	57%
63	Garfield Co RWD #6	14%
63	Garfield Co RWD #7	13%
63	Lahoma	2%
63	Langston	100%
63	Lincoln Co RWD #4	11%
63	Logan Co RWS & SWMD #3	82%
63	Marshall	100%
63	Mulhall	100%
63	Noble Co RWD #1 (Lucien)	3%
63	Payne Co RW Corp #3	25%
63	Payne Co RWD #3	81%
63	Perkins	100%
63	Ripley	7%
63	Tryon	97%
63	Waukomis	16%
64	Alfalfa Co RWS & SWMD #1 (North)	0%
64	Aline	100%
64	Alva	99%
64	Ames	100%
64	Bethany	14%
64	Calumet	0%
64	Canadian Co RWD #4	62%
64	Carmen	100%
64	Cashion	100%
64	Cimarron City	100%
64	Cleo Springs	100%
64	Crescent	90%
64	Dacoma	100%
64	Deer Creek RW Corp	100%
64	Dover	100%
64	Drummond	100%
64	Edmond	42%
64	Enid	91%
64	Fairview	84%
64	Garfield Co RWD #1 (Krem-Hill)	2%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
64	Garfield Co RWD #5	43%
64	Goltry	93%
64	Guthrie	97%
64	Helena	100%
64	Hennessey	100%
64	Hitchcock	97%
64	Kingfisher	100%
64	Lahoma	98%
64	Logan Co RWD #1	78%
64	Logan Co RWD #2	100%
64	Logan Co RWS & SWMD #3	3%
64	Loyal	100%
64	Major Co RWD #1	95%
64	Meno	100%
64	Nichols Hills	10%
64	North Blaine Water	99%
64	Okarche	100%
64	Okarche RWD	92%
64	Okeene	100%
64	Oklahoma City	10%
64	Piedmont	100%
64	Quinlan Community RWD #1	23%
64	Ringwood	100%
64	Waukomis	84%
64	Waynoka	1%
64	Woods Co RWD #3	44%
65	Beaver Co RWD #2 (Gate)	100%
65	Buffalo	100%
65	Forgan	60%
65	Freedom	100%
65	Harper Co Water Corp	97%
65	Quinlan Community RWD #1	65%
65	Waynoka	99%
65	Woods Co RWD #2	78%
65	Woods Co RWD #3	22%
65	Woodward Co RWD #1	97%
67	Blackwell RW Corp	3%
67	Garfield Co RWD #6	8%
67	Kay Co RWD #3	55%
67	Kay Co RWD #5 (Dale Water Corp)	18%
67	Marland	100%
67	Noble Co RWD #3	15%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
67	Noble Co RWD #4	12%
67	Ponca City	100%
67	Tonkawa	47%
68	Alfalfa Co RWS & SWMD #1 (North)	100%
68	Alva	1%
68	Blackwell RW Corp	28%
68	Burlington	100%
68	Cherokee	100%
68	Deer Creek	100%
68	Enid	0%
68	Garfield Co RWD #1 (Krem-Hill)	80%
68	Garfield Co RWD #6	19%
68	Garfield Co RWD #7	87%
68	Goltry	7%
68	Grant Co RWD #1	100%
68	Hillsdale	100%
68	Jet	100%
68	Lamont	100%
68	Manchester	100%
68	Medford	100%
68	Nash	100%
68	Pond Creek	100%
68	R&C Water Corp	100%
68	SW Water Inc	100%
68	Wakita	100%
68	Woods Co RWD #1	100%
68	Woods Co RWD #3	34%
69	Blackwell	97%
69	Blackwell RW Corp	29%
69	Garfield Co RWD #6	0%
69	Kay Co RWD #3	7%
69	Kay Co RWD #5 (Dale Water Corp)	16%
69	Tonkawa	53%
70	Blackwell	3%
70	Blackwell RW Corp	39%
70	Braman	100%
70	Kay Co RWD #5 (Dale Water Corp)	13%
70	R&C Water Corp	0%
71	51 East Corp	100%
71	Breckinridge	100%
71	Covington	10%
71	Creek Co RWD #10	71%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
71	Creek Co RWD #5	100%
71	Cushing	100%
71	Drumright	100%
71	Fairmont	98%
71	Garber	85%
71	Garfield Co RWD #6	15%
71	Glencoe	100%
71	Grayhorse RWD	51%
71	Hallett	100%
71	Jennings	100%
71	Lincoln Co RWD #4	57%
71	Logan Co RWS & SWMD #3	15%
71	Lone Chimney Water Association	100%
71	Mannford	99%
71	Morrison	100%
71	Noble Co RWD #1 (Lucien)	97%
71	Noble Co RWD #2	80%
71	Oilton	100%
71	Osage	100%
71	Osage Co RWD #21	0%
71	Pawnee	100%
71	Pawnee Co RWD #1	100%
71	Pawnee Co RWD #3	100%
71	Pawnee Co RWD #4	100%
71	Pawnee Co RWD #5	100%
71	Payne Co RW Corp #3	75%
71	Payne Co RWD #3	19%
71	Payne Co RWD #4	100%
71	Perry	100%
71	Prue	100%
71	Ralston	100%
71	Ripley	93%
71	Sand Springs	12%
71	Stillwater	100%
71	Westport	100%
71	Yale	100%
72	Billings	100%
72	Burbank	100%
72	Fairfax	100%
72	Garber	15%
72	Garfield Co RWD #1 (Krem-Hill)	18%
72	Garfield Co RWD #6	43%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
72	Grayhorse RWD	49%
72	Kaw City	100%
72	Kay Co RWD #1	100%
72	Kay Co RWD #2	100%
72	Kay Co RWD #3	38%
72	Kay Co RWD #4	100%
72	Kay Co RWD #5 (Dale Water Corp)	53%
72	Newkirk	100%
72	Noble Co RWD #2	20%
72	Noble Co RWD #3	85%
72	Noble Co RWD #4	88%
72	Osage Co RWD #21	76%
72	Osage Co RWS & SWD #3 (Braden)	100%
72	Red Rock	100%
72	Shidler	100%
73	Broken Arrow	3%
73	Catoosa	39%
73	Owasso	93%
73	Rogers Co RWD #3 Lake Plant	9%
73	Rogers Co RWD #5	16%
73	Sperry	13%
73	Tulsa	52%
73	Washington Co RWD #3	20%
73	Water Improvement District #3	42%
74	Avant	100%
74	Barnsdall	100%
74	Collinsville	1%
74	Hominy	100%
74	Osage Co RWD #1	3%
74	Osage Co RWD #15	100%
74	Osage Co RWD #18 (Evergreen)	100%
74	Osage Co RWD #21	23%
74	Osage Co RWD #5	71%
74	Pawhuska	97%
74	Sand Springs	22%
74	Skiatook	100%
74	Sperry	87%
74	Tulsa	0%
74	Washington Co RWD #3	31%
74	Water Improvement District #3	58%
74	Wynona	100%
75	Collinsville	99%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
75	Owasso	0%
75	Rogers Co RWD #3 Lake Plant	6%
75	Rogers Co RWD #4	46%
75	Tulsa	0%
75	Washington Co RWD #3	49%
76	Bar-Dew Water Assoc Inc	100%
76	Bartlesville	100%
76	Birch Creek RWD	100%
76	Copan	100%
76	Dewey	100%
76	Elm Bend RWD Inc	42%
76	Le Ann Water	100%
76	Nowata Co RW & S District #1	68%
76	Nowata Co RWD #2	1%
76	Ochelata	100%
76	Osage Co RWD #1	97%
76	Osage Co RWD #20 (Hulah)	100%
76	Osage Co RWD #21	1%
76	Osage Co RWD #5	29%
76	Pawhuska	3%
76	Ramona	100%
76	Rogers Co RWD #4	1%
76	Strike-Axe Hwy 60	100%
76	Washington Co RWD #1	100%
76	Washington Co RWD #2	100%
76	Washington Co RWD #3	1%
76	Washington Co RWD #5	100%
77	Broken Arrow	8%
77	Coweta	99%
77	Inola	100%
77	Mayes Co RWD #2	42%
77	Okay	41%
77	Porter	48%
77	Red Bird	11%
77	Rogers Co RWD #5	6%
77	Rogers Co RWD #6	67%
77	Tulahassee	91%
77	Tulsa	2%
77	Wagoner	72%
77	Wagoner Co RWD #1	8%
77	Wagoner Co RWD #4	47%
77	Wagoner Co RWD #5	56%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
77	Wagoner Co RWD #6	95%
77	Wagoner Co RWD #7	58%
78	Catoosa	61%
78	Claremore	97%
78	Mayes Co RWD #2	0%
78	Owasso	7%
78	Rogers Co RWD #2	100%
78	Rogers Co RWD #3 Lake Plant	46%
78	Rogers Co RWD #4	31%
78	Rogers Co RWD #5	78%
78	Rogers Co RWD #6	33%
78	Rogers Co RWD #7	65%
78	Rogers Co RWD #8	100%
78	Rogers Co RWD #9	100%
78	Tulsa	4%
78	Wagoner Co RWD #4	7%
78	Washington Co RWD #3	0%
79	Chelsea	91%
79	Craig Co RWD #2	41%
79	Delaware	100%
79	Elm Bend RWD Inc	58%
79	Lenapah	100%
79	Mayes Co RWD #5	8%
79	Nowata	100%
79	Nowata Co RW & S District #1	32%
79	Nowata Co RWD #2	99%
79	Nowata Co RWD #3	100%
79	Nowata Co RWD #6	100%
79	Nowata Co RWD #7	100%
79	Rogers Co RWD #3 Lake Plant	30%
79	Rogers Co RWD #4	22%
79	South Coffeyville	100%
80	Adair	100%
80	Afton	1%
80	Big Cabin	100%
80	Blue Jacket	100%
80	Chelsea	9%
80	Cherokee Co RWD #1 (Ft Gibson)	63%
80	Cherokee Co RWD #11	100%
80	Cherokee Co RWD #3	82%
80	Cherokee Co RWD #9	100%
80	Chouteau	100%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
80	Claremore	3%
80	Colcord	85%
80	Craig Co RWD #1	100%
80	Craig Co RWD #2	59%
80	Craig Co RWS & SWMD #3	100%
80	Delaware Co RWD #1	100%
80	Delaware Co RWD #3	0%
80	Fort Gibson	14%
80	Hulbert	100%
80	Jay	51%
80	Kansas	66%
80	Ketchum	25%
80	Langley	55%
80	Locust Grove	100%
80	Mayes Co RWD #2	58%
80	Mayes Co RWD #3	4%
80	Mayes Co RWD #4	100%
80	Mayes Co RWD #5	92%
80	Mayes Co RWD #6	100%
80	Mayes Co RWD #7	100%
80	Mayes Co RWD #8	100%
80	Mayes Co RWD #9	100%
80	Muskogee Co RWD #7	5%
80	Oaks Water Works Inc	100%
80	Okay	24%
80	Peggs	100%
80	Pryor	100%
80	Pryor East RWD #1	100%
80	Rogers Co RWD #3 Lake Plant	9%
80	Rogers Co RWD #7	35%
80	Salina	100%
80	Spavinaw	100%
80	Tahlequah	6%
80	Vinita	100%
80	Wagoner	28%
80	Wagoner Co RWD #1	92%
80	Wagoner Co RWD #2	100%
80	Wagoner Co RWD #6	5%
80	Wagoner Co RWD #7	42%
80	Wagoner Co RWD #9	100%
80	Welch	57%
81	Afton	99%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
81	Bernice	100%
81	Commerce	100%
81	Delaware Co RWD #10	100%
81	Delaware Co RWD #3	100%
81	Delaware Co RWD #9	100%
81	Grand Lake	100%
81	Grove	100%
81	Jay	49%
81	Ketchum	75%
81	Langley	45%
81	Mayes Co RWD #3	96%
81	Mayes Co RWD #6	0%
81	Miami	100%
81	Ottawa Co RWD #3	100%
81	Ottawa Co RWD #4	100%
81	Ottawa Co RWD #5	100%
81	Ottawa Co RWD #6	100%
81	Ottawa Co RWD #7	100%
81	Quapaw	100%
81	Quapaw Tribe	100%
81	Welch	43%
82	Adair Co RWD #1 (Cherry Tree)	0%
82	Adair Co RWD #2	85%
82	Adair Co RWD #3	100%
82	Adair Co RWD #4	65%
82	Adair Co RWD #5	100%
82	Adair Co RWS & SWMD #6	100%
82	Burnt Cabin RWD	100%
82	Cherokee Co RWD #12	100%
82	Cherokee Co RWD #13	100%
82	Cherokee Co RWD #2 (Keys)	83%
82	Cherokee Co RWD #3	17%
82	Cherokee Co RWD #7 (Welling)	100%
82	Cherokee Co RWD #8 (Briggs)	100%
82	Colcord	15%
82	Gore	71%
82	Kansas	34%
82	Sequoyah Co RWD #5	40%
82	Sequoyah Co Water Assoc	12%
82	Stick Ross Mt Water Co.	15%
82	Stilwell	3%
82	Tahlequah	94%

Table A.1 Public Water Systems within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of PWS within Basin
82	Watts	100%
82	West Siloam Springs	100%
82	Westville	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
1	Garvin	31%
1	Haworth	100%
1	Idabel	32%
1	Millerton	89%
1	Valliant	63%
2	Broken Bow	0%
2	Idabel	36%
3	Broken Bow	100%
3	Garvin	69%
3	Idabel	32%
3	Millerton	11%
3	Valliant	37%
3	Wright City	100%
4	Broken Bow	0%
4	Smithville	100%
5	Fort Towson	100%
5	Hugo	58%
5	Rattan	100%
5	Sawyer	100%
6	Albion	100%
6	Antlers	100%
6	Clayton	100%
6	Talihina	100%
7	Boswell	62%
7	Soper	100%
8	Ada	3%
8	Allen	75%
8	Ashland	100%
8	Atoka	97%
8	Coalgate	100%
8	Gerty	100%
8	Kiowa	98%
8	Lehigh	100%
8	Phillips	100%
8	Stringtown	100%
9	Ada	39%
9	Atoka	3%
9	Boswell	38%
9	Bromide	100%
9	Caddo	40%
9	Caney	100%
9	Centrahoma	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
9	Fitzhugh	1%
9	Stonewall	100%
9	Tupelo	100%
9	Tushka	100%
9	Wapanucka	100%
10	Bennington	9%
10	Hugo	42%
11	Bennington	91%
11	Bokchito	100%
11	Caddo	60%
12	Ada	2%
12	Armstrong	100%
12	Durant	89%
12	Fitzhugh	97%
12	Hickory	10%
12	Kenefic	100%
12	Milburn	100%
12	Roff	100%
12	Silo	48%
13	Achille	100%
13	Calera	100%
13	Colbert	100%
13	Durant	11%
13	Hendrix	100%
13	Kemp	100%
14	Ardmore	48%
14	Bray	100%
14	Byars	87%
14	Davis	100%
14	Dickson	47%
14	Dougherty	100%
14	Duncan	30%
14	Elmore City	100%
14	Foster	100%
14	Gene Autry	100%
14	Katie	100%
14	Lone Grove	17%
14	Marlow	52%
14	Pauls Valley	100%
14	Ratliff City	100%
14	Rush Springs	100%
14	Springer	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
14	Sulphur	100%
14	Tatums	100%
14	Velma	100%
14	Wynnewood	100%
15	Alex	1%
15	Blanchard	0%
15	Bradley	100%
15	Dibble	68%
15	Erin Springs	100%
15	Lindsay	100%
15	Maysville	100%
15	Paoli	100%
15	Purcell	5%
15	Wayne	52%
16	Alex	99%
16	Amber	100%
16	Anadarko	66%
16	Binger	100%
16	Blanchard	1%
16	Bridge Creek	1%
16	Cement	100%
16	Chickasha	100%
16	Cyril	100%
16	Dibble	1%
16	Fletcher	22%
16	Gracemont	100%
16	Hinton	28%
16	Lookeba	100%
16	Ninnekah	100%
16	Norge	100%
16	Pocasset	100%
16	Verden	100%
17	Anadarko	34%
17	Carnegie	2%
17	Fort Cobb	100%
18	Colony	100%
18	Eakly	100%
19	Arapaho	100%
19	Bessie	100%
19	Burns Flat	77%
19	Butler	100%
19	Canute	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
19	Carnegie	98%
19	Clinton	100%
19	Cooperton	100%
19	Cordell	100%
19	Corn	100%
19	Custer City	95%
19	Foss	100%
19	Gotebo	100%
19	Hobart	22%
19	Leedey	13%
19	Mountain View	100%
20	Cheyenne	100%
20	Hammon	100%
20	Leedey	87%
20	Reydon	100%
20	Strong City	100%
21	Ardmore	52%
21	Dickson	53%
21	Durant	0%
21	Hickory	90%
21	Kingston	100%
21	Leon	100%
21	Lone Grove	39%
21	Madill	100%
21	Mannsville	100%
21	Marietta	100%
21	Mead	100%
21	Mill Creek	100%
21	Oakland	100%
21	Ravia	100%
21	Ryan	7%
21	Silo	52%
21	Terral	100%
21	Thackerville	100%
21	Tishomingo	100%
21	Woodville	100%
22	Healdton	96%
22	Lone Grove	44%
22	Wilson	100%
23	Comanche	30%
23	Cornish	100%
23	Duncan	0%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
23	Healdton	4%
23	Loco	100%
23	Ringling	100%
24	Hastings	100%
24	Ryan	93%
24	Sugden	100%
24	Waurika	87%
25	Central High	100%
25	Comanche	7%
25	Duncan	20%
25	Elgin	31%
25	Empire City	63%
25	Fletcher	44%
25	Marlow	48%
25	Sterling	100%
26	Addington	100%
26	Comanche	62%
26	Duncan	50%
26	Empire City	37%
26	Waurika	13%
27	Temple	34%
27	Walters	24%
28	Apache	100%
28	Elgin	69%
28	Fletcher	33%
28	Geronimo	100%
28	Lawton	96%
28	Medicine Park	100%
28	Walters	41%
29	Cache	100%
29	Chattanooga	75%
29	Faxon	100%
29	Indiahoma	100%
29	Lawton	4%
29	Walters	35%
30	Chattanooga	25%
30	Frederick	43%
30	Grandfield	52%
30	Hollister	100%
30	Loveland	100%
30	Manitou	100%
30	Randlett	1%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
31	Davidson	100%
31	Devol	100%
31	Frederick	57%
31	Grandfield	48%
31	Randlett	99%
31	Temple	66%
32	Tipton	100%
33	Altus	75%
33	Headrick	77%
33	Mountain Park	100%
33	Snyder	100%
34	Burns Flat	23%
34	Dill City	100%
34	Elk City	100%
34	Headrick	23%
34	Hobart	78%
34	Lone Wolf	100%
34	Rocky	100%
34	Sentinel	100%
35	Cooperton	0%
35	Roosevelt	100%
36	Carter	1%
36	Granite	16%
36	Willow	100%
37	Carter	99%
37	Elk City	0%
37	Erick	100%
37	Sayre	100%
37	Sweetwater	100%
37	Texola	95%
38	Altus	25%
38	Blair	100%
38	East Duke	100%
38	Elmer	33%
38	Gould	15%
38	Mangum	66%
38	Martha	100%
38	Olustee	100%
39	Mangum	16%
40	Eldorado	100%
40	Elmer	67%
41	Gould	85%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
41	Hollis	100%
42	Granite	84%
42	Mangum	17%
43	Texola	5%
44	Arkoma	99%
44	Panama	100%
44	Pocola	91%
44	Rock Island	0%
44	Spiro	17%
45	Bokoshe	100%
45	Cameron	100%
45	Fanshawe	100%
45	Heavener	100%
45	Howe	100%
45	Le Flore	100%
45	McCurtain	17%
45	Pocola	9%
45	Poteau	100%
45	Red Oak	100%
45	Rock Island	100%
45	Shady Point	100%
45	Wilburton	100%
45	Wister	100%
46	Cowlington	100%
46	Fort Coffee	100%
46	Gans	100%
46	Keota	100%
46	Kinta	100%
46	Marble City	100%
46	McCurtain	83%
46	Moffett	100%
46	Muldrow	100%
46	Quinton	100%
46	Roland	100%
46	Sallisaw	100%
46	Spiro	83%
46	Stilwell	13%
46	Tamaha	99%
46	Vian	100%
47	Braggs	100%
47	Checotah	100%
47	Fort Gibson	83%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
47	Gore	32%
47	Muskogee	75%
47	Oktaha	100%
47	Porum	100%
47	Rentiesville	100%
47	Stigler	100%
47	Summit	100%
47	Tamaha	1%
47	Wainwright	100%
47	Warner	100%
47	Webbers Falls	100%
47	Whitefield	100%
48	Alderson	100%
48	Beggs	90%
48	Bowlegs	46%
48	Canadian	100%
48	Carlton Landing	100%
48	Clearview	100%
48	Council Hill	100%
48	Cromwell	10%
48	Crowder	100%
48	Dewar	100%
48	Dustin	100%
48	Earlsboro	3%
48	Eufaula	100%
48	Grayson	100%
48	Haileyville	100%
48	Hanna	100%
48	Hartshorne	100%
48	Henryetta	100%
48	Hitchita	100%
48	Hoffman	100%
48	Holdenville	51%
48	Horntown	100%
48	Indianola	100%
48	Kiowa	2%
48	Krebs	100%
48	Lamar	100%
48	Lima	100%
48	McAlester	100%
48	Morris	100%
48	Okmulgee	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
48	Pittsburg	100%
48	Savanna	100%
48	Schulter	100%
48	Seminole	100%
48	Stidham	100%
48	Stuart	100%
48	Vernon	100%
48	Weleetka	100%
48	Wetumka	48%
48	Wewoka	100%
48	Winchester	23%
48	Yeager	100%
49	Beggs	6%
49	Bixby	100%
49	Boynton	100%
49	Broken Arrow	67%
49	Coweta	78%
49	Glenpool	100%
49	Haskell	100%
49	Jenks	100%
49	Kellyville	100%
49	Kiefer	100%
49	Liberty	100%
49	Mannford	3%
49	Mounds	100%
49	Muskogee	22%
49	Porter	34%
49	Redbird	89%
49	Sand Springs	96%
49	Sand Springs	0%
49	Sapulpa	100%
49	Sapulpa	0%
49	Slick	2%
49	Taft	100%
49	Tallahassee	11%
49	Tulsa	41%
49	Winchester	77%
50	Bearden	100%
50	Bethany	40%
50	Bethel Acres	94%
50	Boley	100%
50	Castle	95%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
50	Choctaw	100%
50	Cromwell	90%
50	Del City	100%
50	Earlsboro	93%
50	Forest Park	14%
50	Harrah	98%
50	Johnson	100%
50	Jones	99%
50	Jones	0%
50	McLoud	100%
50	Meeker	12%
50	Midwest City	99%
50	Moore	1%
50	Mustang	69%
50	Nicoma Park	100%
50	Okemah	90%
50	Oklahoma City	31%
50	Oklahoma City	0%
50	Paden	6%
50	Pink	5%
50	Prague	52%
50	Shawnee	99%
50	Smith Village	100%
50	Spencer	100%
50	Tecumseh	67%
50	Valley Brook	100%
50	Warr Acres	3%
50	Wetumka	52%
50	Yukon	1%
51	Bethany	47%
51	Calumet	100%
51	Canton	100%
51	El Reno	88%
51	Geary	34%
51	Greenfield	100%
51	Longdale	100%
51	Oklahoma City	8%
51	Union City	21%
51	Warr Acres	0%
51	Watonga	77%
51	Woodlawn Park	100%
51	Yukon	99%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
52	Mooreland	100%
52	Mutual	100%
52	Seiling	100%
52	Sharon	100%
52	Vici	44%
53	Beaver	39%
53	Forgan	46%
53	Fort Supply	100%
53	Knowles	96%
53	Laverne	100%
53	May	100%
53	Rosston	100%
53	Woodward	100%
54	Fargo	100%
54	Gage	100%
54	Shattuck	100%
55	Beaver	61%
55	Boise City	100%
55	Goodwell	100%
55	Guymon	100%
55	Hardesty	100%
55	Hooker	100%
55	Keyes	100%
55	Optima	100%
55	Texhoma	100%
55	Tyrone	100%
56	Ada	56%
56	Allen	25%
56	Asher	100%
56	Atwood	100%
56	Byars	13%
56	Byng	100%
56	Calvin	100%
56	Fitzhugh	2%
56	Francis	100%
56	Holdenville	49%
56	Konawa	100%
56	Lexington	72%
56	Purcell	13%
56	Rosedale	100%
56	Slaughterville	42%
56	Spaulding	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
56	Stratford	100%
56	Tribbey	4%
56	Wanette	100%
56	Wayne	48%
57	Blanchard	98%
57	Blanchard	0%
57	Bridge Creek	31%
57	Bridge Creek	0%
57	Bridge Creek	0%
57	Cole	100%
57	Dibble	31%
57	Goldsby	29%
57	Newcastle	18%
57	Newcastle	0%
57	Purcell	44%
57	Washington	100%
58	Blanchard	1%
58	Bridge Creek	68%
58	Bridge Creek	0%
58	El Reno	1%
58	Geary	45%
58	Goldsby	71%
58	Lexington	28%
58	Minco	100%
58	Minco	0%
58	Moore	6%
58	Mustang	31%
58	Newcastle	82%
58	Newcastle	0%
58	Newcastle	0%
58	Newcastle	0%
58	Noble	86%
58	Norman	21%
58	Norman	0%
58	Oklahoma City	13%
58	Purcell	37%
58	Slaughterville	44%
58	Tuttle	100%
58	Tuttle	0%
58	Union City	79%
58	Union City	0%
59	Arnett	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
59	Bridgeport	100%
59	Camargo	100%
59	Custer City	5%
59	Geary	21%
59	Hinton	72%
59	Hydro	100%
59	Oakwood	100%
59	Putnam	100%
59	Taloga	100%
59	Thomas	100%
59	Vici	56%
59	Weatherford	100%
60	Agra	77%
60	Arcadia	100%
60	Beggs	4%
60	Bethany	0%
60	Bristow	100%
60	Carney	74%
60	Castle	5%
60	Chandler	100%
60	Davenport	100%
60	Depew	100%
60	Edmond	78%
60	Fallis	100%
60	Forest Park	86%
60	Harrah	2%
60	IXL	100%
60	Jones	1%
60	Kendrick	100%
60	Lake Aluma	100%
60	Luther	100%
60	Meeker	88%
60	Meridian	100%
60	Nichols Hills	87%
60	Nichols Hills	0%
60	Okemah	10%
60	Oklahoma City	16%
60	Oklahoma City	0%
60	Paden	94%
60	Prague	48%
60	Shamrock	100%
60	Shawnee	1%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
60	Slick	98%
60	Sparks	100%
60	Stroud	100%
60	Tryon	4%
60	Warr Acres	15%
60	Warwick	100%
60	Wellston	100%
61	Maud	59%
61	Sasakwa	100%
61	St. Louis	100%
61	Tribbey	30%
62	Bethel Acres	6%
62	Bowlegs	54%
62	Brooksville	100%
62	Earlsboro	3%
62	Etowah	100%
62	Macomb	100%
62	Maud	41%
62	Midwest City	1%
62	Moore	94%
62	Noble	14%
62	Norman	79%
62	Oklahoma City	16%
62	Pink	95%
62	Shawnee	0%
62	Slaughterville	13%
62	Tecumseh	33%
62	Tribbey	66%
63	Breckenridge	1%
63	Carney	26%
63	Covington	100%
63	Coyle	100%
63	Crescent	2%
63	Douglas	100%
63	Enid	86%
63	Fairmont	54%
63	Langston	100%
63	Marshall	100%
63	Mulhall	100%
63	North Enid	100%
63	Orlando	68%
63	Perkins	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
63	Ripley	6%
63	Tryon	96%
63	Waukomis	70%
64	Aline	100%
64	Alva	42%
64	Ames	100%
64	Bethany	13%
64	Carmen	100%
64	Carrier	100%
64	Cashion	100%
64	Cedar Valley	100%
64	Cimarron City	100%
64	Cleo Springs	100%
64	Crescent	98%
64	Dacoma	100%
64	Dover	100%
64	Drummond	100%
64	Edmond	22%
64	El Reno	11%
64	Enid	10%
64	Fairview	100%
64	Goltry	84%
64	Guthrie	100%
64	Helena	100%
64	Hennessey	100%
64	Hitchcock	100%
64	Kingfisher	100%
64	Lahoma	100%
64	Loyal	100%
64	Meno	100%
64	Nichols Hills	13%
64	Okarche	100%
64	Okeene	100%
64	Oklahoma City	15%
64	Piedmont	100%
64	Ringwood	100%
64	The Village	100%
64	Warr Acres	82%
64	Watonga	23%
64	Waukomis	30%
64	Waynoka	13%
65	Buffalo	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
65	Forgan	54%
65	Freedom	100%
65	Gate	100%
65	Knowles	4%
65	Waynoka	87%
67	Kildare	65%
67	Marland	53%
67	Newkirk	99%
67	Ponca City	38%
67	Tonkawa	95%
68	Alva	58%
68	Amorita	100%
68	Burlington	100%
68	Byron	100%
68	Capron	100%
68	Cherokee	100%
68	Deer Creek	100%
68	Enid	0%
68	Goltry	16%
68	Hillsdale	100%
68	Jefferson	100%
68	Jet	100%
68	Kremlin	100%
68	Lambert	100%
68	Lamont	100%
68	Manchester	99%
68	Medford	100%
68	Nash	100%
68	Pond Creek	100%
68	Renfrow	100%
68	Tonkawa	5%
68	Wakita	100%
69	Blackwell	97%
69	Tonkawa	0%
70	Blackwell	3%
70	Braman	100%
71	Agra	23%
71	Blackburn	100%
71	Breckenridge	69%
71	Cleveland	100%
71	Cushing	100%
71	Drumright	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
71	Enid	0%
71	Fairmont	46%
71	Garber	86%
71	Glencoe	100%
71	Hallett	100%
71	Jennings	100%
71	Lawrence Creek	100%
71	Lone Chimney	100%
71	Mannford	97%
71	Maramec	100%
71	Morrison	100%
71	Mule Barn	100%
71	Oak Grove	100%
71	Oilton	100%
71	Orlando	32%
71	Osage	100%
71	Pawnee	100%
71	Perry	100%
71	Prue	100%
71	Quay	100%
71	Ralston	100%
71	Ripley	94%
71	Sand Springs	2%
71	Skedee	100%
71	Skiatook	0%
71	Stillwater	100%
71	Terlton	100%
71	Westport	100%
71	Yale	100%
72	Billings	100%
72	Breckenridge	30%
72	Burbank	100%
72	Enid	4%
72	Fairfax	100%
72	Foraker	100%
72	Garber	14%
72	Grainola	100%
72	Hunter	100%
72	Kaw City	100%
72	Kildare	35%
72	Marland	47%
72	Newkirk	1%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
72	Ponca City	62%
72	Red Rock	100%
72	Shidler	100%
72	Webb City	100%
73	Broken Arrow	2%
73	Catoosa	44%
73	Owasso	88%
73	Sperry	7%
73	Tulsa	46%
74	Avant	100%
74	Barnsdall	100%
74	Collinsville	1%
74	Hominy	100%
74	Owasso	0%
74	Pawhuska	100%
74	Sand Springs	2%
74	Skiatook	86%
74	Sperry	93%
74	Tulsa	0%
74	Vera	17%
74	Wynona	100%
75	Claremore	0%
75	Collinsville	99%
75	Owasso	11%
75	Ramona	18%
75	Skiatook	14%
75	Tulsa	0%
75	Vera	83%
76	Bartlesville	100%
76	Copan	100%
76	Dewey	100%
76	Ochelata	100%
76	Ramona	82%
76	Wann	100%
77	Broken Arrow	28%
77	Coweta	22%
77	Fair Oaks	53%
77	Inola	100%
77	Muskogee	1%
77	Okay	100%
77	Porter	66%
77	Redbird	11%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
77	Tulahassee	89%
77	Tulsa	5%
77	Wagoner	63%
78	Broken Arrow	2%
78	Catoosa	56%
78	Catoosa	0%
78	Claremore	97%
78	Fair Oaks	47%
78	Fair Oaks	0%
78	Foyil	100%
78	Oologah	100%
78	Owasso	1%
78	Talala	100%
78	Tulsa	7%
78	Valley Park	100%
78	Verdigris	100%
79	Delaware	100%
79	Jamestown	100%
79	Lenapah	100%
79	New Alluwe	100%
79	Nowata	100%
79	South Coffeyville	100%
80	Adair	100%
80	Big Cabin	100%
80	Bluejacket	100%
80	Chelsea	100%
80	Chouteau	100%
80	Claremore	2%
80	Colcord	86%
80	Disney	20%
80	Fort Gibson	17%
80	Hoot Owl	100%
80	Hulbert	100%
80	Jay	42%
80	Kansas	76%
80	Ketchum	51%
80	Langley	93%
80	Locust Grove	100%
80	Muskogee	2%
80	Oaks	100%
80	Pensacola	100%
80	Pryor	100%

Table A.2 Communities within OCWP Planning Basins

Basin Number	Public Water System	Approximate Percentage of Municipality within Basin
80	Salina	100%
80	Spavinaw	100%
80	Sportsmen Acres	100%
80	Strang	100%
80	Tahlequah	18%
80	Vinita	100%
80	Wagoner	37%
80	Welch	100%
81	Afton	100%
81	Bernice	100%
81	Commerce	100%
81	Disney	80%
81	Fairland	100%
81	Grand Lake Towne	100%
81	Grove	100%
81	Jay	58%
81	Ketchum	49%
81	Langley	7%
81	Miami	100%
81	North Miami	100%
81	Peoria	100%
81	Quapaw	100%
81	Wyandotte	100%
82	Colcord	14%
82	Gore	68%
82	Kansas	24%
82	Oaks	0%
82	Paradise Hill	100%
82	Stilwell	87%
82	Tahlequah	82%
82	Watts	100%
82	West Siloam Springs	100%
82	Westville	100%



APPENDIX B 2025 H2O TOOL REPORT



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Abbreviations

AF	acre-feet
AFY	acre-feet per year
AGW	alluvial groundwater
BGW	bedrock groundwater
.CSV	comma-separated value, comma delimited text files
EPA	Environmental Protection Agency
H2O Tool	Oklahoma H2O Tool, 2025 Tool
HUC	Hydrologic Unit Code
MOVE2	Maintenance of Variance Extension
NED	National Elevation Database
OCWP	Oklahoma Comprehensive Water Plan
OWRB	Oklahoma Water Resources Board
SWMM	Storm Water Management Model
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

SECTION 1 INTRODUCTION

The Oklahoma H2O Tool was originally developed in 2012 as a joint effort between CDM Smith, the Oklahoma Water Resources Board (OWRB), and the United States Army Corps of Engineers (USACE). The Oklahoma H2O Tool (referred to herein as the "Original Tool") provides a computational platform for use in support of the 2012 Update of the Oklahoma Comprehensive Water Plan (2012 OCWP). The Original Tool was built to model an estimate of physical water supply availability for 82 surface water planning basins representing the entirety of the State of Oklahoma and compare each basin's water supply to projections of future water demand to identify "gaps" in water supply.

The Original Tool was developed primarily within Microsoft Access, which was then utilized to perform the functions described above. This format aggregated numerous data sets to perform a large number of calculations manufactured within the code of the database itself, generating outputs used to populate independently developed graphics and tables comprising the 2012 OCWP Report and its supporting documentation.

The 2025 Update to the OCWP (i.e., the "2025 OCWP") has provided the opportunity to develop an enhanced, updated tool (referred to herein as the "2025 Tool") more readily updatable with the most recently available data sources, and capable of performing water supply planning calculations in a format constructed to support internal OWRB analyses as well as external-facing, web-based reporting. The framework of this new approach entails the 2025 Tool, which generates model output which informs analyses used to populate one (or more) databases that populate a backend dashboard(s). To accomplish this, the 2025 Tool has been migrated to a PCSWMM model framework, evaluated to confirm accuracy within the underlying calculations of demand and supply throughout the 82-basin network covering the state of Oklahoma, and extended with additional hydrology up through 2021.

This report serves as the documentation of this development of the 2025 Tool and will inform upon later reporting of supply/gap analyses of water demand. It is organized by the following areas.

- Key Assumptions
- Model Structure
- Data Sources
- Example Basin Structure
- Model Calibration
- Key Design Enhancements
- Model Outputs

1.1 Key Assumptions

The 2025 Tool has been developed to perform supply availability calculations based on the following key assumptions.

1. [Surface water availability for meeting future demand can be adequately represented through the characterization of observed historical variations in streamflow.](#)

The primary assumption of the 2025 Tool is that historically observed streamflows over the 1950 to 2021 period inherently reflect conditions where existing surface water demands were met and thus provide an adequate representation of the potential surface water supply available for potential future demands greater than those demands observed historically. It has been assumed that current surface water

demand, diversions, return flows, and reservoir operations are embedded in the streamflow data and that supply shortages for existing demands have been negligible. Given this assumption, the model has been constructed for the evaluation of only the *incremental* increases in demand for future decades when assessing available streamflow and supply gaps.

2. Historical streamflow records account for reservoir operations.

The United States Geological Survey (USGS) maintains a network of gauges for monitoring streamflow (and other data) throughout the United States. The historical record of streamflow observations reflects the effects of past and present reservoir operations, including diversions from the reservoir, evaporative losses, reservoir releases, and other reservoir operational elements. As reservoir operations are assumed to be a part of the gauged record, representations of existing reservoirs are not explicitly included in the model unless the reservoir has supply volume that has not been utilized.

3. Oklahoma has access to only 40 percent of surface water inflows from out of state.

The State of Oklahoma is a party to four separate interstate stream compacts involving surface water that flow into or out of Oklahoma. These are the Canadian River Compact among New Mexico, Texas, and Oklahoma; the Arkansas River Basin Compact between Kansas and Oklahoma; the Arkansas River Basin Compact between Arkansas and Oklahoma; and the Red River Compact among Arkansas, Louisiana, Oklahoma, and Texas. To conservatively estimate streamflow for planning basins receiving water from contributing watersheds located outside of Oklahoma, conditions of the applicable compact have been assumed whereby flow is reduced by 60 percent. For the baseline application of the 2025 Tool for the present planning process, wherein historical hydrology is utilized to characterize flow availability (1 and 2 above), it has been assumed that in a future condition the upstream state consumptively uses surface water supplies such that only 40 percent of the gaged record of flow is available for use within Oklahoma.

4. The 2025 Tool models water supply availability and water demands on a monthly timestep.

Although the PCSWMM platform utilized as the basis for the 2025 Tool can perform simulations at a small timestep (minutes), a monthly timestep is initially used so that results of the 2025 Tool can be compared to the results of the Original Tool. However, the 2025 Tool is run at a daily timestep, and the results are aggregated to monthly output for reporting and direct comparison to the Original Tool. The timestep of measurements, or estimates thereof, utilized within the 2025 Tool can vary (a listing of the sources of data utilized is presented later herein).

For example, while long-term historical observations of streamflow from USGS gauges are typically available as a time series of daily average flows, incremental water demands for different categories of use (e.g., Public Supply, Self-Supplied Industrial, Crop Irrigation) are generally estimated by their monthly variations. Further, throughout the period of record, there are periods where surface water data are missing (e.g., a gauge having gone offline, or discontinued). To reduce the computational complexities in estimating such missing records when having to account for travel-times of individual watershed events (e.g., high flow pulses, floods) that can vary from watershed to watershed, statistical methods employing a monthly timestep have been used.

5. Surface water directly connects to alluvial groundwater.

Alluvial groundwater (AGW) is the groundwater adjacent to a stream that is directly recharged by the hydraulically connected surface water source. This hydraulic connection means that a diversion from an AGW source results in a commensurate reduction in the streamflow of the surface water source connected to the alluvial aquifer. It is therefore assumed that the source of supply for AGW use is surface water only. There is no additional AGW recharge within the model.

Within each basin, the 2025 Tool reduces the available surface water supply by the surface water diversions first, and then subsequently the AGW diversions. For a given month, if the available

streamflow in a basin is less than the AGW demand, then a depletion of the AGW occurs. In the following month, if there is sufficient streamflow available to meet that month's demand and refill the alluvial aquifer depletion, then the aquifer is recharged. Thus, the 2025 Tool has been constructed to model the impact of recharging of the alluvial aquifer on downstream water availability.

6. Constant groundwater recharge rates for bedrock groundwater aquifers estimated for the 2012 OCWP have been used in this analysis.

For the 2012 OCWP, recharge estimates for the bedrock groundwater (BGW) aquifers were determined from available literature (see Attachment 1). County specific recharge rates were used, when available, to distribute aquifer-based rates to OCWP basins. Recharge rates are assumed to be distributed evenly across the aquifer or county.

7. Return flows are generated based on the volume of demand satisfied.

For the purposes of the 2025 OCWP, the 2025 Tool has been developed to capture a more accurate representation of calculated return flows in a basin. The Original Tool calculated return flows for only those demands that were met without causing a depletion in surface water storage, AGW storage, or BGW storage. For the present effort, the return flow calculation has been revised such that all water uses that would generate a return flow will generate a return flow from a future incremental demand (if that demand could be met by its source supply).

For example, if a future incremental demand in a basin were calculated to exceed the recharge rate of a BGW source - and thus cause a depletion of the BGW storage - all the demand (including the volume that resulted in a depletion) would be utilized to calculate an estimated return flow. This approach has been utilized as it is recognized that a use of water, even water from storage, would result in a discharge of return flows.

8. Planning horizon is 2020 through 2075.

For the purposes of the 2025 Update to the OCWP, the 2025 Tool calculates estimates of decadal supply availability relative to incremental future demands over the planning horizon, from 2020 through 2075.

Key to the analyses performed utilizing the 2025 Tool are the two uses of the term *incremental* in the above assumptions, as the basin-level planning analyses of physical water availability performed for the purposes of the 2025 OCWP Update must simultaneously consider each. The two uses of this term are differentiated for clarity here:

- The incremental flow for each basin – As downstream gauged records reflect upstream activities, it is necessary to evaluate each basin's physical water availability by first characterizing each basin's incremental flow amount.
- Incremental demand - The 2025 Tool facilitates the comparative assessment of the *incremental* additional demand beyond present-day demands. As past- and present- water demands are already reflected in the historical gauged record, incremental future demands are utilized within the 2025 Tool to assess physical water availability.

SECTION 2 MODEL STRUCTURE

The 2025 Tool is a model developed in PCSWMM. The PCSWMM software (available by CHI), provides graphical and GIS tools to manage model inputs and output. PCSWMM's computation engine from the United States Environmental Protection Agency (EPA) SWMM5, a free publicly available Storm Water Management Model (SWMM) software. Therefore, PCSWMM - as well as the EPA SWMM5 - can be used to run model simulations, providing an open model structure that has been supported since 1972 and used across the globe. This model has been used for the present effort to represent the 82 planning basins utilized for evaluation of water supply availability and calculating gaps in physical water supply based on assumed water demand conditions. Figure 1 illustrates major river segments and the connectivity of the planning basins as now represented within the 2025 Tool in the PCSWMM environment.

The 2025 Tool allows a user to perform a basin level mass balance of incremental water supplies available for a specified future demand scenario, with consideration for the potential impact of upstream planning basins on downstream planning basins. The mass balance calculation of the water supplies within a basin is performed at the outlet of the basin, where all tributary inflows and all basin-wide demands would have had an impact on available water supplies.

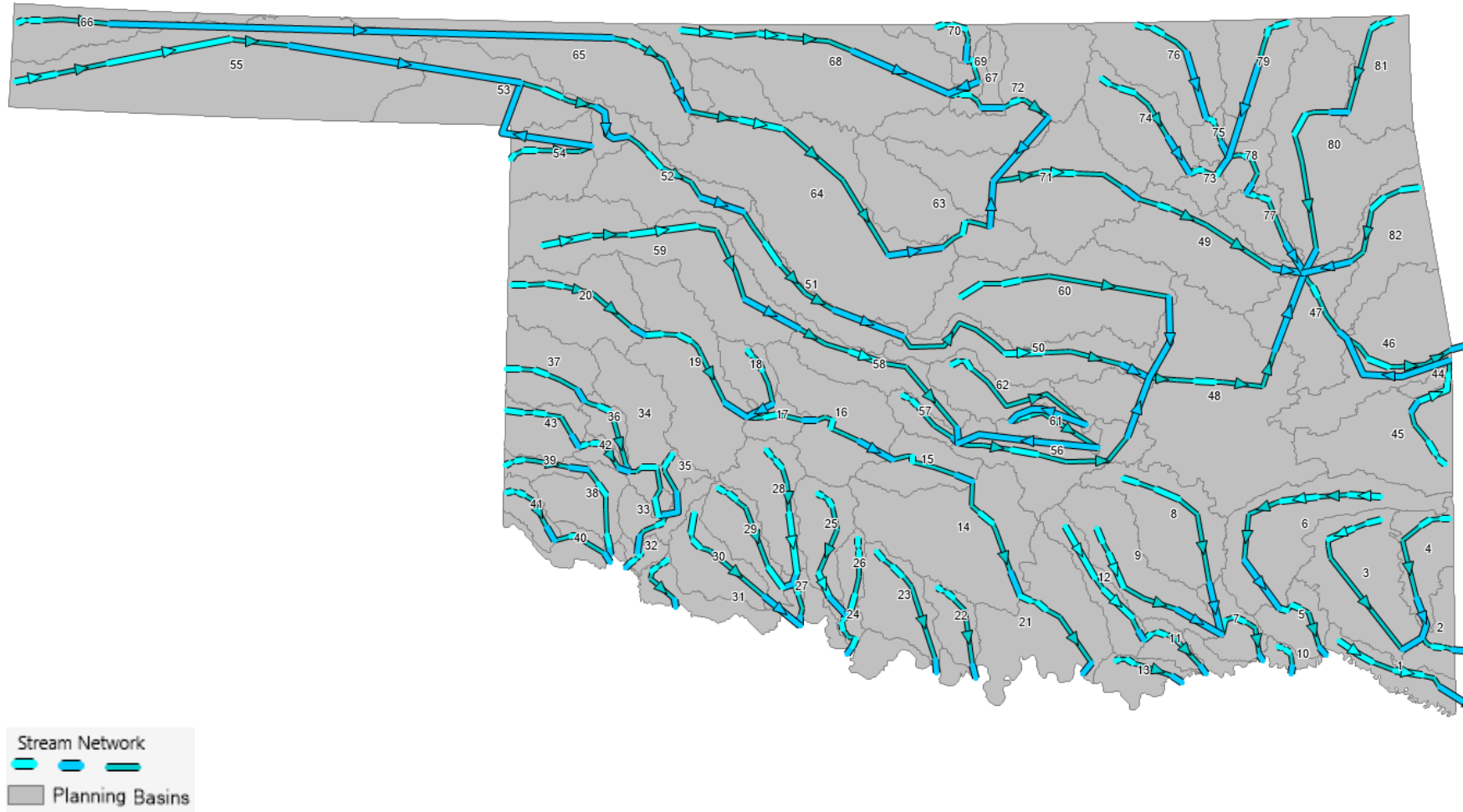


Figure 1 2025 Tool Structure Overview

2.1 Model Elements

The basin level mass balance modeled within the 2025 Tool is composed of numerous elements. For each basin, a schematic of these supply, demand, and diversion elements has been constructed (an example of which is shown in Figure 2). The 2025 Tool has been developed not to represent any hydrologic or hydraulic elements but rather serves as an additive water balance routing tool that graphically represents, in a simplified structure, the elements and the routes where water is conveyed in only an upstream to downstream direction to each basin's outlet. The 2025 Tool consists of the following elements.

1. Junctions: Model nodes that link conduits and do not store water.
2. Outfalls: Model nodes that serve as an end point where flow leaves the model.
3. Storages: Model nodes where water is held per a defined storage curve. Outlets and weirs (defined below) can only originate from a storage node. These elements are utilized in the 2025 Tool to represent AGW/BGW/Reservoir storage capacity.
4. Conduits: Model linkages that allow water to flow from one model point to another.
5. Outlets: Model linkages that divert flow from storage nodes using rating curves. These are employed to represent the demand diversions within a planning basin.
6. Weirs: Model element utilized to move flow from storage nodes downstream. In the context of the 2025 Tool, weirs are used as a conduit to maintain stream continuity when a storage node is utilized and forces the storage node to free flow to the next downstream node.

While various water sources and demands typically vary geographically throughout a basin, within the model the available supplies and demands located throughout a basin are reflected through the calculated mass balance located at the downstream outlet of a particular basin, using each of the elements where applicable. These elements perform as objects in the model framework wherein physical characteristics (e.g., inflow, outflow, storage, demand) are represented. Some of these elements incorporate upstream and/or out of basin effects (such as interbasin transfers), and surface water/AGW interactions.

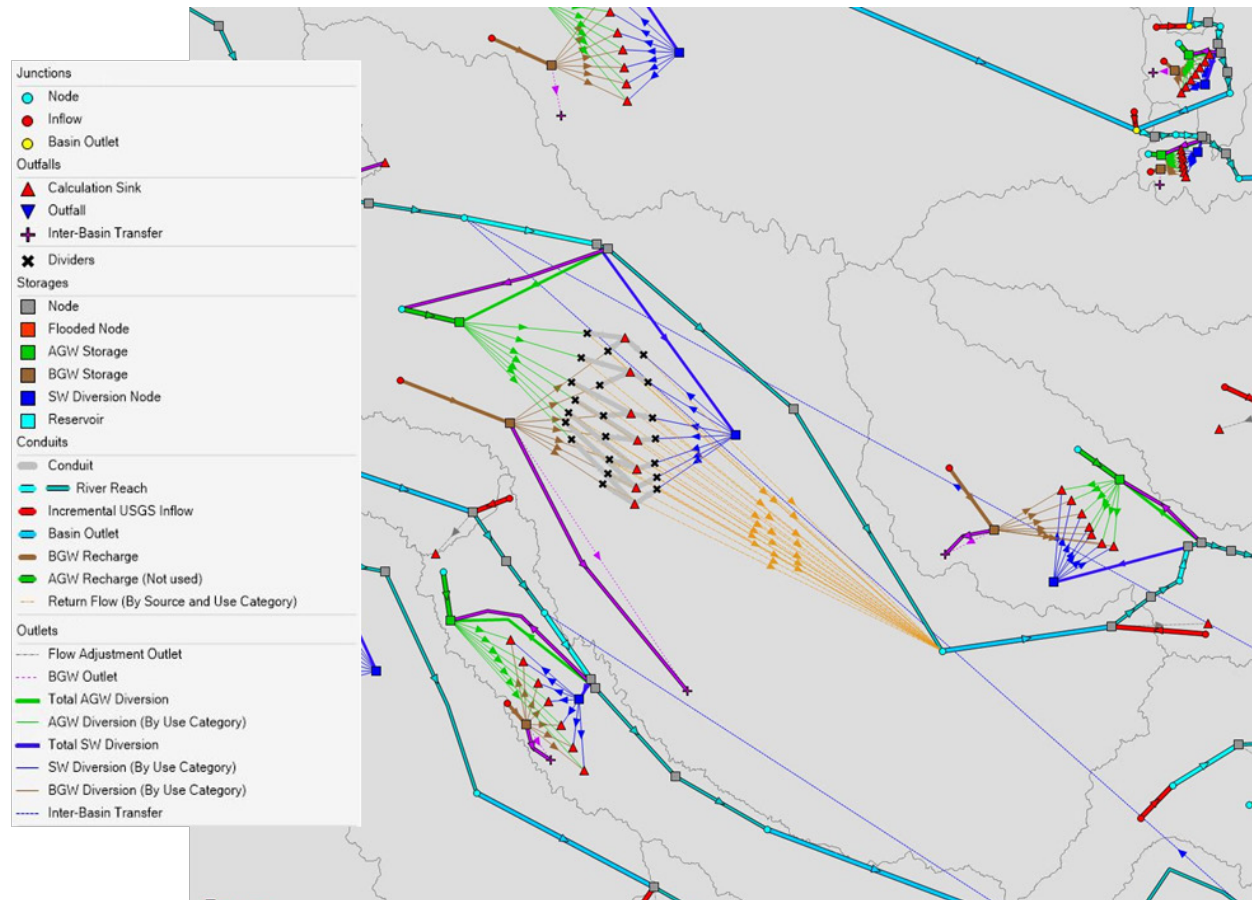


Figure 2 2025 Tool Schematic of Planning Basin Analysis Elements

2.2 Data Input

The PCSWMM interface allows the capability to access all model elements, their input, and output data via a graphical user interface. Data can also be input using automated scripts. The ability to develop and execute scripts within the PCSWMM environment allows for an increased efficiency in inputting large volumes of data. Additionally, existing data can be readily revised and updated, and model simulation results can be retrieved and written to an external file for post processing or visualization.

The script for importing model parameter data into the 2025 Tool has been programmed to import data from Microsoft Excel-based .XLSX files; however, additional scripts could be written to read input data from delimited text, comma-separated values (CSV), or alternatively formatted .XLSX files. The scripts developed for the 2025 Tool have been designed to import a specific dataset into the model and write that data into the appropriate variables. The source .XLSX file must have data fields representing the target model element and related variable. The following data have been imported into the 2025 Tool via scripts.

- Decadal incremental average flow demands (e.g., 2025, 2035, 2060, 2075) for all basins, source types, and use categories
- Basin-specific monthly water demand curves (applying monthly variability to the average decadal demands)
- BGW recharge rates
- BGW, AGW and surface water reservoir storage capacities

2.3 Model Controls

Operational control rules in the model are programmed, conditional statements that can interact with controlled model elements (identified above). The model uses operational control rules for several important purposes. These rules are used to simulate demands at specific nodes and determine how flow regulation (e.g., demand diversion, recharge rates, and storage limiters) will be adjusted over the course of a simulation. Operational control rules are conditional statements programmed directly into the model as an attribute of the model element being controlled. Figure 3 shows the control rules editor and examples of the rules coded into the model.

Within the 2025 Tool the control rules can be used to apply monthly patterns to vary the flow demand at diversions and engage model elements that operate contingent on storage volumes in aquifers (AGW and BGW) or reservoir refilling elements. PCSWMM's elements - such as pumps, weirs, and outlets - do not represent physical infrastructure. Rather, these elements have been employed in the 2025 Tool to facilitate the water accounting simulation of intricate demand calculations and flow diversions.

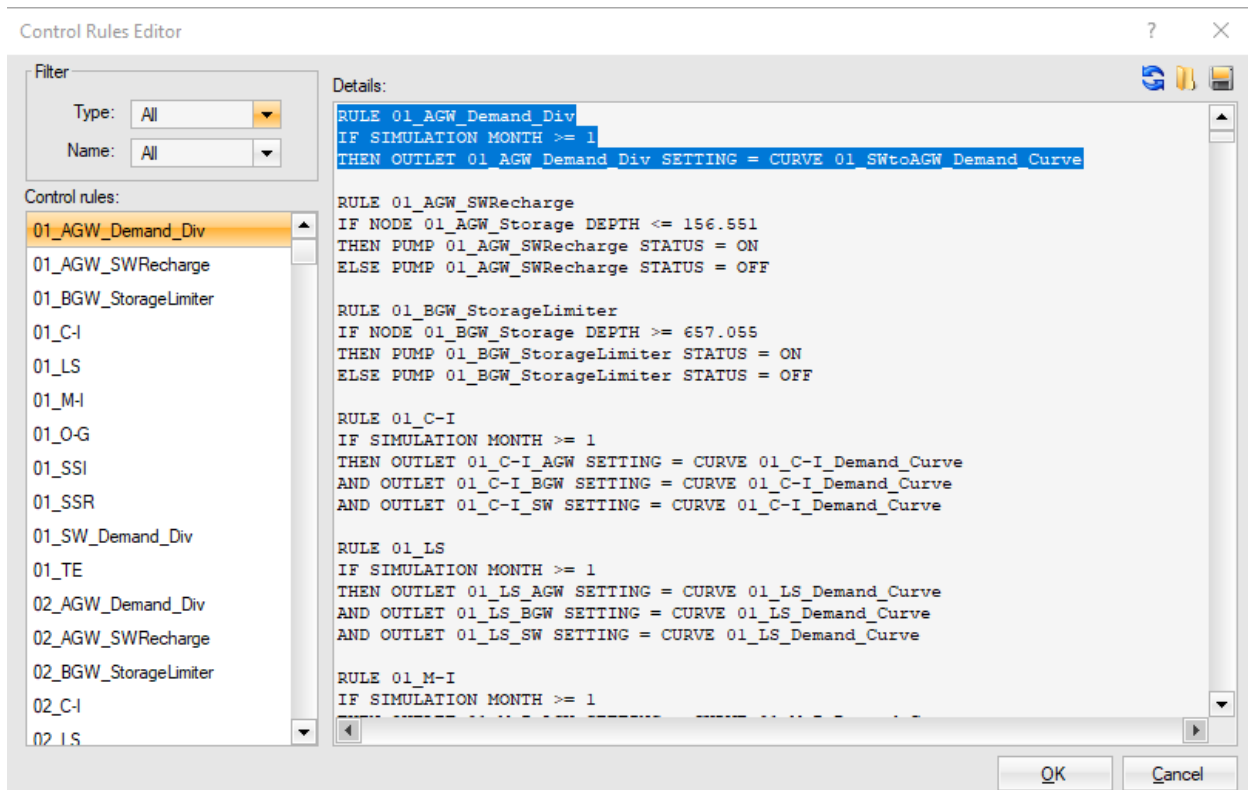


Figure 3 PCSWMM Control Rules Editor

SECTION 3 DATA SOURCES

The 2025 Tool has been constructed to rely on historically observed data from several sources, as described in detail below. These sources of data serve as inputs to the calculations of mass balance incrementally derived for each basin. These sources are organized as: streamflow (supplies), interbasin transfers, return flows, and storage.

3.1 Streamflow

The input of streamflow into the 2025 Tool is comprised of a time series dataset of monthly incremental flow values (in units of acre-feet [AF]) which have been discretized to daily average flow amounts (in units of cubic feet per second) for the modeled period of record, 1950 through 2021. The incremental monthly flow volume-time series has been pre-processed using Excel from aggregated monthly USGS streamflow gauge data that has been translated to the planning basin outlet.

The Original Tool included a dataset of monthly flow volumes for the 82 planning basins derived from USGS gauge data for the period October 1949 through September 2007. The flow dataset for the 2025 Tool has been extended to include monthly flow volumes derived from USGS gauge data through September 2021. For each planning basin, a USGS gauge representing the streamflow leaving the basin has been identified as the planning basin's "primary gauge."

3.1.1 USGS Streamflow Gauge Selection

For the present effort, USGS streamflow gauges were used to determine the monthly streamflow from October 1949 to September 2021 (water years 1950 through 2021). This period of record provides streamflow data for the three previous major hydrologic droughts (1952 through 1956, 1961 through 1972, and 1976 through 1981), as well as recent intense droughts. The USGS streamflow gauge locations utilized in the development of the 2021 OCWP were utilized in the development of the current OCWP. The periods of record for USGS streamflow gauges in Oklahoma and in surrounding states were downloaded from the USGS streamflow website, waterdata.usgs.gov. USGS gauges with a long period of record, preferably with flow data in the 1950s were used to determine the surface water supply for each basin where available. Gauges that are at or near a basin outlet, gauges that isolate a reservoir, gauges that isolate an area of intense demand, or gauges that divide large tributary areas were also preferentially selected to determine the surface water supply for each basin when available. The selected gauges are shown in Figure 4.

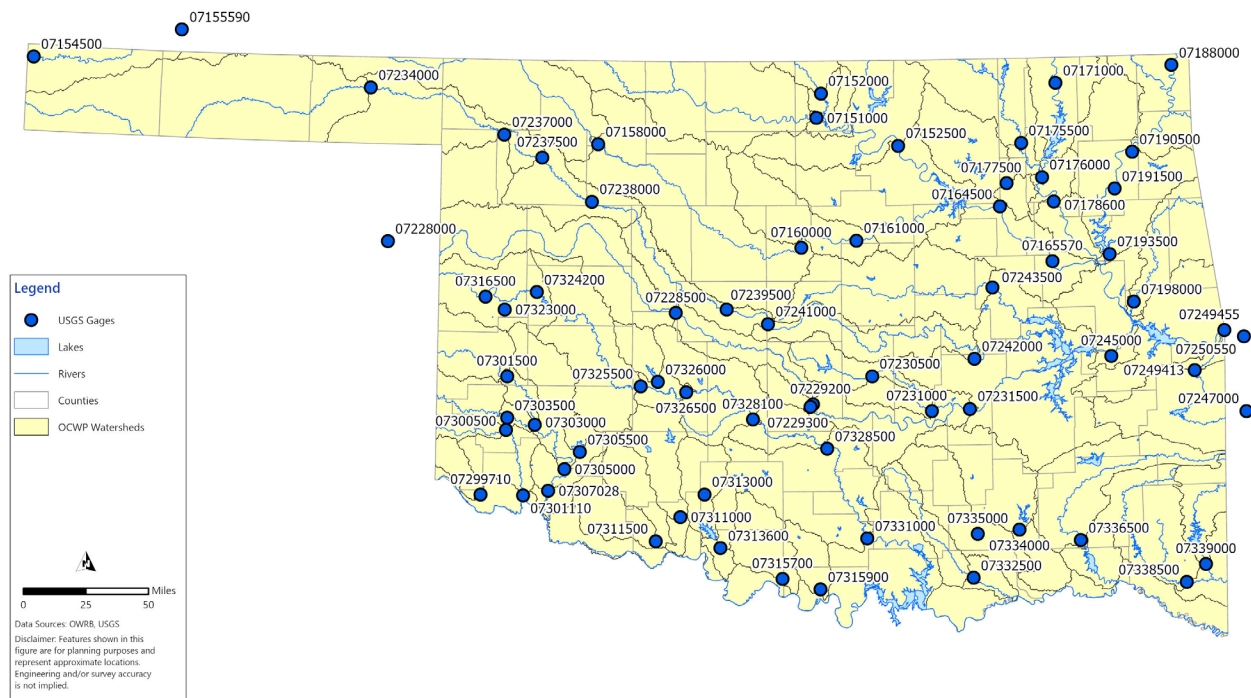


Figure 4 Selected USGS Streamflow Gauges for Calculation of Surface Water Supplies

3.1.2 Filling Streamflow Records with MOVE2 Technique

Periods of missing data were filled based on the hydrologic patterns in nearby gaged streams using the Maintenance of Variance Extension (MOVE2) statistical technique (Hirsch 1982). MOVE2 is a statistical flow record extension technique that fills missing data in a streamflow record (y) based on the flow in a nearby reference stream gage (x). The technique shown in the equation below uses the mean (m) and standard deviation (s) of the flow in each of the two streams. The MOVE2 technique was applied to monthly volume of flow data in units of AF.

$$y_i = m_y + \frac{s_y}{s_x} \times (x_i - m_x)$$

Figures 5 and 6 provide examples of how a missing portion of the monthly flow record for USGS Gauge No. 07160000 (a "target" gauge) was filled using surface water data from USGS Gauge No. 07161000 (the "reference" gauge).

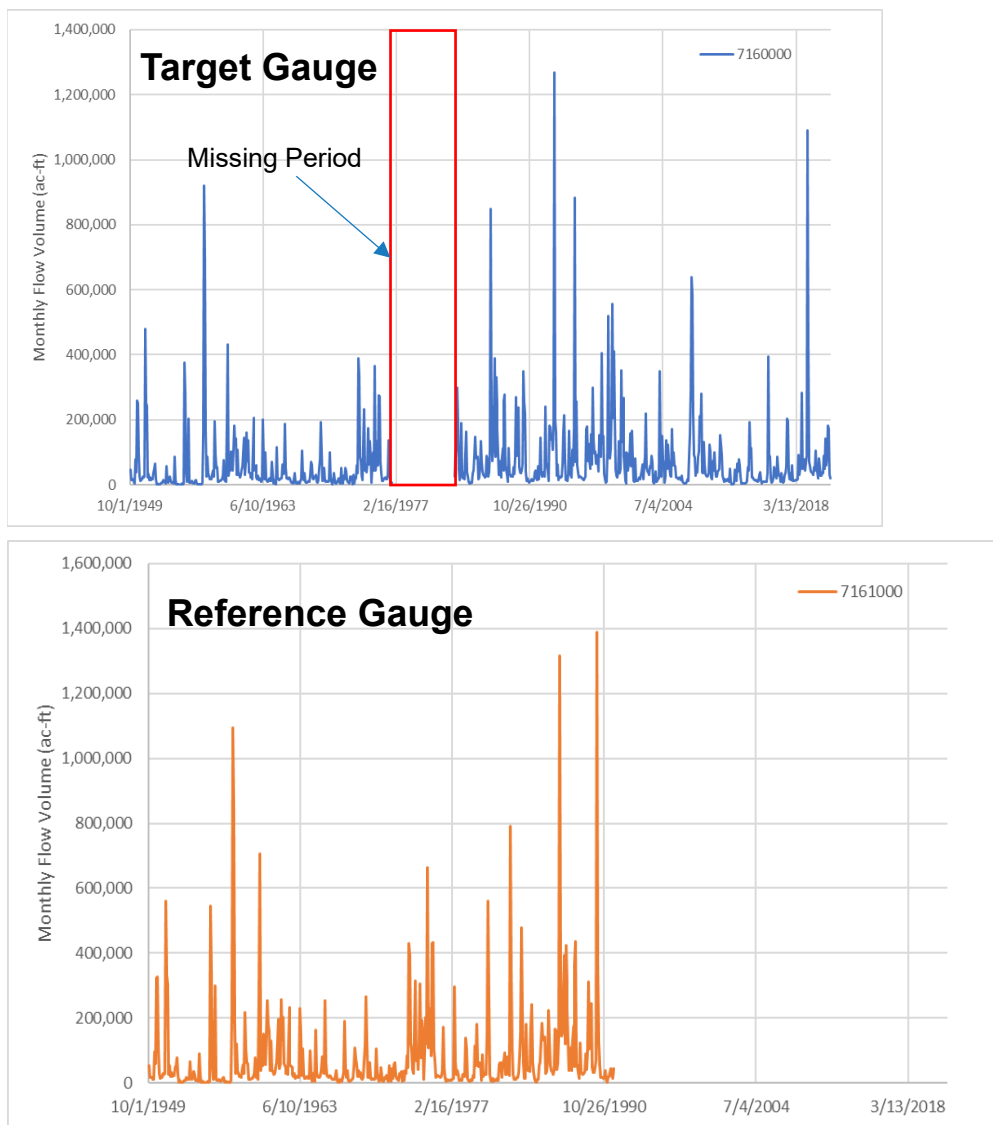


Figure 5 Example of Gap in Observed Surface Water Flow from USGS Gauge No. 07160000 and Reference Surface Water Flows from USGS Gauge No. 07161000 (AF)

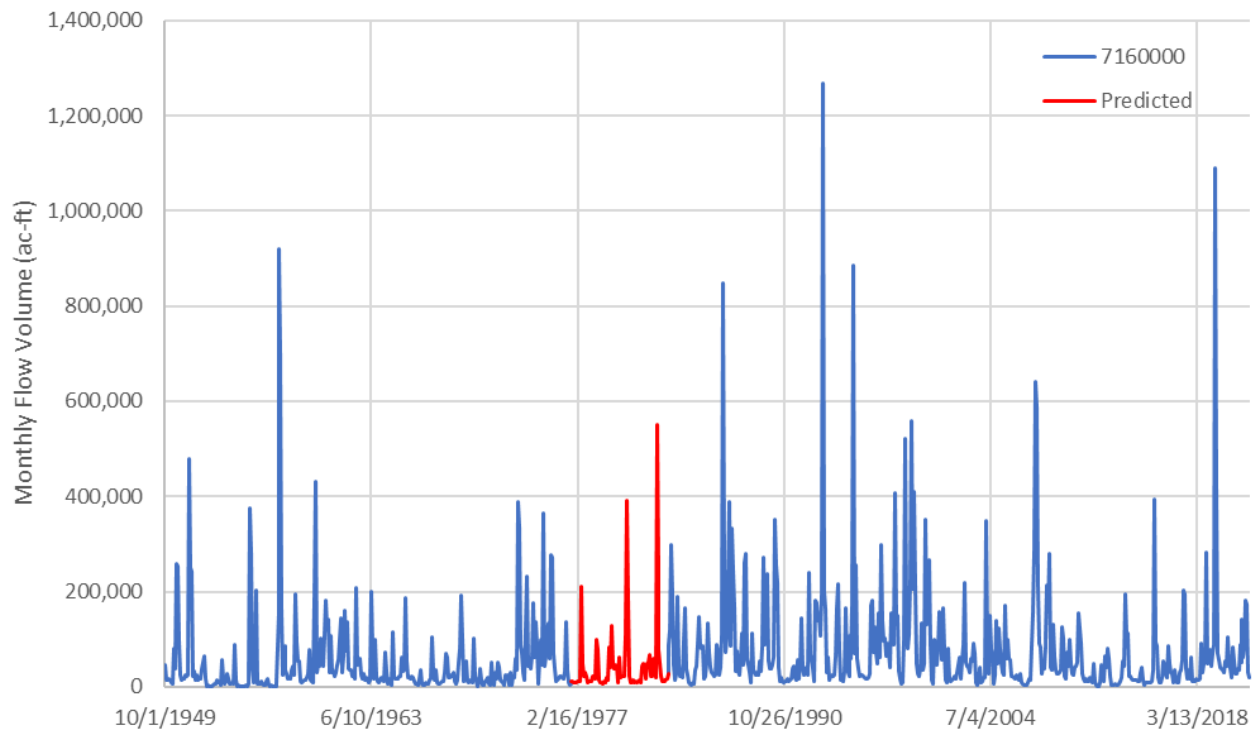


Figure 6 Filled Surface Water Record for USGS Gauge No. 07160000 using Predicted Estimates from MOVE2 Analysis

The selection of an appropriate reference gage is an important aspect of applying the MOVE2 technique. Due to Oklahoma's pronounced east-west precipitation gradient, it was preferred that only nearby reference gages were selected. Additionally, streamflow records that are measured with and without a reservoir can substantially affect the streamflow estimation therefore, reference basins with major reservoirs were avoided where possible. Table 1 provides a list of the planning basins, along with key elements utilized for the calculation of the complete time series of incremental flows at each basin's outlet. The following information is included in Table 1.

- Selected USGS gauge for the planning basin
- Indication if the surface water calculation includes out-of-state flows
- Methodology employed for filling gaps in the gauge record
- Reference gauge for filling the missing data (if required)
- Method of translating flow data from the gauge to the basin outlet
- Additional inflow sources included in the flow record (unit area flow ratio only)

Those planning basins wherein the primary gauge is located at the basin outlet and has a complete period of record are described as "Direct Gauge Record" in the "Translation to Basin Outlet Method" column of Table 1. A graphical summary of the USGS gages with data gaps filled using MOVE2 and the reference gauge utilized is presented in Figure 7.

Table 1 Planning Basin Information on Primary Gauge, Gap Filling, Reference Gauge, Translation Method for Surface Water Representation

Basin	Primary Gauge ID	Primary Gauge Name	Out of State Flows	Gap Filling Method	Gap Reference Gauge ID	Gap Reference Gauge Name	Translation to Basin Outlet Method	Additional Inflow Source included in Unit Area Flow Calculation
1	7338500	Little River blw Lukfata Creek, nr Idabel, OK	No				Unit Area Flow	
2	7339000	Mountain Fork near Eagletown, OK	No				Unit Area Flow	Basins 3 and 4
3	7338500	Little River blw Lukfata Creek, nr Idabel, OK	No				Direct Gauge Record	
4	7339000	Mountain Fork near Eagletown, OK	Yes				Direct Gauge Record	
5	7336500	Kiamachi River near Belzoni, OK	No	MOVE2	7334000	Muddy Boggy Creek near Farris, OK	Area Ratio	
6	7336500	Kiamachi River near Belzoni, OK	No	MOVE2	7334000	Muddy Boggy Creek near Farris, OK	None	
7	7334000	Muddy Boggy Creek near Farris, OK	No				Unit Area Flow	
8	7334000	Muddy Boggy Creek near Farris, OK	No				Direct Gauge Record	
9	7335000	Clear Boggy Creek near Caney, Ok	No	MOVE2	7332500	Blue River near Blue, OK	Area Ratio	
10	7332500	Blue River near Blue, OK	No				Unit Area Flow	
11	7332500	Blue River near Blue, OK	No				Area Ratio	
12	7332500	Blue River near Blue, OK	No				Direct Gauge Record	
13	7332500	Blue River near Blue, OK	No				Unit Area Flow	
14	7331000	Washita River near Dickson, OK	No				Direct Gauge Record	
15	7328500	Washita River near Pauls Valley, OK	No				Direct Gauge Record	
16	7328100	Washita River at Alex, OK	No	MOVE2	7328500	Washita River near Pauls Valley, OK	None	
17	7326500	Washita River at Anadarko, OK	No	MOVE2	7325500	Washita River Carnegie, OK	None	
18	7326000	Cobb Creek near Fort Cobb, OK	No				Direct Gauge Record	
19	7325500	Washita River Carnegie, OK	No	MOVE2	7326500	Washita River at Anadarko, OK	None	
20	7324200	Washita River near Hammon, OK	Yes	MOVE2	7316500	Washita River near Cheyenne, OK	Area Ratio	
21	7332500	Blue River near Blue, OK	No				Unit Area Flow	Basin 14
22	7315900	Walnut Bayou near Burneyville, OK	No	MOVE2	07313000 and 07315700	Little Beaver Creek near Duncan, OK Mud Creek near Courtney, OK	Area Ratio	
23	7315700	Mud Creek near Courtney, OK	No	MOVE2	7311000	East Cache Creek near Walters, OK	Area Ratio	
24	7313600	Cow Creek at Waurika, Ok	No				Unit Area Flow	Basin 25
25	7313000	Little Beaver Creek near Duncan, OK	No	MOVE2	7311000	East Cache Creek near Walters, OK	Area Ratio	
26	7313600	Cow Creek at Waurika, Ok	No	MOVE2	7311000	East Cache Creek near Walters, OK	None	
27	7311000	East Cache Creek near Walters, OK	No				Unit Area Flow	
28	7311000	East Cache Creek near Walters, OK	No	MOVE2	7311500	Deep Red Creek near Randlett, OK	None	
29	7311500	Deep Red Creek near Randlett, OK	No		7311500	Deep Red Creek near Randlett, OK	Unit Area Flow	
30	7311500	Deep Red Creek near Randlett, OK	No				Direct Gauge Record	
31	7311500	Deep Red Creek near Randlett, OK	No				Unit Area Flow	
32	7307028	North Fork Red River near Tipton, OK	No				Unit Area Flow	Basin 33
33	7307028	North Fork Red River near Tipton, OK	No	MOVE2	7305000	North Fork Red River near Headrick, OK	None	
34	7305000	North Fork Red River near Headrick, OK	No				Direct Gauge Record	
35	7305500	West Otter Creek at Snyder Lk nr Mt Park, OK	No	MOVE2	7305000	North Fork Red River near Headrick, OK	None	
36	7303000	North Fork Red River blw Altus Dam nr Lugert, OK	No	MOVE2	7301500	North Fork Red River near Carter, OK	None	
37	7301500	North Fork Red River near Carter, OK	Yes	MOVE2	7323000	Sandstone Creek near Cheyenne, OK	None	
38	7301110	Salt Fork Red River near Elmer, OK	No	MOVE2	7300500	Salt Fork Red River at Mangum, OK	None	
39	7300500	Salt Fork Red River at Mangum, OK	Yes				Direct Gauge Record	
40	7299710	Sandy Creek near Eldorado, OK	No				Unit Area Flow	

Basin	Primary Gauge ID	Primary Gauge Name	Out of State Flows	Gap Filling Method	Gap Reference Gauge ID	Gap Reference Gauge Name	Translation to Basin Outlet Method	Additional Inflow Source included in Unit Area Flow Calculation
41	7299710	Sandy Creek near Eldorado, OK	Yes	MOVE2	7300500	Salt Fork Red River at Mangum, OK	None	
42	7303500	Elm Fork of North Fork Red River nr Mangum, OK	No	MOVE2	7300500	Salt Fork Red River at Mangum, OK	Area Ratio	
43	7303500	Elm Fork of North Fork Red River nr Mangum, OK	Yes	MOVE2	7300500	Salt Fork Red River at Mangum, OK	Area Ratio	
44	7249413	Poteau River near Panama, OK	No	MOVE2	7247000	Poteau River at Cauthron, AR	Area Ratio	
45	7249413	Poteau River near Panama, OK	Yes	MOVE2	7247000	Poteau River at Cauthron, AR	None	
46	7250550	AR River at James W Trimble L&D nr Van Buren, AR	Yes	MOVE2	7249455	Arkansas River at Ft. Smith, Ar.	None	
47	7250550	AR River at James W Trimble L&D nr Van Buren, AR	No				Unit Area Flow	Basins 48, 49, 77, 80, 82
48	7245000	Canadian River near Whitefield, OK	No				Direct Gauge Record	
49	7165570	Arkansas River near Haskell, OK	No	MOVE2	7164500	Arkansas River at Tulsa, OK	None	
50	7242000	North Canadian River near Wetkuma, OK	No				Direct Gauge Record	
51	7241000	North Canadian River blw lk Overholser nr OKC, OK	No	MOVE2	7239500	North Canadian River near El Reno, OK	None	
52	7238000	North Canadian River near Seiling, OK	No				Area Ratio	
53	7237500	North Canadian River at Woodward, OK	Yes				Direct Gauge Record	
54	7237000	Wolf Creek near Fort Supply, OK	Yes	MOVE2	7237500	North Canadian River at Woodward, OK	None	
55	7234000	Beaver River at Beaver, OK	Yes				Direct Gauge Record	
56	7231500	Canadian River at Calvin, OK	No				Direct Gauge Record	
57	7229300	Walnut Creek at Purcell, OK	No	MOVE2	7230500	Little River near Tecumseh, OK	None	
58	7229200	Canadian River at Purcell, OK	No	MOVE2	7228500	Canadian River at Bridgeport OK	None	
59	7228500	Canadian River at Bridgeport OK	Yes	MOVE2	7239500	North Canadian River near El Reno, OK	None	
60	7243500	Deep Fork near Beggs, OK	No				Direct Gauge Record	
61	7231000	Little River near Sasakwa, OK	No	MOVE2	7230500	Little River near Tecumseh, OK	None	
62	7230500	Little River near Tecumseh, OK	No				Area Ratio	
63	7161000	Cimarron River at Perkins, OK	No	MOVE2	7160000	Cimarron River near Guthrie, OK	None	
64	7160000	Cimarron River near Guthrie, OK	No	MOVE2	7161000	Cimarron River at Perkins, OK	None	
65	7158000	Cimarron River near Waynoka, OK	Yes				Direct Gauge Record	
66	7155590	CIMARRON R NR ELKHART, KS	Yes	MOVE2	7154500	Cimarron River near Kenton, OK	Area Ratio	
67	7152000	Chikaskia River near Blackwell, OK	No				Unit Area Flow	Basin 68
68	7151000	Salt Fork Arkansas River at Tonkawa, OK	Yes				Direct Gauge Record	
69	7152000	Chikaskia River near Blackwell, OK	No	MOVE2	7151000	Salt Fork Arkansas River at Tonkawa, OK	Area Ratio	
70	7152000	Chikaskia River near Blackwell, OK	Yes	MOVE2	7151000	Salt Fork Arkansas River at Tonkawa, OK	None	
71	7164500	Arkansas River at Tulsa, OK	No				Area Ratio	
72	7152500	Arkansas River at Ralston, OK	Yes				Direct Gauge Record	
73	7177500	Bird Creek near Sperry, OK	No				Area Ratio	
74	7177500	Bird Creek near Sperry, OK	No				Direct Gauge Record	
75	7175500	Caney River near Ramona, OK	No				Area Ratio	
76	7175500	Caney River near Ramona, OK	Yes				Direct Gauge Record	
77	7178600	Verdigris River near Inola, OK	No	MOVE2	7176000	Verdigris River near Claremore, OK	Area Ratio	
78	7178600	Verdigris River near Inola, OK	No	MOVE2	7176000	Verdigris River near Claremore, OK	None	
79	7171000	Verdigris River near Lenapah, OK	Yes				Area Ratio	
80	7193500	Neosho River blw Ft Gibson Lake nr Ft Gibson, OK	Yes	MOVE2	7191500	Neosho River near Chouteau, OK	None	
81	7190500	Neosho River near Langley, OK	Yes	MOVE2	7188000	Spring River near Quapaw, OK	None	
82	7198000	Illinois River near Gore, OK	Yes				Direct Gauge Record	

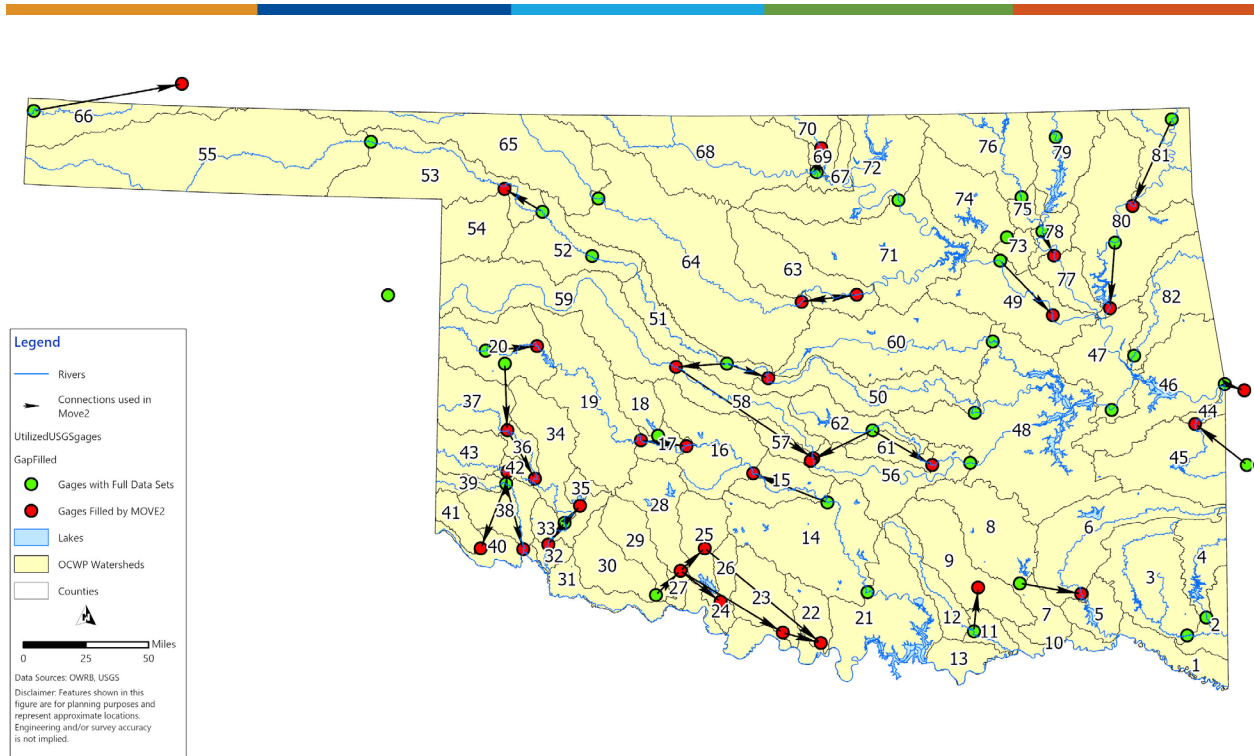


Figure 7 Summary of USGS Streamflow Gages with Data Gaps Filled

3.1.3 Allocating Streamflow to Basins

Monthly average and median surface water supply was determined using the gage data at the outlet of each basin. Since high-quality gages are not located exactly at the outlet of each basin, adjustments were made to the measured flow to synthetically produce a gage at the outlet. The location of the gages relative to the basin outlet is shown in Figure 8. The following tree typical scenarios were identified for the location of preferred gages within a basin.

- A gage was located at or near the basin outlet.
- A gage was located on the basin's major stream but was located upstream or downstream of the basin outlet.
- A gage could not be used to directly measure the surface water supply in the basin.

Where there was no gage located at or near the basin outlet, a synthetic flow was generated based on measured flow data at a reference gage. The synthetic flow was generated by multiplying the monthly unit flow (AF/square mile/month) of the reference gage by the tributary area of the synthetic gage. Thirty-three of the 82 OCWP basins required the generation of synthetic flows, and 19 of the 33 synthetic flow basins use a gage located away from the basin outlet on the same stream or river. Table 2 identifies the planning basins for which the drainage area ratio or unit area flow methods were used, the reference gauge/basin, and the drainage area employed in the calculations. Drainage areas reported in Table 2 have been estimated using reported USGS gage total drainage area or GIS estimated basin area based on Hydrologic Unit Codes (HUC) 12 drainage basin areas and OWRB stream system management basins. Estimated areas presented may differ from total basin areas from other reports due to differences in watershed area estimation methods and spatial resolutions.

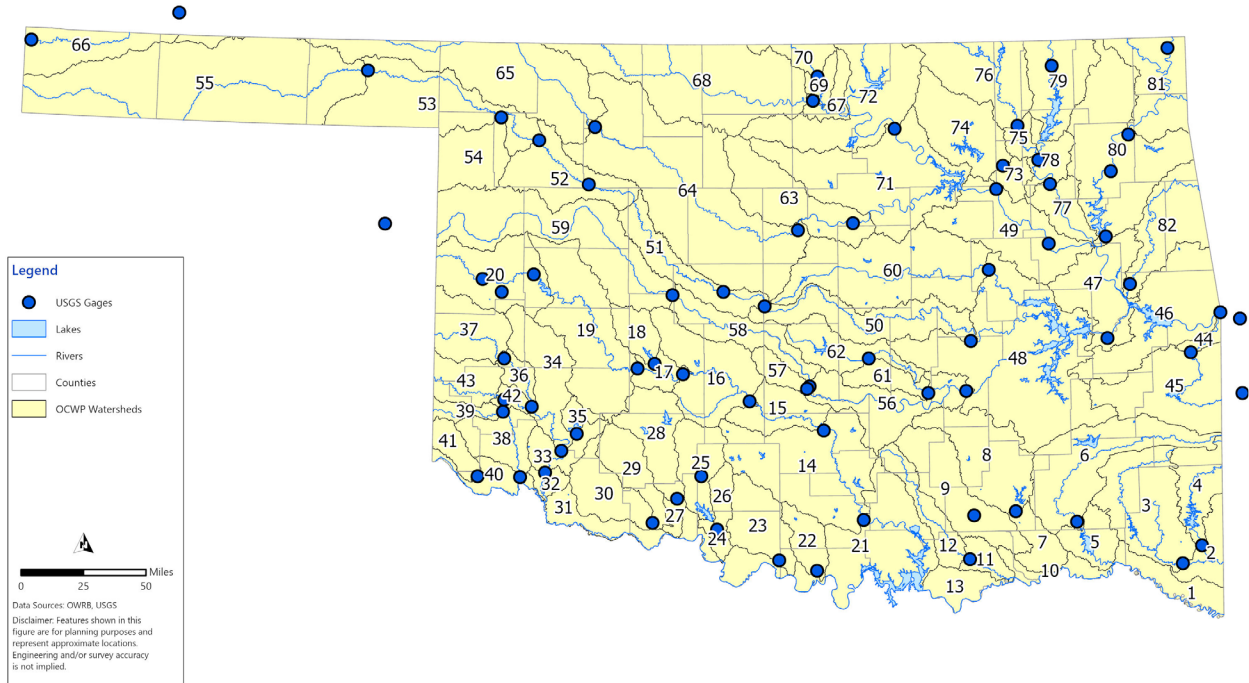


Figure 8 Watershed Boundaries of Oklahoma Stream Systems

Table 2 Planning Basin Drainage Areas Used for Translation to Basin Outlet

Basin	Translation Method	Total Basin Drainage Area (sq-mi)	Reference Gauge/Basin	Reference Drainage Area (sq-mi)
1	Unit Area Flow	414.94	Basin 3	1,228
2	Unit Area Flow	351.73	Basin 4	800
5	Area Ratio	1802.49 ⁽¹⁾	07336500	1,423
7	Unit Area Flow	347.57	Basin 8	1,089
9	Area Ratio	1067.02	07335000	713
10	Unit Area Flow	211.92	Basin 12	477
11	Area Ratio	696.68 ⁽²⁾	07332500	477
13	Unit Area Flow	327.35	Basin 12	477
20	Area Ratio	1505.08 ⁽³⁾	07324200	1,367
21	Unit Area Flow	1677.21	Basin 12	477
22	Area Ratio	342.11	07315900	314
23	Area Ratio	619.4	07315700	574
24	Unit Area Flow	106.3	Basin 26	193
25	Area Ratio	564.83	07313000	157
27	Unit Area Flow	106.16	Basin 28	694
29	Unit Area Flow	498.42	Basin 30	604
31	Unit Area Flow	524.78	Basin 30	604

Basin	Translation Method	Total Basin Drainage Area (sq-mi)	Reference Gauge/Basin	Reference Drainage Area (sq-mi)
32	Unit Area Flow	120.29	Basin 33	4,431
40	Unit Area Flow	272.46	Basin 41	281
42	Area Ratio	920.85 ⁽⁴⁾	07303500	838
43	Area Ratio	810.57 ⁽⁵⁾	07303500	838
44	Area Ratio	1883.12 ⁽⁶⁾	07249413	1,785
47	Unit Area Flow	945.82	Basin 46	150,547
52	Area Ratio	9285.36 ⁽⁷⁾	07238000	9,058
62	Area Ratio	600.32	07230500	463
66	Area Ratio	2182.5 ⁽⁸⁾	07155590	2,416
67	Unit Area Flow	233.9	Basin 69	2,021.8
69	Area Ratio	2021.8 ⁽⁹⁾	07152000	1,873
71	Area Ratio	62701.67 ⁽¹⁰⁾	07164500	62,811
73	Area Ratio	1086.58 ⁽¹¹⁾	07177500	907
75	Area Ratio	2133.69 ⁽¹²⁾	07175500	1,936
77	Area Ratio	8303.61 ⁽¹³⁾	07178600	7,911
79	Area Ratio	4260.93 ⁽¹⁴⁾	07171000	3,584

Notes:

- (1) Basin Area represents total area upstream of basin 5 which includes the gauged area of Basin 6.
- (2) Basin Area represents total area upstream of basin 11 which includes the gauged area of Basin 12.
- (3) Basin Area represents total area upstream of basin 20 which includes the gauged area of Basin 12.
- (4) Basin Area represents total area upstream of Basin 42 which includes Basin 43 and out of state area.
- (5) Basin Area includes out of state watershed area.
- (6) Basin Area represents total area upstream of basin 44 which includes the gauged area of USGS 07249413.
- (7) Basin Area represents total area upstream of Basin 52 which includes Basins 53, 45, 55, and out of state watershed area.
- (8) Basin Area includes out of state watershed area.
- (9) Basin Area represents total area upstream of Basin 69 which includes Basin 70 and out of state watershed area.
- (10) Basin Area represents total area upstream of Basin 71 which includes Basins 63-70, 72, and out of state watershed area.
- (11) Basin Area represents total area upstream of Basin 73 which includes Basin 74.
- (12) Basin Area represents total area upstream of Basin 75 which includes Basin 76 and out of state watershed area.
- (13) Basin Area represents total area upstream of Basin 77 which includes Basins 73-76, 78, 79, and out of state watershed area.
- (14) Basin Area represents total area upstream of Basin 79 which includes out of state watershed area.

3.1.3.1 Determination of Gage Watershed

The tributary area of each gage, referred to as the gage watershed, was used to aid in determining surface water supply at each basin outlet. The watershed of each gage was established based on the OWRB basins, USGS 12-digit HUCs, the USGS 1:250,000 scale HUCs, and the topography from the National Elevation Database (NED). Using the OWRB basins as a base, the USGS 12-digit HUCs were used to subdivide an existing OWRB basin at or near the gage. If the gage was not located along a HUC boundary, then the watershed was delineated using topography from the NED. The watershed delineation was created by dividing an existing 12-digit HUC and did not involve re-delineating existing HUCs. All existing OWRB basin boundaries were maintained, but many of the OWRB basins were subdivided.

The USGS 1:250,000 HUCs were also used to determine the tributary watershed area outside of Oklahoma; however, because of the large watershed area for the Canadian and Arkansas Rivers, the 1:250,000 HUCs were not used directly. The watershed area for the gages along these rivers was determined using the reported USGS gage watershed area at the closest gage to the Oklahoma border.

3.1.3.2 Methodology for Gages at or Near the Basin Outlet

For basins where high-quality gages were at or near the basin outlet, the measured daily data were used directly to determine the monthly average and median flow. A gage was considered at or near the basin outlet if the area of the gage watershed between the basin boundary and the gage (upstream or downstream of the gage) was less than 5 percent of the total basin area. In these cases, the small area was effectively ignored; basins with gage data in this category are shown as green polygons in Figure 9.

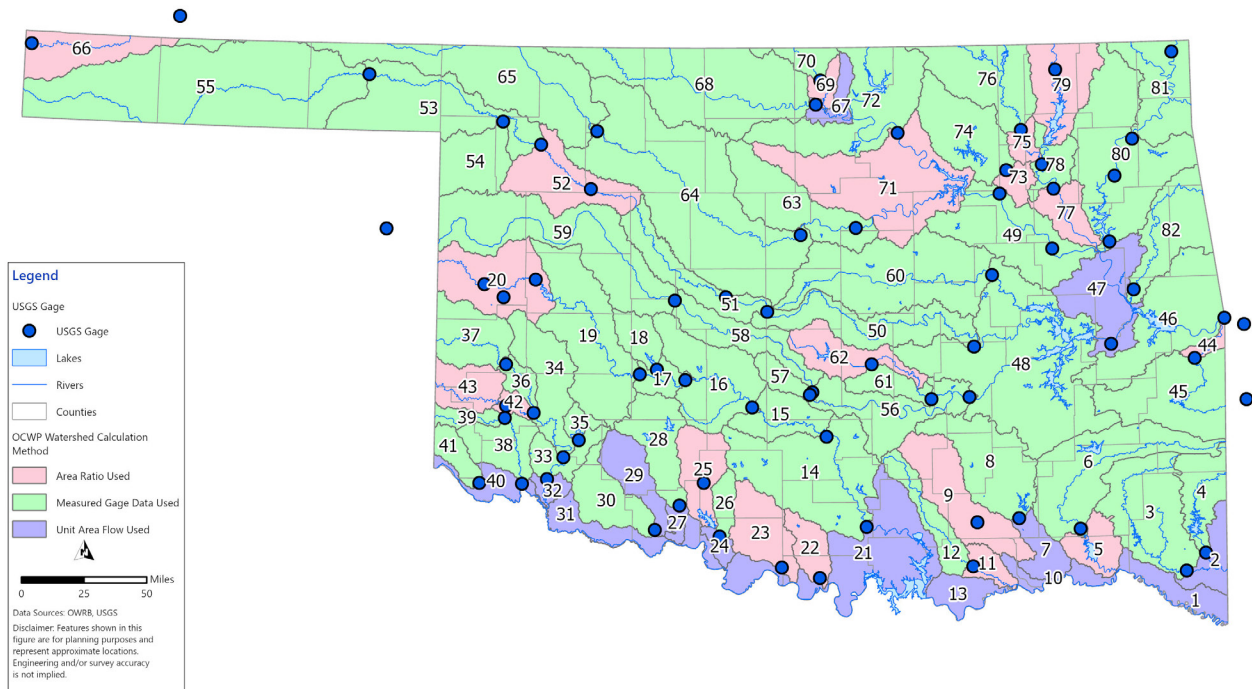


Figure 9 Methods Used to Calculate Surface Water Supply for OCWP Basins

3.1.3.3 Methodology for Gages Located Away from the Basin Outlet

Where a gage was not located near the basin outlet (more than 5 percent tributary area between the gage and the basin boundary), flow for a synthetic gage was generated to account for the differences between the watershed area at the basin outlet and the watershed area tributary to the gage. The monthly unit flow (AF/square mile/month) for the period of record was calculated from the measured gage data. This unit flow was applied to the synthetic gage watershed area, which may be different from the basin area, to determine the surface water supply at the basin outlet. In this scenario, the watershed of the measured data was effectively extended or contracted. For example, if a gage with tributary area of 100 square miles and a unit flow equal to 10 AF/square mile/month (measured flow of 1,000 AF/month) was applied to a synthetic gage at the basin outlet with a 150-square-mile watershed, the synthetic basin surface water volume would be estimated as 1,500 AF/month. If the confluence with an upstream basin was downstream of the gage being extended, the upstream basin's flow was added to determine the total basin flow. This method was applied to the basins shaded in pink in Figure 9.

3.1.3.4 Methodology for Basins without Usable Gages

When a high-quality gage could not be used directly within a basin, a reference gage was chosen to estimate flow in the ungauged basin. This is different than the MOVE2 method, because the ungauged basins using this methodology did not have any gage within the basin, as opposed to the MOVE2 basins where the data for the basin was not full for the entire period of record. Reference gages were chosen based on the following considerations.

- Nearby location (hydrologically similar)
- Similar demand
- Similar land use, soils, and slope
- Presence or absence of reservoir(s)

The monthly unit flow from the reference gage was applied to the basin area to estimate the surface water supply at the basin outlet. The flow from any upstream basins was added to the ungauged basin to determine the total basin flow.

$$Q_2 = Q_1/A_1 \times A_2 + Q_3$$

Where Basin 1 is the reference basin, Basin 2 is the basin or partial basin with absent high-quality gage data, and Basin 3 is the upstream basin.

This method was used on portions of basins and it was also used on entire basins if no preferred gage data were available. This method was also used extensively on the tributaries to the Red River. The basins utilizing this method for estimating streamflow are shown with purple shading in Figure 9.

3.1.3.5 Methodology for Special Case Basins

There were several basins that were considered special cases. Boundary conditions for the Canadian River (Basin 59) and Arkansas River (Basin 72) were set at the USGS Gage 7228000 (Canadian River) and USGS Gage 7146500 (Arkansas River). To determine out-of-state flow where the Upper Cimarron River re-enters Oklahoma at multiple locations, the flow leaving the state at Basin 66 was subtracted from the flow entering the state at Basin 65.

The incremental surface water flow of the planning basin is calculated as the gauged amount of surface water estimated at the basin outlet gauge less the sum of upstream surface water. The resulting incremental flow time series represents the amount of streamflow entering or lost from the river system from within the planning basin.

The calculation of the incremental flow time series for each basin has been performed as a pre-processing task using Excel. The flow pre-processing spreadsheet, provided as a separate .XLSX file for Attachment 2, references a table of the monthly flow time series for all 82 basins. These time series are used in conjunction with a table of interbasin relationships defining basins' upstream connectivity to determine both the total inflow into the target basin and the incremental flow time series. Since the PCSWMM framework operates on a daily timestep, yet the surface water flow data utilized for the tool is monthly, the spreadsheet generates a daily time series of the monthly flow volume averaged to the number of days in the month (with 29 days in February assigned on leap years).

The calculation of incremental flow can be either positive or negative, due to several natural and manmade causes, some of which are identified below.

- Variations between the observed hydrology within the basin and the contributing basin, such as peak flows, pulse, or flood timing of an event
- Significant loss of streamflow to aquifer recharge
- Water supply operations, e.g., diversions

As the PCSWMM framework does not accept negative values for streamflow input, the incremental flow time series must be converted to the following two individual time series data sets.

1. A data set representing the time series of positive incremental flows, wherein negative values have been automatically replaced with zero values. This data set is input to the 2025 Tool as a surface water inflow time series.
2. A data set representing negative incremental flows, wherein the positive values have been replaced with zero values and the absolute value of the negative flow data utilized. This dataset is input as a diversion target in the basin, which is incorporated into the model prior to the calculation of available surface water streamflow for basin demands and interbasin transfers.

These data sets are automatically generated in a separate preprocessing .XLSX file for Attachment 3, and input to the 2025 Tool as a surface water inflow time series.

3.2 Interbasin Transfers

Water sources used to meet demands are not always derived from the basin in which the demand occurs. The conveyance of such supplies from one source basin to another is defined as an interbasin transfer, and can represent a pipeline, canal, or other conveyance mechanisms.

There are a total of 40 interbasin water transfers in the state that were identified for the purposes of the 2012 OCWP. For the 2025 OCWP, there are a total of 75 interbasin water transfers representing over 100 interbasin transfer permits represented within the 2025 Tool. These interbasin transfers are represented as a constant diversion from available streamflow and reservoir storage, if available, in the source basin, and are added to the streamflow available for demand diversion in the receiving basin. Table 3 identifies these modeled interbasin transfers by transfer name, source basin number, and destination basin number.

Table 3 Interbasin Transfers Utilized in 2025 Tool

Permit No.	Permit Holder	Source Basin	Use Basin
19050005	Anadarko, City of	17	16, 17
19510128	Ft Cobb Master Conservancy District	18	16, 17
19690030	Frederick, City of	30	31
19670671	Mt Park Master Conservancy District	35	33, 38
19260006	Altus, City of	36	33, 38
19880007	Southwest Soil & Water Conservation District	41 and 40	N/A
19390055	Oklahoma City, City of	51	50, 51, 58, 60, 62, 64
19820119	Oklahoma City, City of	51	50, 51, 58, 60, 62, 64
20110009	Cimarex Energy Co	51	51, 58, 59, 64
20190047	Tri-City Construction, Inc.	58	16

Permit No.	Permit Holder	Source Basin	Use Basin
20190048	Tri-City Construction, Inc.	58	16
20190050	Tri-City Construction, Inc.	58	16
20160017	Shelton, Robert L	64	63, 64
20160030	Ovintiv USA, Inc.	64	63, 64
20170001	Five - G - Water	64	51, 58, 63, 64
19640884	Chelsea, Town of	79	80
19760001	Rogers Co Rural Water District #4	79	75, 76, 78, 79
19760094	Rogers Co Rural Water District #3	79	73, 75, 78, 79, 80
19770162	Claremore, City of	79	78
19780063R	Broken Arrow, City of	79	49, 73, 77, 78
20130038	Washington Co Rural Water District #3	79	73, 74, 75
19540517	Tulsa Metropolitan Utility Authority	79	49, 73, 77, 78
19570115	Collinsville, City of	79	75
19650363	Waurika Lake Project Master Conservancy District	25	24, 25, 26, 28, 31
19830041	Waurika Lake Project Master Conservancy District	25	24, 25, 26, 28, 31
19550061	Duncan, City of	14	25, 26
19550278	Duncan, City of	14	25, 26
19620028	Duncan, City of	14	25, 26
19650046	Ardmore, City of	14	14, 21
19650047	Ardmore, City of	14	14, 21
19680181	Duncan, City of	14	25, 26
19680182	Duncan, City of	14	25, 26
19710468	Lindsay, City of	14	15
19810093	South Central Oklahoma Water Association	14	14, 15, 16, 23, 24, 25, 26
19890003	Duncan, City of	14	25, 26
20140076	Duncan, City of	14	25, 26
20180046	Ovintiv Mid-Continent, Inc.	14	14, 15, 23, 25, 26
20140002	Continental Resources, Inc.	15	14, 15, 16, 23, 25, 26
19810021	Holdenville, City of	56	48, 56
19760011	Holdenville, City of	56	48, 56
20170034	Laze, LLC	57	15, 56, 57
20180085	Bluefin Water Solutions, LLC	57	15, 56, 57
20180094	Snell, Robert Clay	57	15, 56, 57, 58, 62
20190008	Bluefin Water Solutions, LLC	57	15, 56, 57

Permit No.	Permit Holder	Source Basin	Use Basin
20190010	Bluefin Water Solutions, LLC	57	15, 56, 57
20190024	Bluefin Water Solutions, LLC	57	14, 15, 16, 56, 57
19650637	Central Oklahoma Master Conservancy District	62	50, 58, 62
20100001	Norman, City of	62	58, 62
19760057	Pottawatomie Co Development Authority	50	50, 62
19740175	Edmond, City of	60	60, 64
19840039	Okemah, City of	60	50, 60
20110066	Edmond, City of	60	60, 64
20140037	Pierce, Earl Allen	63	63, 64, 68, 71, 72
20170051	Oklahoma Energy Acquisitions LP	63	63, 64
20190054	Coe, Matthew	63	60, 63, 64, 71
19340060	Ponca City, City of	72	67, 72
19690327	Newkirk, City of	72	67
19720491	Stillwater, City of	72	71
19740390	Osage Tribe of Indians	72	72, 74, 76
19810180	City of Enid	72	63, 64, 72
19870031	Tonkawa, City of	72	67, 68
19930034	Ponca City, City of	72	67, 72
19930035	Ponca City, City of	72	67, 72
20030001	Perkins PWA	72	63
20140047	City of Enid	72	63, 64, 72
19810193	Phillips 66 Company	67	67, 72
19660293	Sand Springs, City of	74	49
19740120	Sapulpa, City of	74	49
19760013	Osage Co RWD #15	74	74
19760049	Rogers Co Rural Water District #4	74	75, 76, 78, 79
19770169	Washington Co Rural Water District #3	74	73, 74, 75
19740120A	Sand Springs, City of	74	49
20030042	Washington Co Rural Water District #3	75	73, 74, 75
20130009	Fugate, John Bret	73	73, 74
19640789	Creek Co Rural Water District #1	49	49, 60
19660568	Haskell County Water Corporation	48	45, 46, 47, 48
19810098	Checotah, City of	48	47
20000018	Juniper Water Company, LLC	48	8
20000040	Juniper Water Company, LLC	48	8
20060057	Checotah, City of	48	47

Permit No.	Permit Holder	Source Basin	Use Basin
20070017	Oklahoma City, City of	6	50, 51, 58, 60, 62, 64
19540613	Oklahoma City, City of	8	50, 51, 58, 60, 62, 64
19680042	Midwest City, City of	8	50
19680104	Ada, City of	8	9, 56
19730176	Moore, City of	8	58, 62
19800048	Oklahoma City, City of	8	50, 51, 58, 60, 62, 64
19730282B	County Commissioners of Atoka Co	8	7, 9, 10
20020014	Hefley, Gay	7	7, 10
19590157	Ada, City of	9	9, 56
19800107	Ada, City of	9	9, 56
19770025	Bryan County RWS & SWM #2	12	12, 21
20210015	Adams, Gary Chad and Kimberly K	10	5, 10
19720249	Durant City Utility Authority	13	12, 13
19660337	McCurtain Co Rural Water District #1	2	1, 2, 3
19550764	Idabel Public Works Authority	3	1, 2, 3
19800132	Valliant, City of	3	1, 3
19820137	Idabel Public Works Authority	3	1, 2, 3
19820105	Broken Bow Public Works Authority	4	3, 4
19860015	Broken Bow Public Works Authority	4	3, 4
19910001	Latimer Co Rural Water District #1	45	45, 48
20140014	Stigler, City of	46	47
19630131	Broken Arrow, City of	77	49, 73, 77, 78
19780063	Broken Arrow, City of	77	49, 73, 77, 78
19800184	Coweta, City of	77	49, 77
19910022	Wagoner Co Rural Water District #4	77	49, 77
20000035	Wagoner Co Rural Water District #4	77	49, 77
20040011	Wagoner Co Rural Water District #5	77	49, 77
20110032	Phillips Farms, LLC	77	77, 80
20200008	Ten Point Farms, LLC	77	49, 77
19800006	Washington Co Rural Water District #3	78	73, 74, 75
19880006	Rogers Co Rural Water District #3	78	73, 75, 78, 79, 80
19900001	Rogers Co Rural Water District #5	78	73, 77, 78
20020005	Rogers Co Rural Water District #5	78	73, 77, 78
19700139	Sallisaw, City of	82	46
19710110	Muskogee, City of	82	47, 49
19790060	Broken Arrow, City of	82	49, 73, 77, 78

Permit No.	Permit Holder	Source Basin	Use Basin
19790107	Sallisaw, City of	82	46
19800029	East Central Okla Water Authority	82	47, 82
19890052	Gore Public Works Authority	82	47, 82
20030028	Tenkiller Utilities Authority	82	46, 49, 80, 82
19820020A	Stick Ross Mountain Water Co, Inc.	82	47, 80, 82
19220033	Tulsa Metropolitan Utility Authority	80	49, 73, 77, 78
19320030	Muskogee, City of	82	47, 49
19320034	Wagoner, City of	80	77
19350064	Fort Gibson, Town of	80	47
19760120	Fort Gibson, Town of	80	47
19320032	Vinita, City of	81	80
19260006	Lutger Altus Irrigation District	36	33, 38

3.3 Demands

The historical streamflow data utilized within the 2025 Tool already reflects historical surface water demands; thus, the characterization of demands for modeling future scenarios in each planning basin must incorporate incremental future water demand increases. Such incremental increases in demand can then be comparatively assessed against the availability of supplies to meet those incrementally larger demands.

For the 2025 Update to the OCWP, annual water demands have been estimated by county for each planning decade and have been apportioned to the individual planning basin based on either diversion location or population density – depending on the category of water use (Carollo Engineers 2024). The development of these demands is performed external to the 2025 Tool, via implementation of a spreadsheet analysis (Attachment 3). The following are the categories of water use by water supply source utilized for the present effort.

- Crop Irrigation
- Livestock
- Public Supply
- Oil and Gas
- Self-Supplied Industrial
- Self-Supplied Domestic
- Thermoelectric Power

Water demands are input using model elements to simulate demands on a water supply source. These demands are represented as an average single number per basin, use category, and supply source. To reflect monthly variability, an assumed monthly pattern is applied (as illustrated in Figures 10 through 17). Monthly patterns of water use vary by category and geographically. Thus, demand patterns representing the average of the basin-specific use for each water use category have been derived from the historical use data employed to identify existing demands. Figure 17 presents an example distribution of the decadal demands for a planning basin disaggregated by water use category and water supply source.

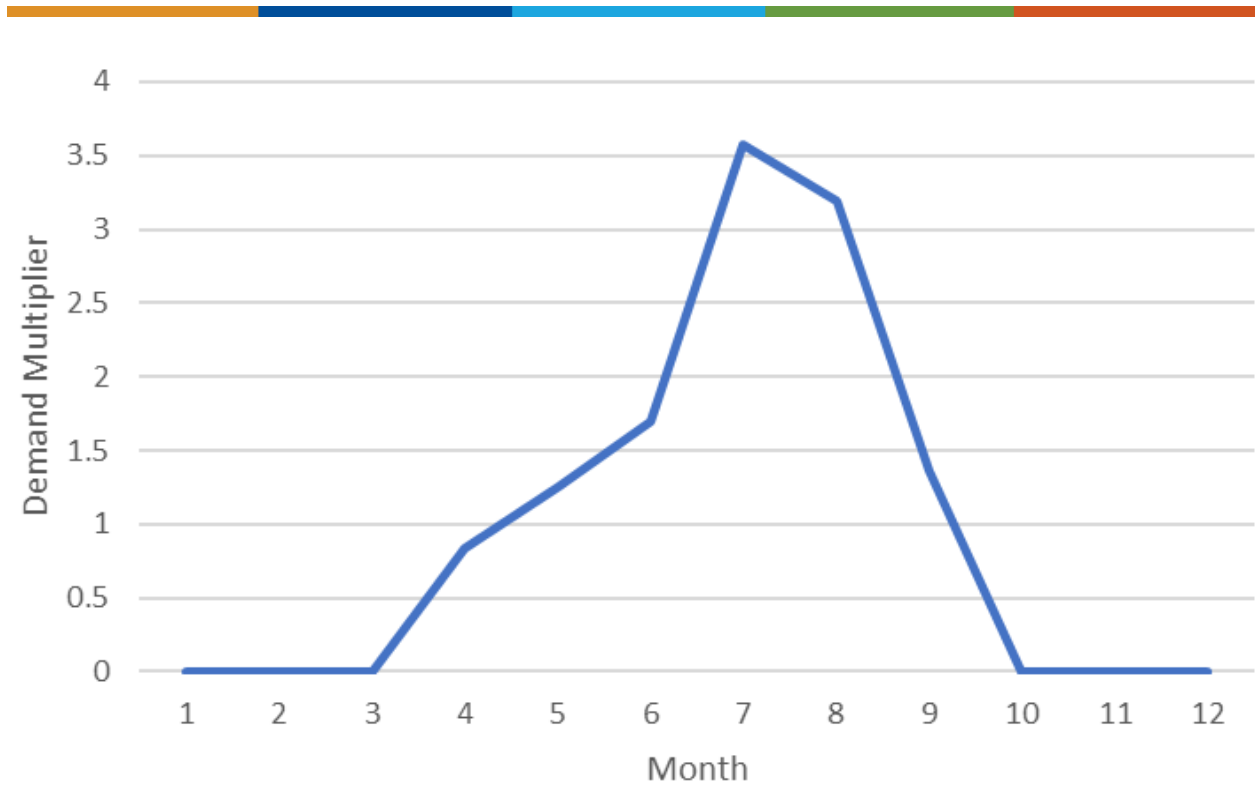


Figure 10 Example Crop Irrigation Monthly Demand Pattern

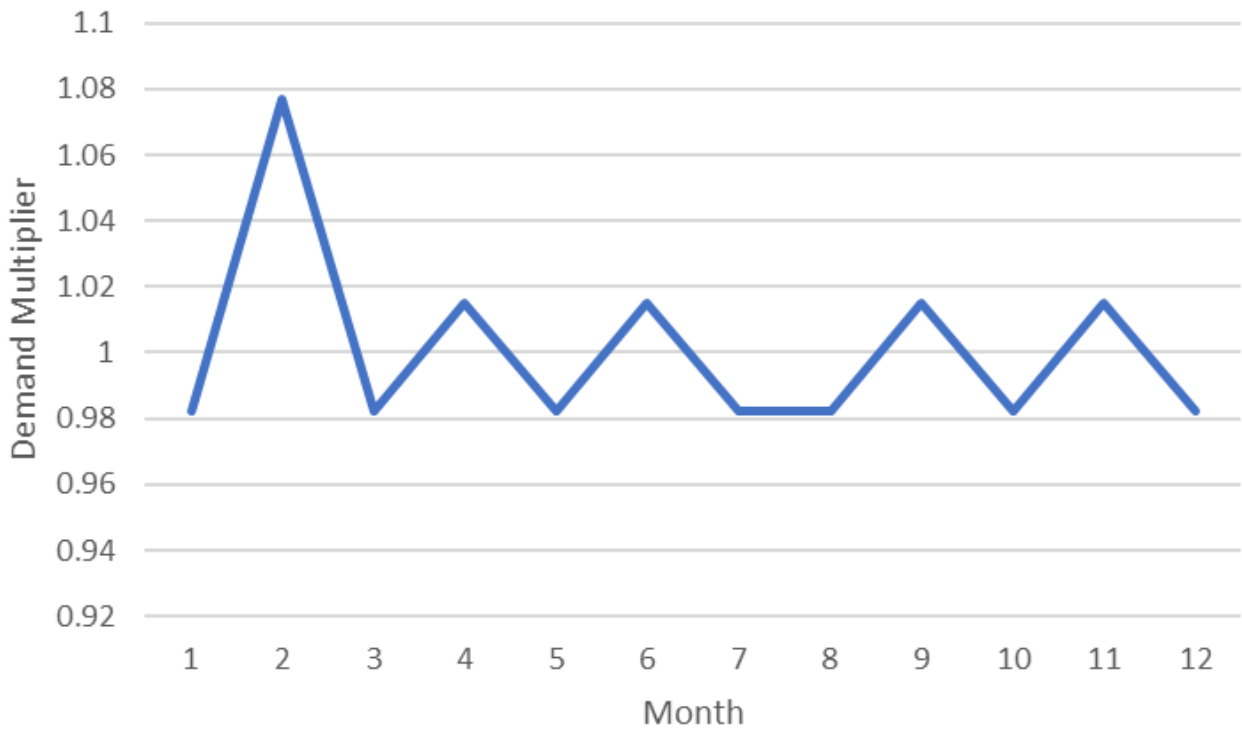


Figure 11 Example Livestock Monthly Demand Pattern

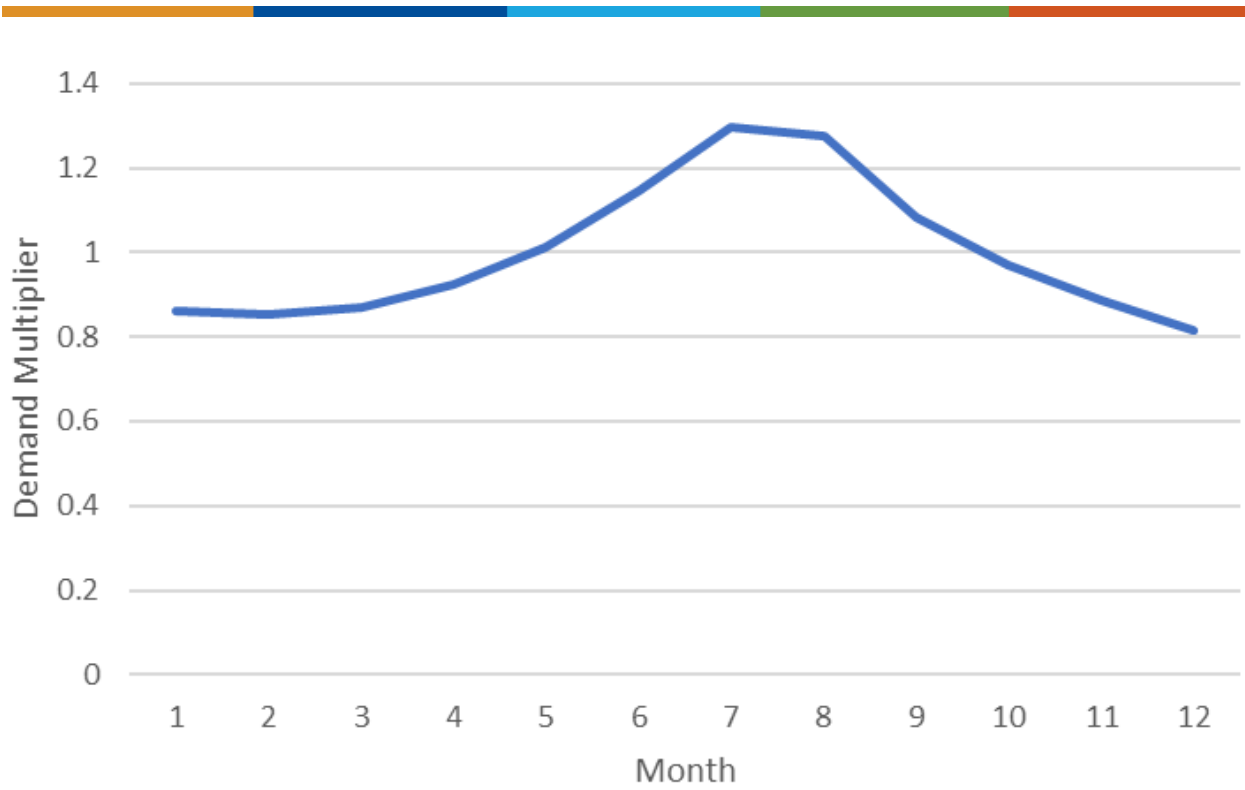


Figure 12 Example Public Supply Monthly Demand Pattern

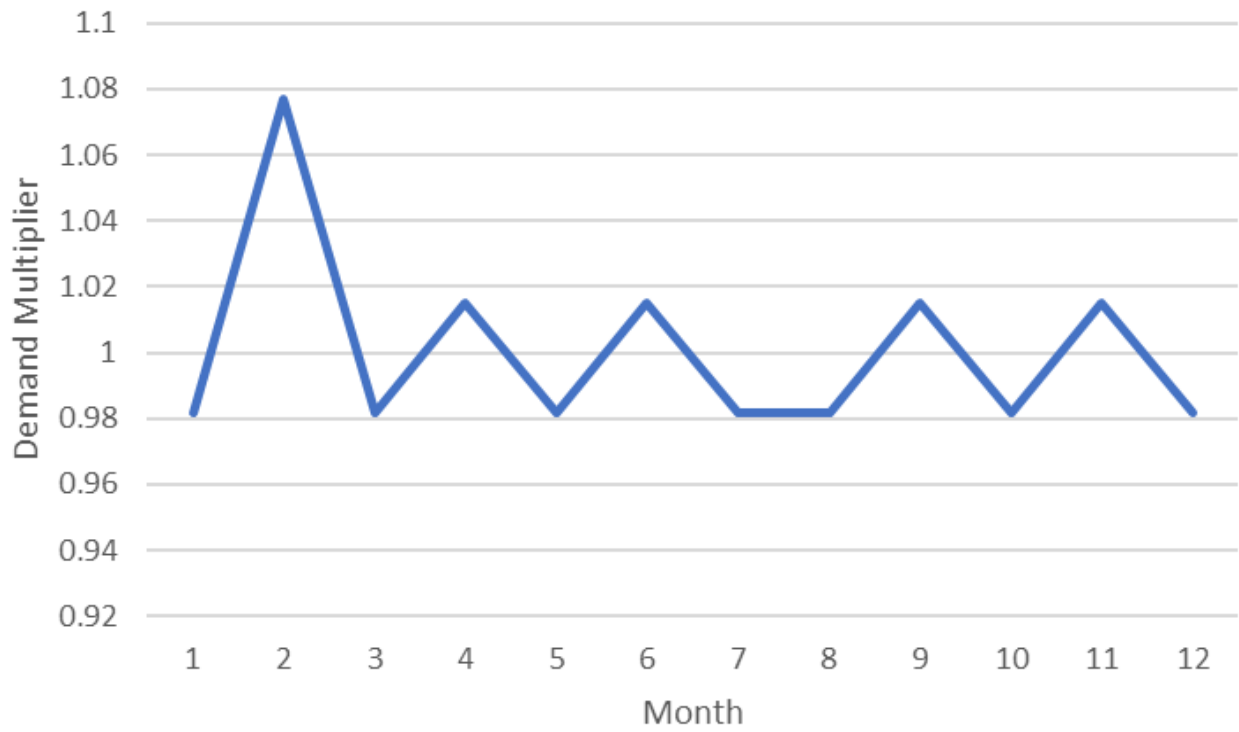


Figure 13 Example Oil and Gas Monthly Demand Pattern

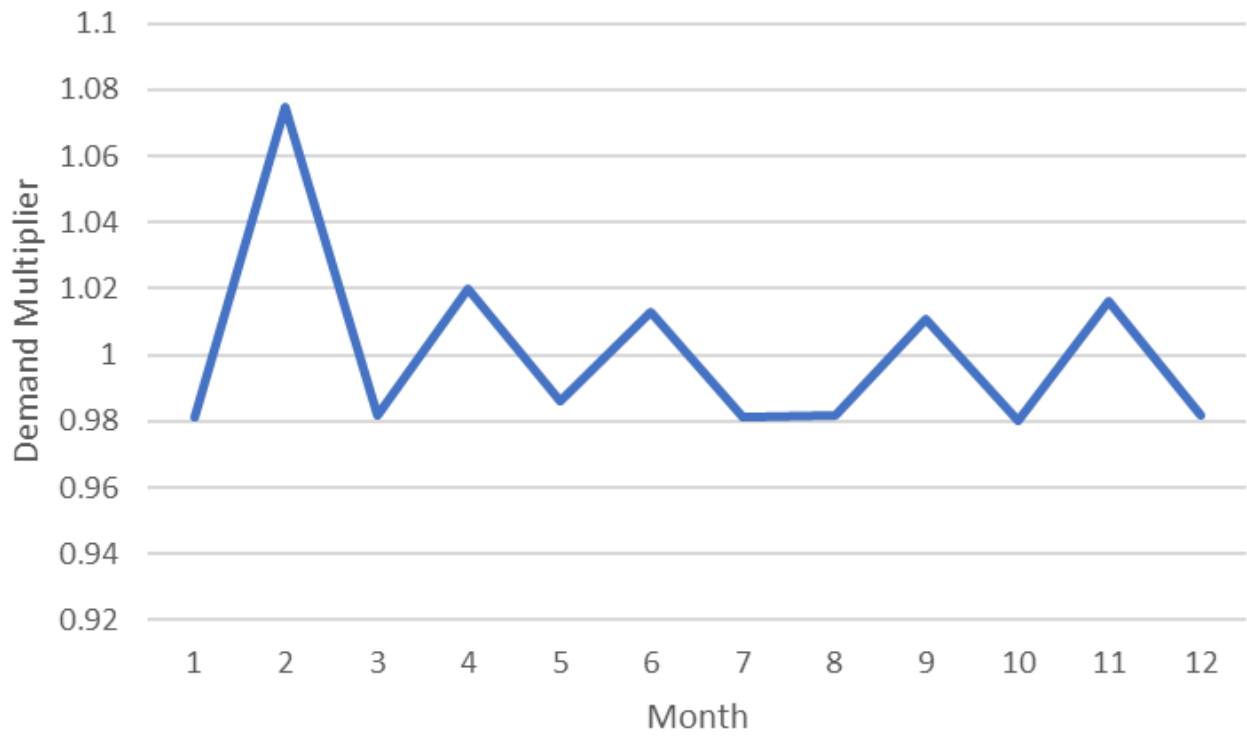


Figure 14 Example Self-Supplied Industrial Monthly Demand Pattern

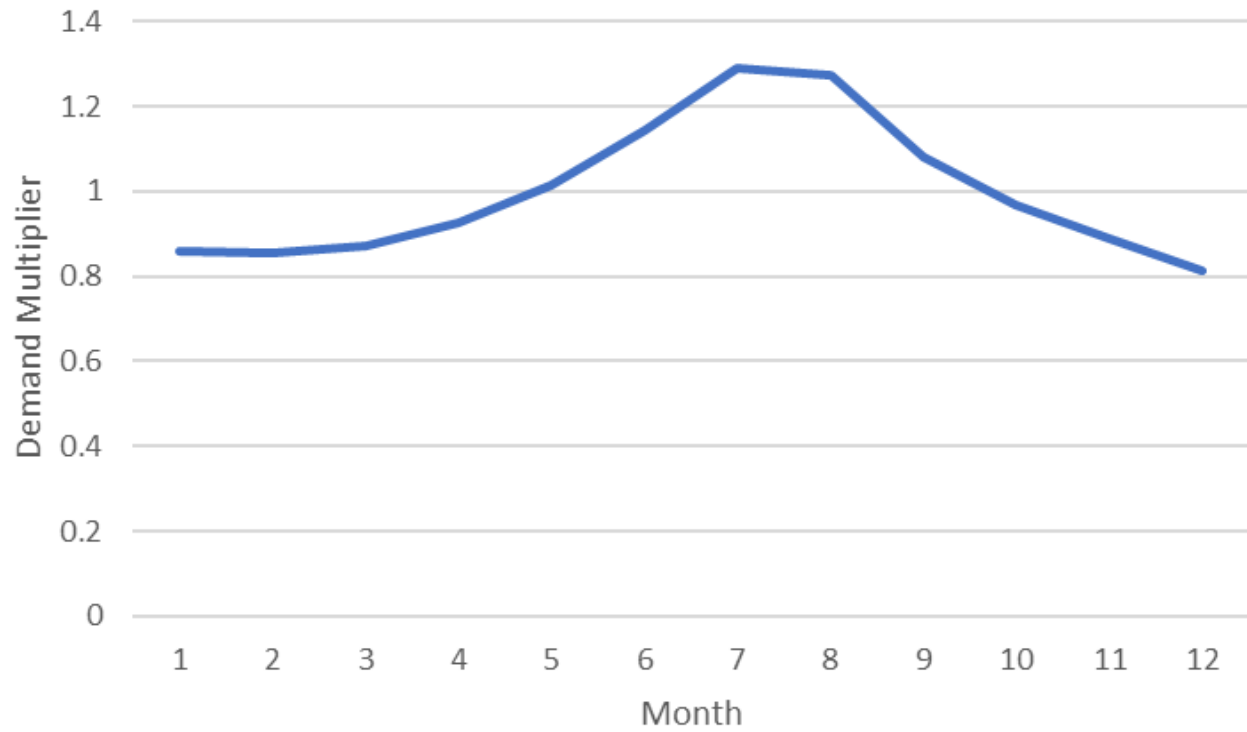


Figure 15 Example Self-Supplied Domestic Monthly Demand Pattern

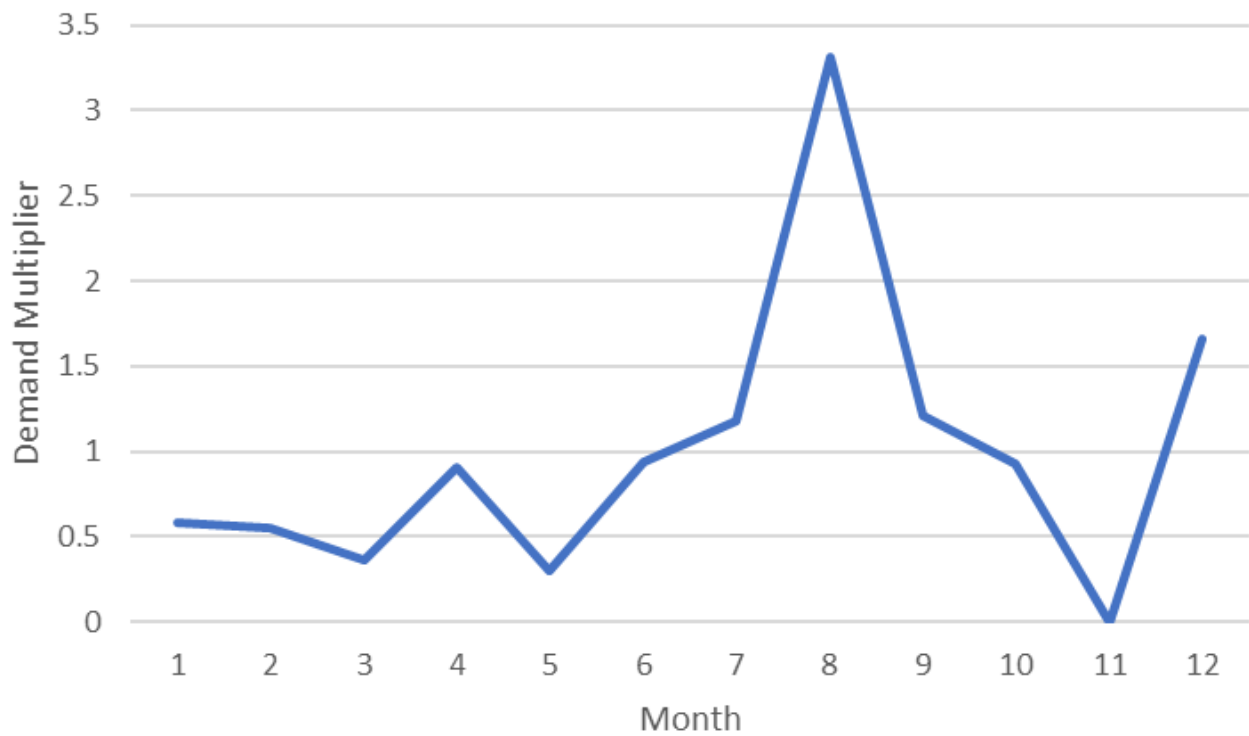


Figure 16 Example Thermoelectric Power Monthly Demand Pattern

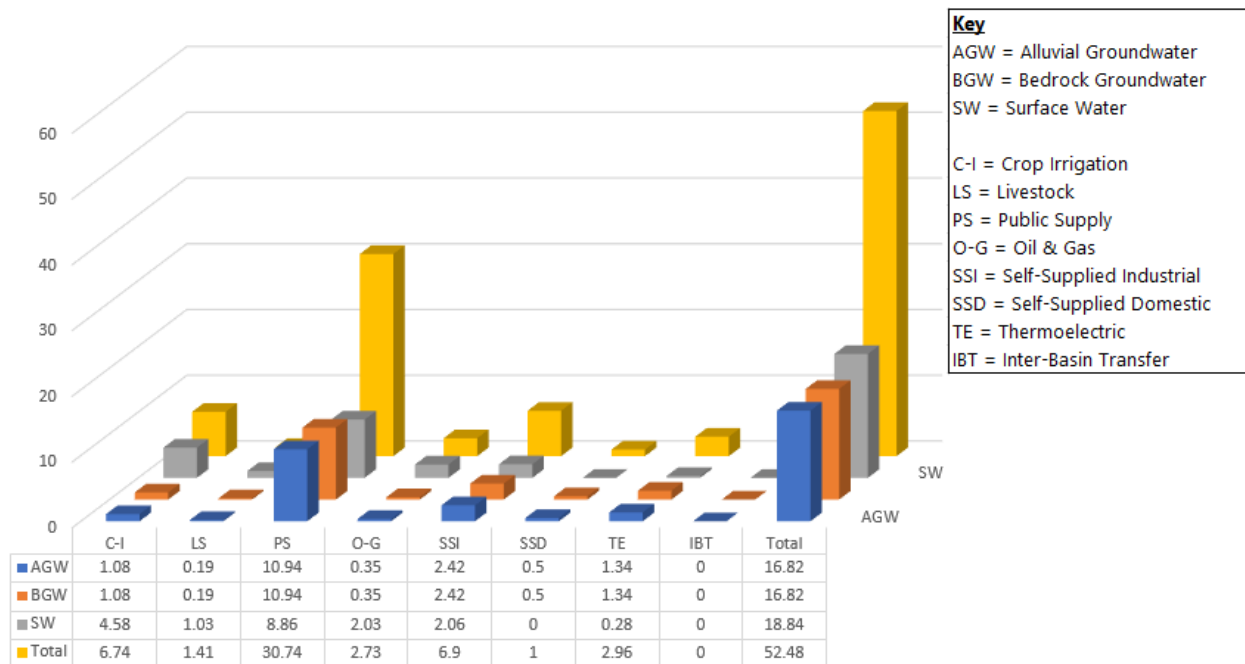


Figure 17 Example of Decadal Demands for Basin by Use Category and Supply Source

The historical use data have also been used to derive the water supply sources between surface water, AGW, and BGW, for use as a multiplier in developing the demand input data. The 2025 Tool's complete incremental demand dataset for each basin in a specified planning decade contains seven distinct use categories and three distinct water supply sources, resulting in 21 demand inputs. The use pattern for each category varies from basin to basin. During a model simulation, each of the individual demands in the basin are multiplied by the appropriate basin-specific water use category pattern to model the appropriate water demand for the modeled monthly timestep.

As noted previously, the calculation of model input data representing the dissemination of the demands by basin, use type, and water source is performed in an Excel workbook external to the model (Attachment 3). This workbook also serves as the location to store basin-specific water use patterns.

3.4 Return Flows

After water is taken or diverted for use, return flows represent the portion of water *not* consumed, but instead returned (i.e., discharged) back to the system. The amount of this portion can vary due to a number of factors, including by the type of source and category of use, and once returned may be utilized immediately or for downstream purposes.

The 2025 Tool estimates future return flows generated by future incremental demands through the use of assumed return flow factors, i.e., an estimated percentage of use that would be subsequently discharged for a particular water use category. The return flow factors presently input into the 2025 Tool for each water use category are shown in Table 4.

Table 4 Return Flow Factors by Water Use Category

Water Use Category	Return Flow Factor
Crop Irrigation	0.1
Livestock	0
Public Supply	Varies by basin
Oil and Gas	0
Self-Supplied Industrial	0
Self-Supplied Domestic	0
Thermoelectric Power	0

Two water use categories presently have non-zero return flow factors: crop irrigation and public supply.

The return flow factor for public supply use is a constant return flow rate that varies by planning basin, representing the return flow generated in the lowest water use month of the annual cycle. The return flow factor is derived based on wastewater treatment plant capacity and technology within the planning basin. It is applied and generated each month as a constant proportion (percentage) of the minimum annual water demand. The return flow factors utilized for public supply by basin are presented in Table 5.

Table 5 Return Flow Factors for Public Supply Water Use by Basin

Basin No.	Basin ID	Basin Name	Public Supply
1	10100	Red River Mainstem (To Kiamichi River)	51%
2	10201	Little River (McCurtain County) - 1	57%
3	10202	Little River (McCurtain County) - 2	63%
4	10203	Little River (McCurtain County) - 3	95%

Basin No.	Basin ID	Basin Name	Public Supply
5	10301	Kiamichi River - 1	95%
6	10302	Kiamichi River - 2	95%
7	10411	Muddy Boggy River - 1	95%
8	10412	Muddy Boggy River - 2	81%
9	10420	Clear Boggy Creek	56%
10	10500	Red River Mainstem (To Blue River)	63%
11	10601	Blue River - 1	48%
12	10602	Blue River - 2	48%
13	10700	Red River Mainstem (To Washita)	95%
14	10810	Lower Washita	41%
15	10821	Middle Washita - 1	95%
16	10822	Middle Washita - 2	59%
17	10831	Upper Washita - 1	95%
18	10832	Upper Washita - 2	0%
19	10833	Upper Washita - 3	46%
20	10840	Washita Headwaters	48%
21	10900	Red River Mainstem (To Walnut Bayou)	52%
22	11000	Walnut Bayou	84%
23	11100	Mud Creek	41%
24	11201	Beaver Creek - 1	16%
25	11202	Beaver Creek - 2	5%
26	11203	Beaver Creek - 3	84%
27	11311	Cache Creek - 1	0%
28	11312	Cache Creek - 2	33%
29	11321	Deep Red Creek And West Cache Creek - 1	35%
30	11322	Deep Red Creek And West Cache Creek - 2	27%
31	11400	Red River Mainstem (To North Fork of Red)	52%
32	11511	Lower North Fork Red River - 1	0%
33	11512	Lower North Fork Red River - 2	43%
34	11513	Lower North Fork Red River - 3	19%
35	11514	Lower North Fork Red River - 4	0%
36	11521	Upper North Fork Red River - 1	71%
37	11522	Upper North Fork Red River - 2	26%
38	11601	Salt Fork Red River - 1	48%
39	11602	Salt Fork Red River - 2	0%
40	11701	Prairie Dog Town Fork Red River - 1	0%

Basin No.	Basin ID	Basin Name	Public Supply
41	11702	Prairie Dog Town Fork Red River - 2	63%
42	11801	Elm Fork Red River - 1	95%
43	11802	Elm Fork Red River - 2	0%
44	20101	Poteau River - 1	95%
45	20102	Poteau River - 2	93%
46	20201	Lower Arkansas River - 1	84%
47	20202	Lower Arkansas River - 2	63%
48	20300	Canadian River (To North Canadian River)	64%
49	20400	Middle Arkansas River	42%
50	20510	Lower North Canadian River	35%
51	20520	Middle North Canadian River	22%
52	20531	Upper North Canadian River - 1	5%
53	20532	Upper North Canadian River - 2	15%
54	20533	Upper North Canadian River - 3	0%
55	20540	North Canadian Headwaters	3%
56	20611	Lower Canadian River - 1	23%
57	20612	Lower Canadian River - 2	15%
58	20620	Middle Canadian River	31%
59	20630	Upper Canadian River	17%
60	20700	Deep Fork River	15%
61	20801	Little River - 1	79%
62	20802	Little River - 2	5%
63	20910	Lower Cimarron River	59%
64	20920	Middle Cimarron River	29%
65	20930	Upper Cimarron River	22%
66	20940	Cimarron Headwaters	0%
67	21011	Lower Salt Fork Arkansas River - 1	25%
68	21020	Upper Salt Fork Arkansas River	22%
69	21012	Lower Salt Fork Arkansas River - 2	24%
70	21013	Lower Salt Fork Arkansas River - 3	0%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	55%
72	21200	Arkansas River Mainstem (To Kansas State Line)	50%
73	21301	Bird Creek - 1	39%
74	21302	Bird Creek - 2	32%
75	21401	Caney River - 1	14%
76	21402	Caney River - 2	21%

Basin No.	Basin ID	Basin Name	Public Supply
77	21511	Verdigris River (To Oologah Dam) - 1	74%
78	21512	Verdigris River (To Oologah Dam) - 2	60%
79	21520	Verdigris River (To Kansas State Line)	89%
80	21601	Grand (Neosho) River - 1	76%
81	21602	Grand (Neosho) River - 2	89%
82	21700	Illinois River	59%

3.5 Storage

As noted previously, the surface water data already reflects historically observed surface water reservoir operations (e.g., diversions, evaporative losses, releases). Thus, existing reservoir storage and use has not been represented separately in the 2025 Tool. Noting that not all of Oklahoma's water supply reservoirs are fully appropriated and may have available storage that could be used as a source to meet future demands, the remaining storage volumes of existing reservoirs as identified within the Original Tool has been used as the present model input for each planning basin. Review of these amounts suggest differences from the remaining storage volumes presented in the 2012 OCWP's Physical Water Supply Availability Report. A compilation of the present remaining storage volumes used in the 2025 Tool, and supporting reservoir information, is presented in Table 6.

Table 6 Modeled Reservoir Storage Capacity Remaining for Future Demands

Planning Basin No.	Reservoirs in Basin	Remaining Yield ⁽¹⁾ (AF)	Water Supply Storage ⁽²⁾ (AF)	Water Supply Yield (AFY)
3	Pine Creek	31,755	49,400	94,080
4	Broken Bow	47,606	152,500	58,386
6	Sardis	34,457	297,200	156,800
8	McGee Creek	7,192	109,800	71,800
14	Fuqua	3,065	21,100	3,427 ⁽³⁾
	Jean Neustadt		0	2,150
18	Fort Cobb	19,588	78,350	18,000
20	Foss	366	0	18,000
21	Texoma	49,999	150,000	168,000
22	Healdton City Lake	1,527	0	3,000 ⁽³⁾
48	Eufaula	33,351	79,552	76,451
60	Bellcow Lake	613	0	4,558 ⁽³⁾
	Stroud Lake		0	1,299 ⁽³⁾
71	Keystone	8,434	20,000	22,400
	Lone Chimney Lake		0	2,509 ⁽³⁾
74	Birch	560	7,600	3,360
76	Hulah	2	19,800	13,888

Notes:

AFY - acre-feet per year

(1) As of June 2023, permitting data.

(2) Reservoir storage for water supply purposes only.

(3) Estimated yield.

Aquifer storage amounts also serve as inputs to the model, as both the AGW and BGW components of the model have an associated storage volume parameter. For each basin there is one storage volume for AGW and a separate storage volume for BGW - the values of which are provided in Attachment 1. The aquifer storage volume data utilized in the 2025 Tool represents the surface area and saturated thickness of the aquifers within the basin.

As described in the key assumptions, each AGW aquifer in a basin is recharged by surface water. The BGW aquifer storage in each basin has been modeled to have a constant recharge rate determined from available literature (see Attachment 1). The 2025 Tool representation of aquifer storage is a simplistic volumetric representation and does not reflect physical water level changes within the aquifer.

SECTION 4 EXAMPLE PLANNING BASIN STRUCTURE

Provided herein is an example of the process for evaluating physical water supply within a planning basin. This process utilizes the above-described assumptions, sources of data, methods, and pre-processing.

Within each planning basin, there are three water supply calculations that are modeled.

- Surface water supply
- AGW supply
- BGW supply

Each planning basin in the 2025 Tool is organized in the manner shown previously in Figure 2. Within each planning basin, a mass balance of the incremental surface water supplies, AGW supplies, and BGW supplies is evaluated with the basins' projected demands for a planning period. The following three fundamental equations of the 2025 Tool were employed to calculate surface water supply gaps and AGW and BGW aquifer depletions.

1. $SW\ Gap = SW\ Gage\ Data + SW\ Transfers\ Into\ the\ Basin - SW\ Transfers\ Out\ of\ Basin - \Delta\ SW\ Demand - \Delta\ Reservoir\ Volume + Return\ Flows$
2. $AGW\ Storage\ Depletions = AGW\ recharge\ from\ SW\ (1:1\ rate) - \Delta\ AGW\ Demand$
3. $BGW\ Storage\ Depletions = (BGW\ Annual\ Average\ Recharge - Existing\ BGW\ Pumping) - \Delta\ BGW\ Demand$

* Where " Δ Demand" terms refer to incremental demand (future – current) for the planning decade.
SW = surface water

For the above equations, a value less than zero represents a surface water gap or a AGW or BGW aquifer depletion. For the surface water gap equation, a value greater than zero represents a surface water surplus. The AGW and BGW storage depletion equations are valid when demand is greater than recharge, and equal to zero when demand is less than recharge.

The modeled representation of each of the source water supply calculations performed within the 2025 Tool is described below.

4.1 Surface Water Calculation

Incremental surface water inflow is determined within the 2025 Tool as the incremental streamflow entering the planning basin from any upstream planning basins, adjusted by the incremental difference between the USGS streamflow at the outlet of the planning basin and the sum of the USGS streamflow gages from the upstream planning basins. This adjustment is modeled as inflow for months where there is more incremental streamflow originating within the planning basin, and as a diversion for months where there is a loss of streamflow within the planning basin.

In cases where a planning basin is receiving streamflow from out of the state, the USGS streamflow is reduced by an assumed planning level representation of the upstream compact obligation. The simplifying assumption is made to conservatively model meeting the upstream compact requirement as a loss of 60 percent of the streamflow physically entering the state, i.e., Oklahoma receives 40 percent of the streamflow. This avoids over-estimation of water supply potentially available from outside of the state and avoids the need for evaluating and projecting estimates of potential future out-of-state water uses. The physical water supply calculations do not include any downstream compact apportionments.

There are several planning basins that receive water from a different planning basin through interbasin transfer. To model this interaction, the incremental surface water available for future use is adjusted to add interbasin transfers into the receiving basin, and subtract interbasin transfers from the basin of origin.

Modifications to streamflow due to future uses and/or return flows in an upstream basin(s), and future reservoir depletions in an upstream basin(s) are embedded in the incremental streamflow entering a planning basin.

With the streamflow adjustments modeled, the incremental streamflow available for use by future demands is next calculated. The model calculates the diversion of the planning basins' incremental surface water demand, represented as an aggregated total of the monthly demand for each of the use categories. After surface water demands have been diverted within the model, the incremental demand from the AGW aquifer is deducted from the surface water available.

Next, the modeled planning basin's surface water reservoir storage diverts available streamflow to refill the storage that may have been used in a previous month to meet surface water demands. Return flows from the demand use categories from surface water, AGW, and BGW sources are added to the surface water streamflow available for use, resulting in a calculated incremental surface water outflow of the planning basin. This calculated basin outflow then serves as an inflow into the next downstream planning basin.

Figure 18 presents an example of the time series of estimated surface water outflow from a selected basin (Basin 51). Figure 19 presents the modeled time series of surface water demand gaps calculated for Planning Basin 51 over a selected 10-year (1980 through 1989) period. As shown in Figure 19, with modeled 2030 incremental demand scenario in place, there are multiple periods of time over the 10-year (1980 through 1989) period where there would have been insufficient surface water supply in Basin 51 if 2030 demands were in place. These gaps (or shortages) range in magnitude seasonally from approximately 0.5 to 5 AF per month with 5 years having months with a gap of more than 10 AF per month.

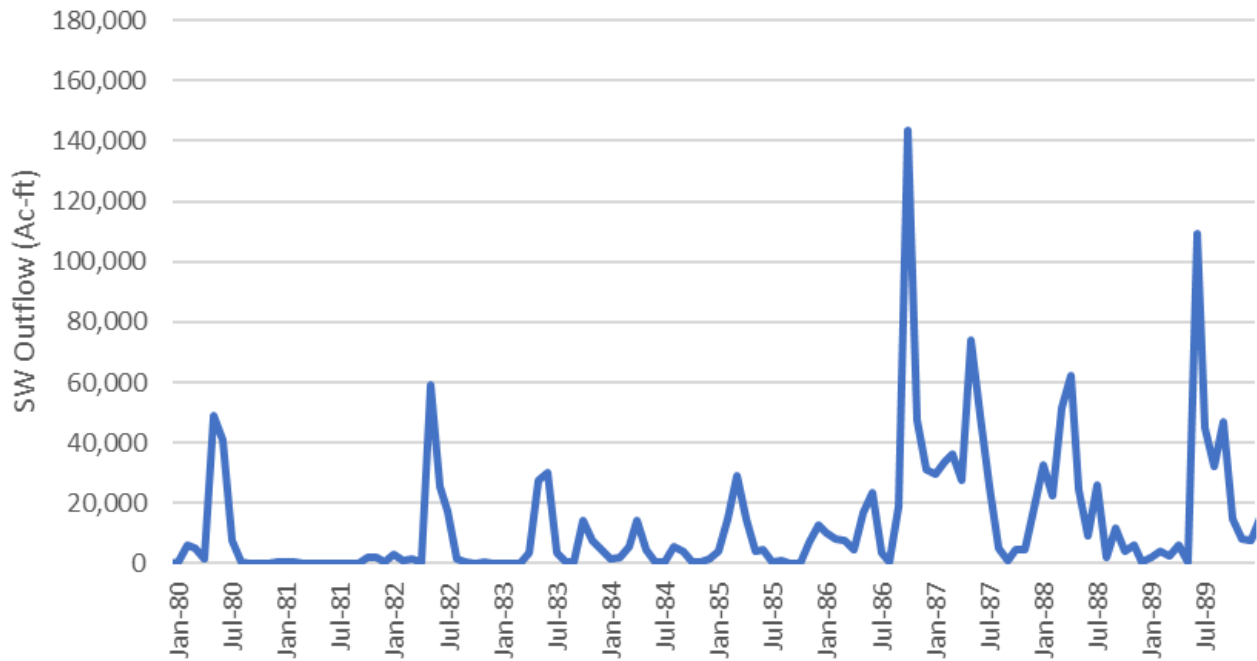


Figure 18 Modeled Surface Water Outflow from Planning Basin 51 under Projected 2030 Demand Conditions (1980-1989)

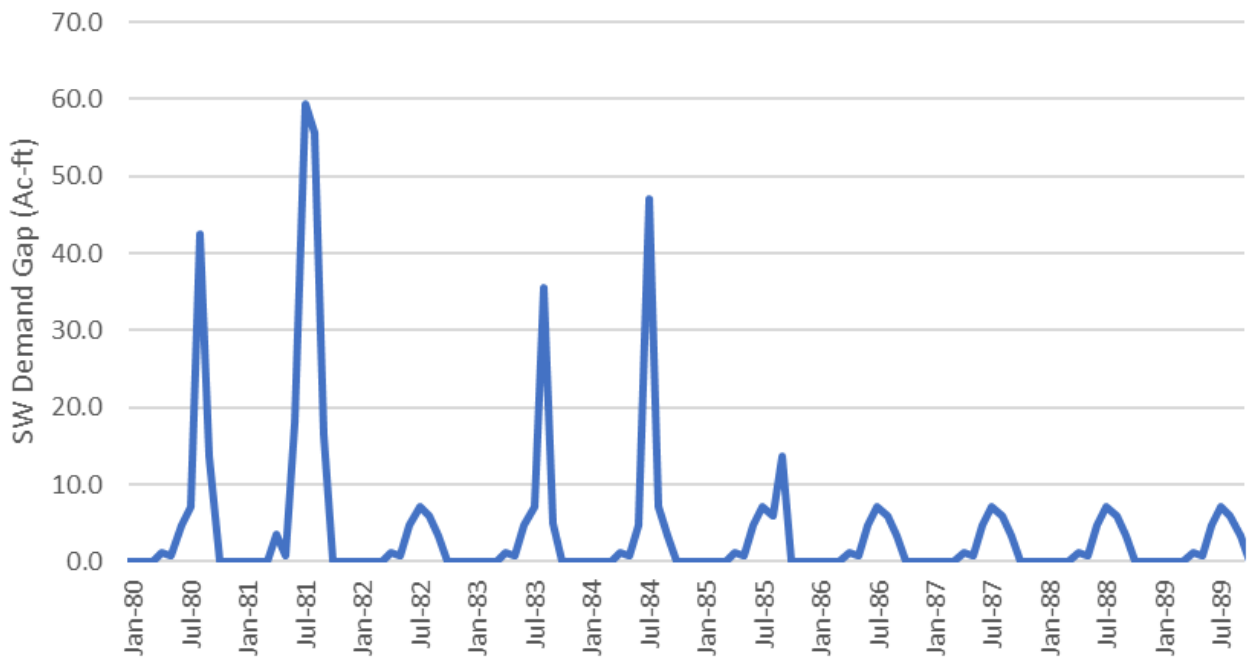


Figure 19 Modeled Estimate of Surface Water Demand Gap within Planning Basin 51 under Projected 2030 Demand Conditions (1980-1989)

4.2 Alluvial Groundwater Calculation

Incremental AGW is modeled as a storage volume representing a given planning basin's alluvial aquifer volume. The planning basins' incremental demands are diverted from the alluvial aquifer storage, and the alluvial aquifer storage diverts the aggregate demand volume from available streamflow at a 1 to 1 recharge rate. As noted in the Key Assumptions section herein, there is no additional alluvial aquifer recharge in the model. Depletion of the volume of water in the alluvial aquifer storage occurs when alluvial aquifer demand is greater than the available streamflow and represents a future aquifer depletion.

4.3 Bedrock Groundwater Calculation

Incremental BGW is modeled as a storage volume representing a given planning basin's bedrock aquifer volume. The bedrock aquifer is recharged through the application of the assumed constant recharge rate. The recharge dataset is an overall total recharge volume and does not represent the effects of historical pumping and use in the basin.

Thus, the incremental recharge volume is calculated in a pre-processing Excel workbook external to the model. This workbook is included in Attachment 3, presenting the calculation of the recharge rate (converted to a monthly average volume) less the existing BGW demand and the demand from existing out-of-basin uses not already represented by the other categorical uses' demands. When the incremental recharge volume is less than zero, the recharge volume is revised to zero automatically in the pre-processing workbook. The resulting monthly incremental recharge pattern then serves as the input into the 2025 Tool for the BGW recharge available for future demands.

The planning basins' incremental BGW demands by water use category are then applied in the model as a diversion from the BGW storage. When the demands exceed the incremental recharge rate, a depletion of the bedrock aquifer is calculated to occur. An artificial diversion is also modeled, representing a diversion from the bedrock aquifer's excess flow from the incremental recharge to the BGW aquifer (that is not used by the groundwater demands). This artificial diversion has been constructed to confirm that there is not more groundwater placed into storage than the aquifers' physical capacity.

SECTION 5 COMPARISON BETWEEN RESULTS OF 2025 TOOL AND ORIGINAL TOOL

To assess the accuracy of the 2025 Tool, results were first compared between the Original Tool and the 2025 Tool using the same input data (referred to hereafter as the Model Comparison). The input data for the projected 2020 Planning Decade (developed for the original 2012 OCWP) were used for the Model Comparison, which were then utilized to simulate physical supply availability throughout Oklahoma's 82 planning basins. While these older input data are dated, this Model Comparison was beneficial and necessary for QA/QC of the 2025 Tool's functionality, which is detailed further herein.

The following key parameters representing the primary functional elements of the calculation of physical supply availability were selected and evaluated as part of the Model Comparison.

- Monthly volume of surface water entering a planning basin
- Surface water exiting a planning basin (not including return flows)
- Surface water demand gap
- AGW depletion
- BGW depletion

- Return flow discharge volume
- Reservoir storage volume

Linear regressions of the monthly time series of the above-named model output parameters, from both the Original Tool and 2025 Tool, were developed to assess how well the 2025 Tool performs in comparison to the Original Tool.

The regression analysis comparing the Original Tool's surface water inflow and outflow results against the 2025 Tool results indicated that the 2025 Tool can accurately reproduce the projected surface water streamflow volumes. The goodness of fit comparison between the other model variables (e.g., BGW, AGW, or return flow) was similarly determined to be adequate for the planning basins.

A workbook containing a representative summary of the comparisons performed by basin is presented in as a separate .XLSX for Attachment 4. The comparisons presented in this attachment are for selected time periods for the aforementioned parameters. A tool was developed to support detailed comparisons between the Original Tool and 2025 Tool for all basins' outputs and parameters. This tool was developed as a PowerBI dashboard to allow for greater efficiencies in the performance of the comparative evaluations. The project team will coordinate with OWRB to share this dashboard for OWRB's review.

Variables that remained relatively constant (i.e., reservoir storage and interbasin transfers) do not provide sufficient variance to facilitate development of a regression. Thus, times eries outputs were comparatively analyzed and confirmed to be accurately reproducing the magnitude and timing of depletions between the models.

AGW depletions had modeled differences of near-zero amounts that the Original Tool represented as zero. Analysis of these differences indicates they are due to the computational differences between the two models' platforms (Access vs. PCSWMM). The Original Tool's Access platform only allows for the evaluation of solely monthly volumes and diversion amounts. The 2025 Tool's PCSWMM framework allows for the performance of a monthly evaluation from an initial aggregation of daily average streamflows. Instantaneous changes at the monthly timestep can manifest minimal differences when evaluating a parameter at a daily timestep. Such differences have not been found to significantly affect the quality of the resultant calculation.

SECTION 6 KEY 2025 TOOL ENHANCEMENTS

Over the course of the development of the 2025 Tool and the Model Comparison, several opportunities were identified to enhance and improve the calculations of physical supply availability. Such enhancements resulted in modifications that, in several instances, resulted in differences from the results of the Original Tool. These enhancements are described by category below.

6.1 Return Flows

The Original Tool was designed to treat return flows generated by crop irrigation water use as being returned in the same planning basin, and thus made available for use again within the same basin. For example, a planning basin may have 100 AF of surface water available for diversion, then a crop irrigation diversion of 100 AF occurs and generates a return flow of 10 AF. The Original Tool would then make this 10 AF available as a supply which could be diverted in the same month.

The original assumption cannot (and arguably should not) be modeled inside of a connected model such as that of the PCSWMM platform, as such an assumption creates a circular loop whereby the same water that was diverted becomes source water. Such a loop cannot be solved within the PCSWMM model and could only be previously solved by forcing a single mathematical iteration in the Access platform. For the

2025 Tool, this issue has been removed by assuming that all return flows, including return flows resulting from crop irrigation use, would only count towards the calculation of downstream supply availability. This approach is consistent with how other types of return flows have been modeled.

The Original Tool was also designed to limit the availability of return flows originating from BGW use to the incremental demands met by the incremental recharge volume. If a future, incremental demand depleted the bedrock aquifer, no return flow from that demand was modeled as an available supply. The 2025 Tool has been designed to calculate return flows from all groundwater demands met, including those originating from BGW use.

6.2 Interbasin Transfers

Several planning basins either send, or receive, water via an interbasin transfer (see Table 3).

The mass balance calculation in the 2025 Tool has been structured such that for a given planning basin (with an outgoing interbasin transfer), that transferable flow volume is diverted from the originating basin's streamflow prior to diversion of in-basin demands routed through the basin's local reservoir supply (if one is present). This is performed so the interbasin transfer can be met even if streamflow is not available.

For a basin receiving an interbasin transfer, the transferred flow volume enters that basin's streamflow *after* the calculation of outgoing interbasin transfer diversion occurs, and prior to the calculation of the basin's demands.

During development of the 2025 Tool, it was identified that 17 interbasin transfers constructed in this manner resulted in a continuous loop that could prevent the model from successfully running; generally, these transfers involved the following basins.

1. Transfers from Basin 2 to Basin 3
2. Transfers from Basin 14 to Basins 15 and 16
3. Transfers between Basin 63 and Basin 64
4. Transfers from Basin 73 to Basin 74
5. Transfers from Basin 74 between Basins 75, 78, and 79
6. Transfer from Basin 78 to Basin 75
7. Transfers between Basin 78 and Basins 79 and 80

For these five interbasin transfers, the planning basin receiving the interbasin transfer receives the flow in a modeled "place-holder" node, which is then used for the calculation of the individual diversion of the basins' surface water demands. This routing approach prevents the circular loop from occurring within the model by keeping the transferred water out of the primary flow network, while allowing for accurate representation of the transfer.

SECTION 7 MODEL OUTPUTS

The results of the 2025 Tool's simulations are comprised of a time series of daily average flows (from conduits) and volumes (from nodes) for every modeled element. The modeled physical source supply gaps and aquifer/reservoir storage depletions are two of the most critical outputs from the 2025 Tool for the purposes of the 2025 OCWP Update, as these outputs inform the subsequent analyses and computations necessary for the broader planning process and reporting.

The PCSWMM platform allows a user to graph selected output data from within the software, allowing for the ready and straightforward generation of user-specified results. Additional data products can be

generated from the flow and volume results using post-processing scripts, databases, or readily available spreadsheet software.

These data products are obtained by post-processing the data from the model elements representing demand and the corresponding demand input dataset. Any representation of flow-related data (e.g., streamflow, demand diversions, modeled aquifer supply volume) can be exported and post-processed to generate data tables, statistics on magnitude and frequency of event occurrences, and other detailed characterizations.

The scripts for exporting the 2025 Tool's output currently write data to comma delimited text files (.CSV). However, data exportation to Excel can be readily accomplished via a script. The data output is typically a table of time series data points that have been processed by the script to be in monthly timestep. Data output for the following parameters are currently available.

1. Available surface water entering a planning basin
2. Available surface water leaving a planning basin, prior to inclusion of return flow
3. Reservoir storage volume
4. AGW aquifer volume
5. BGW aquifer volume
6. Surface water supply gap
7. Interbasin Transfers entering and/or entering the planning basin

SECTION 8 **PATH FORWARD**

As described herein, significant enhancements to the 2025 Tool have been made to increase its functionality and accuracy. This newly developed model allows for increased efficiency and capability to characterize physical water supply in support of the 2025 OCWP Update. This capability represents a significant milestone towards development of the 2025 OCWP Update, as it provides the tool upon which physical water supply will be assessed. However, it is not yet the final product of the present planning process. Described herein are considerations of the path forward for the development and use of the 2025 Tool, focusing upon anticipated applications and ongoing efforts that will influence the model's continued development.

8.1 Applications for 2025 Tool

The analyses forming the backbone of the 2025 OCWP Update's water supply assessment will rely, in part, upon the physical supplies generated from the application of various modeled scenarios implemented using the 2025 Tool. Application of the 2025 Tool will initially inform upon the identification of focus basins within the state. For these focus basins, more detailed assessments of water management strategies will be developed.

In coordination with OWRB, the project team's identification and development of specific "what-if" scenarios will also inform what is needed from the 2025 Tool. Additional model applications may include investigations into the impacts of climate variability on demand (identifying accordant comparative differences in supply gaps), and/or the assessment of flow frequencies for consumptive and non-consumptive purposes.

As noted previously, the 2025 Tool and results of analyses will generate data used in the broader framework for the backend presentation of information, both internal to OWRB and separate, public facing

information. The management and presentation of such information will likely influence the functional needs of the 2025 Tool.

These considerations are organized in terms of inputs and outputs below.

8.2 Updating Inputs

The 2025 Tool as presented herein reflects several sources of input data that were derived from the Original Tool. The Original Tool was developed and implemented for the purposes of the 2012 OCWP. There are multiple simultaneous efforts presently underway that are being performed for the 2025 OCWP Update. These ongoing efforts are generating information that will be used for refining the 2025 Tool's present inputs. Further, there are initial assumptions and representations in the present 2025 Tool that merit discussion and input from OWRB staff to determine which remain appropriate, and which warrant revisions (or assessments of alternatives). At a minimum, updated input data on groundwater recharge rates and water demands are under development and are anticipated to be incorporated. The following elements have been preliminarily identified for further consideration, in no order of priority.

- Assumed availability of water from out-of-state, upstream contributing watersheds, considering interstate compact obligations
- Unused reservoir storage
- Interbasin transfers
- Aquifer storage capacity

Ongoing collaboration between the project team and OWRB will determine these and other modifications necessary for what will ultimately serve as the final 2025 Tool used in support of the 2025 OCWP Update. The 2025 Tool will be progressively refined through the development and use of modified assumptions, scenarios, and data, in collaboration with OWRB.

8.3 Updating Outputs

Updates to the 2025 Tool's outputs are also likely, in terms of both form and function, as the current production of model outputs will likely need further adaptation to produce both additional outputs and data processing capabilities. Greater detail on database needs and backend uses (internally and public facing) will inform what information is needed from the 2025 Tool, and how that information is produced. It is anticipated that additional scripts and user-interfaces will be developed to improve importation of model scenario parameters, as well as to facilitate the exportation, post-processing, and analysis of the 2025 Tool's outputs.



ATTACHMENT 1 **AQUIFER RECHARGE AND
STORAGE TABLE**

Planning Basin ID	Bedrock Groundwater Recharge Rate (cfs)	Bedrock Groundwater Recharge Rate (Ac-ft per Year)	Bedrock Groundwater Aquifer Storage Capacity (Ac-ft)	Alluvial Groundwater Aquifer Storage Capacity (Ac-ft)
1	21.00	15,216.48	6,570,550	156,551
2	11.37	8,236.52	3,648,640	3,516
3	13.01	9,428.66	3,802,390	100
4	0.05	37.35	16,544	100
5	18.63	13,499.59	3,508,420	65,761
6	12.30	8,908.10	713,092	100
7	24.12	17,475.47	3,371,070	42,721
8	5.23	3,786.54	215,642	8,646
9	55.89	40,492.08	3,612,510	100
10	9.29	6,730.09	2,367,640	198,432
11	4.85	3,514.93	2,097,470	35,913
12	71.21	51,587.87	4,105,010	923
13	7.17	5,193.10	3,098,890	451,957
14	57.99	42,008.46	2,452,690	612,847
15	1.33	963.66	77,753	583,414
16	59.27	42,940.35	7,442,560	447,875
17	24.78	17,949.53	3,613,820	203,019
18	40.77	29,536.59	8,378,640	100
19	94.12	68,186.13	24,784,220	1,240,070
20	29.57	21,420.63	1,555,330	994,196
21	129.18	93,582.85	10,682,040	579,070
22	11.27	8,161.69	622,554	170,996
23	0.85	617.25	50,647	136,695
24	0.00	0.00	0	29,156
25	9.85	7,133.34	656,172	100
26	0.00	0.00	0	100
27	0.00	0.00	0	100
28	11.01	7,978.13	1,124,860	100
29	1.85	1,340.90	171,096	100
30	0.00	0.00	0	22,280

Planning Basin ID	Bedrock Groundwater Recharge Rate (cfs)	Bedrock Groundwater Recharge Rate (Ac-ft per Year)	Bedrock Groundwater Aquifer Storage Capacity (Ac-ft)	Alluvial Groundwater Aquifer Storage Capacity (Ac-ft)
31	0.00	0.00	0	658,081
32	0.00	0.00	0	297,606
33	0.00	0.00	0	544,210
34	28.53	20,671.99	897,053	556,517
35	0.00	0.00	0	57,417
36	0.00	0.00	0	540,314
37	14.62	10,588.27	590,500	1,312,600
38	28.21	20,438.88	394,832	59,878
39	4.15	3,005.51	58,215	100
40	21.35	15,466.35	297,333	139
41	26.55	19,233.29	371,524	1,000
42	0.00	0.00	0	108,588
43	0.00	0.00	0	79,927
44	0.05	37.31	1,905	10,325
45	0.00	0.00	0	100
46	145.75	105,590.83	5,719,540	129,727
47	48.07	34,821.32	1,854,920	115,434
48	5.70	4,129.51	1,315,690	737,963
49	4.80	3,474.92	211,440	274,957
50	67.98	49,245.69	11,494,620	1,233,230
51	0.71	517.36	181,135	1,049,210
52	4.30	3,113.49	1,504,680	1,431,710
53	11.36	8,230.88	11,257,480	1,335,470
54	13.43	9,727.01	4,907,050	147,859
55	33.95	24,595.88	42,539,960	100
56	22.84	16,544.67	4,124,520	1,037,330
57	0.00	0.00	0	166,531
58	20.78	15,051.09	3,451,940	983,016
59	91.40	66,214.58	20,877,880	1,262,640
60	126.78	91,848.57	14,595,100	21,525

Planning Basin ID	Bedrock Groundwater Recharge Rate (cfs)	Bedrock Groundwater Recharge Rate (Ac-ft per Year)	Bedrock Groundwater Aquifer Storage Capacity (Ac-ft)	Alluvial Groundwater Aquifer Storage Capacity (Ac-ft)
61	19.82	14,355.41	2,622,260	16,206
62	51.00	36,947.86	9,821,920	88,081
63	21.02	15,228.90	2,320,390	224,400
64	34.93	25,304.69	5,369,810	3,157,920
65	3.21	2,327.77	5,340,580	832,618
66	4.21	3,051.59	1,946,370	100
67	0.00	0.00	0	87,569
68	0.00	0.00	0	1,691,410
69	0.00	0.00	0	3,806
70	0.00	0.00	0	100
71	53.29	38,603.09	2,840,510	68,747
72	3.07	2,226.94	58,238	98,099
73	0.00	0.00	0	0
74	34.90	25,282.05	661,165	100
75	0.00	0.00	0	100
76	26.89	19,479.80	509,427	100
77	0.00	0.00	0	106,446
78	0.00	0.00	0	0
79	21.66	15,693.86	652,660	100
80	300.74	217,873.84	11,735,200	5,755
81	164.90	119,466.77	7,265,570	100
82	164.96	119,507.24	7,194,820	5,408



ATTACHMENT 2 **INCREMENTAL FLOW
PREPROCESSING**

Email Matt Cogburn <Matt.Cogburn@owrb.ok.gov>, OWRB's Director of Water Planning, to request a copy of Attachments 2-4.



ATTACHMENT 3 **SWMM INPUT DATA PREPROCESSOR**

Email Matt Cogburn <Matt.Cogburn@owrb.ok.gov>, OWRB's Director of Water Planning, to request a copy of Attachments 2-4.



ATTACHMENT 4 **COMPARISON SNAPSHOT**

Email Matt Cogburn <Matt.Cogburn@owrb.ok.gov>, OWRB's Director of Water Planning, to request a copy of Attachments 2-4.

APPENDIX C

DIFFERENCES BETWEEN SURFACE WATER PHYSICAL AND LEGAL AVAILABILITY

DIFFERENCES BETWEEN SURFACE WATER PHYSICAL AND LEGAL AVAILABILITY

A reliable water source is contingent upon having the water physically present for diversion and use (physical supply or "wet water"), possessing the necessary water rights to divert water (legal supply or "paper water"), adequate water quality for intended use, and sufficient infrastructure to divert, treat, and convey the water for use. The Oklahoma Comprehensive Water Plan (OCWP) evaluates supply and demand factors at the region and/or basin level.

The physically available and legally available surface water flows are two separate analyses.

Generally, similarities between physical and legal analysis are:

- Both account for unappropriated dependable yield from reservoirs. The physical analysis used an earlier unappropriated dependable yield database. The values may differ slightly but are generally similar.
- Both account for interstate compact requirements. The physical surface water analysis takes compact water out from water coming into the state (most upstream basin), while the legal analysis takes it out from selected basins. The amount of water removed is similar.

Generally, differences between physical and legal availability are:

- The surface water legal analysis removes domestic use and pending permit application amounts from the available water. These are in addition to factoring in future changes in water demand for the seven use sectors used throughout the OCWP. The pending permit application amounts are a significant driver of the differences between surface and legal water availability in Basins 5, 7, 8, and 27.
- Physical surface water supply analysis uses United States Geological Survey (USGS) stream gage data from October 1949 to September 2021 (water years 1950 to 2020). The surface water legal analysis uses flow data from 1940 to 2007.
- The physical surface water analysis is based on the June 2023 permit database. All in-basin permits are accounted for, while only permitted interbasin transfers greater than 500 acre-feet per year are included in the physical surface water analysis.
- The normal storage volume of Natural Resources Conservation Service (NRCS) reservoirs is not included in the physical surface water analysis but is included in the legal analysis. The presence of the NRCS reservoirs is embedded in the historical USGS gage record that is used for the physical water availability analysis. However, the physical analysis does not account for any additional available firm yield that might still be available for use from the NRCS reservoirs.
- The physical and legal availability analysis assumes that all water from upstream basins is available to downstream basins (Figure 1).

More information on the water supply analyses is available in the *Physical Water Supply Availability Report* and *Legal Availability Analysis Report*.

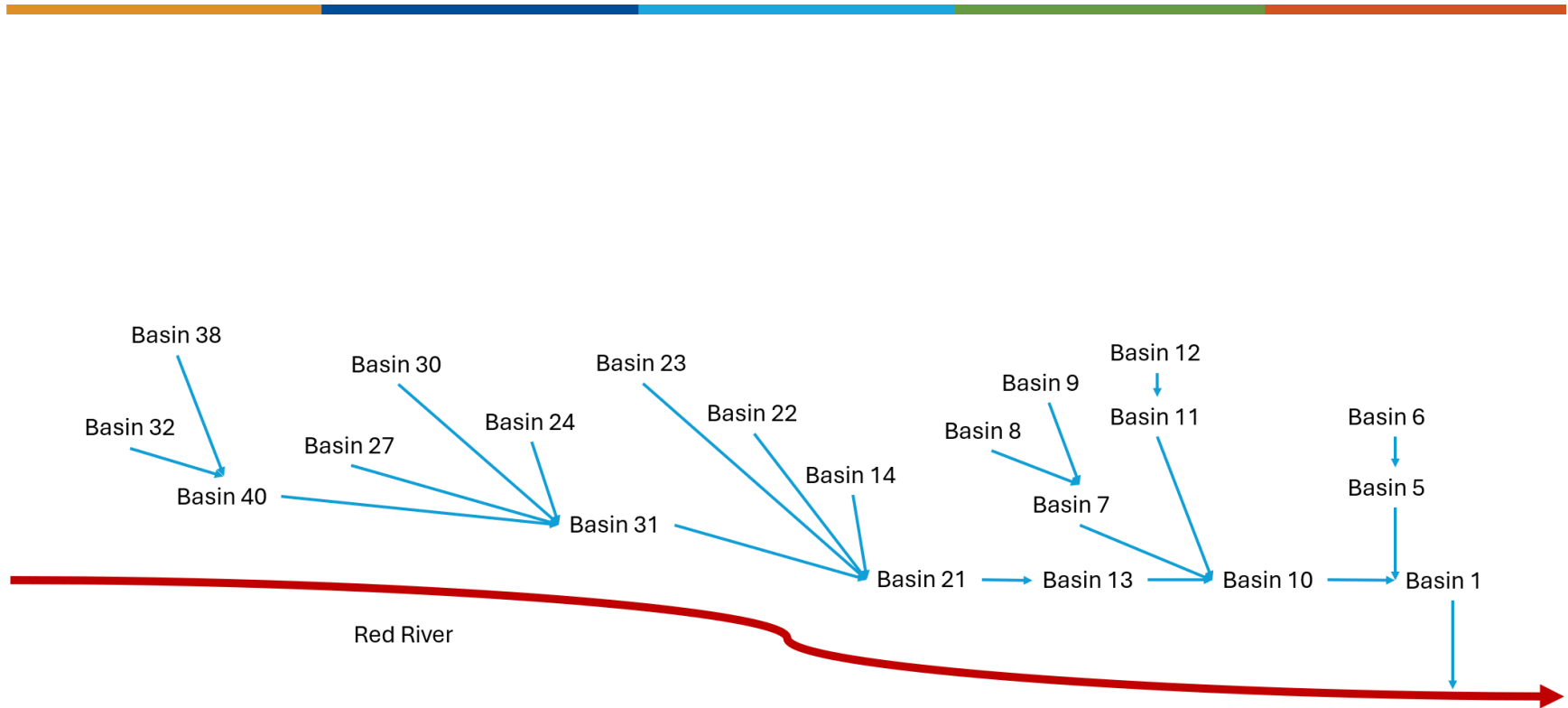


Figure 1 Flow Schematic Used for Physical and Legal Surface Water Availability Analysis