Characteristics of the Coal Creek Watershed

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Acronyms

BMP – Best Management Practice

CPP – Continuing Planning Process

FEMA – Federal Emergency Management Agency

GIS – Geographic Information System

INCOG – Indian Nations Council of Governments

MAWPR – Middle Arkansas Watershed Planning Region

OCWP – Oklahoma Comprehensive Water Plan

ODEQ – Oklahoma Department of Environmental Quality

OWRB – Oklahoma Water Resources Board

PBCR – Primary Body Contact Recreation

SCAP – Site Cleanup Assistance Program

TMDL – Total Maximum Daily Load

WBID – Water Body Identification Number

WQS – Water Quality Standard

WWAC – Warm Water Aquatic Community

Introduction

This report provides information obtained through numerous sources regarding the physical characteristics of the Coal Creek watershed. Maps, data tables and photos are used along with text to help watershed managers gain more insight into watershed activities that can have an impact on water quality. Coal Creek is an impaired waterbody and not meeting water quality criteria established by the State of Oklahoma for all assigned beneficial uses. By better understanding the population and activities along with the features within a watershed it becomes easier to select and place best management practices (BMPs) designed to reduce the pollutant load causing the impairment.

The Coal Creek watershed along with the Haikey Creek, Polecat Creek and Ranch Creek watersheds made up the study area for this report. Each watershed is listed separately, but combined; they make up the whole study.

Physical Description and Location

Coal Creek (WBID OK121300010090_00) is 6.71 miles long and begins within the City of Tulsa and flows north to Bird Creek. Recreation Creek (OK121300010100_00) is 2.38 miles long, a tributary of Coal Creek, originates within the City of Tulsa and flows east before discharging to Coal Creek. Yahola Lake (OK121300010130_00) covers 424.2 acres and Recreation Lake (OK121300010110_00) is 60.9 acres. Both of these lakes drain through Recreation Creek to Coal Creek. The Coal Creek watershed covers approximately 17.1 square miles with 9.1 miles of creek and 485.1 acres of lake.

Map 1: Coal Creek Watershed and City Limits

Waterbodies within this watershed are listed and shown in Table 1 and Map 1. The advent of stormwater collection systems has changed the shape of some watersheds in developed areas. Runoff does not always flow to the closest receiving stream. It may get intercepted by a stormwater collection system inlet and piped somewhere else. Therefore caution should be exercised when determining watershed boundaries in developed areas with just topo maps.

Table 1: Coal Creek Streams, Lakes and WBIDs		
Water Body Identification (WBID)	DEQ/OWRB Water Body Name	Length (Miles) Area (Acres)
OK121300010090_00	Coal Creek	6.71
OK121300010100_00	Recreation Creek	2.38
OK121300010110_00	Recreation Lake	60.9
OK121300010130_00	Yahola Lake	424.2

Coal Creek at Mohawk
Blvd. bridge 3-29-18

Watershed Demographics

To manage a watershed you have to manage the people within the watershed. Any changes that occur within the watershed will be made through the actions of the people living there so it is advisable to understand the population demographics. The following tables show the current demographics and how they have changed from 2000 to 2017 with projections out to 2022. The 2017 values are estimates. Data from the United States Census Bureau were used for these demographics.

Some comments are offered following some of the tables to help get individuals thinking about how demographic information can be used to help develop watershed plans and what actions could be implemented to improve watershed conditions. Detailed studies of the data will reveal opportunities that are sometimes overlooked.

Table 2: Population Demographics										
	2000 Census	%	2010 Census	%	2017A Estimates	%	2022 Projections	%	Percent Change	
									2000 to 2010	2017 to 2022
Total Population	34,107		32,667		33,579		32,587		-4.2%	-3.0%
Population Density (Pop/Sq Mi)	1,994.83		2,114.43		1,963.90		1,905.87		6.0%	-3.0%
Total Households	13,680		12,867		13,174		13,131		-5.9%	-0.3%
Population by Gender										
Male	16,593	48.7%	16,270	49.8%	16,642	49.6%	16,158	49.6%	-1.9%	-2.9%
Female	17,515	51.4%	16,397	50.2%	16,937	50.4%	16,429	50.4%	-6.4%	-3.0%

The total population within the watershed decreased 4.2% from 2000 to 2010 and is expected to decrease another 3.0% from 2017 to 2022. The population density increased by 6.0% from 2000 to 2010, but is expected to decrease by 3.0% from 2017 to 2022. Overall the population has been and is predicted to remain relatively stable and without a big shift from rural to urban areas.

Table 3: Population by Race										
	2000 Census	%	2010 Census	%	2017A Estimates	%	2022 Projections	%	**Percent Change**	
									2000 to 2010	2017 to 2022
White	22,749	66.7%	18,889	57.8%	18,331	54.6%	17,173	52.7%	-17.0%	-6.3%
Black	4,335	12.7%	4,357	13.3%	4,536	13.5%	4,347	13.3%	0.5%	-4.2%
American Indian or Alaska Native	2,500	7.3%	2,613	8.0%	2,857	8.5%	2,750	8.4%	4.5%	-3.7%
Asian/Native Hawaiian/Other Pacific Islander	312	0.9%	391	1.2%	504	1.5%	526	1.6%	25.5%	4.6%
Some Other Race	1,976	5.8%	4,008	12.3%	4,668	13.9%	4,904	15.1%	102.8%	5.1%
Two or More Races	2,235	6.6%	2,409	7.4%	2,684	8.0%	2,886	8.9%	7.8%	7.6%

Table 4: Population by Ethnicity										
	2000 Census	%	2010 Census	%	2017A Estimates	%	2022 Projections	%	**Percent Change**	
									2000 to 2010	2017 to 2022
Hispanic	3,755	_11.0%_	6,769	_20.7%_	7,889	_23.5%_	8,263	_25.4%_	80.3%	4.7%
Not Hispanic or Latino	30,352	_89.0%_	25,898	_79.3%_	25,690	_76.5%_	24,323	_74.6%_	-14.7%	-5.3%

Educational outreach efforts should take into consideration the race and ethnicity of the target audience. Cultures and languages vary and priorities may be different so these factors need to be evaluated when coordinating educational outreaches, forming watershed alliances and trying to gain support for changes that could improve watershed conditions.

Table 5: Population by Age										
	2000 Census	**%**	**2010 Census**	**%**	**2017A Estimates**	**%**	**2022 Projections**	**%**	**Percent Change**	
									2000 to 2010	**2017 to 2022**
0 to 4	2,707	7.9%	2,944	9.0%	3,023	9.0%	2,878	8.8%	8.8%	-4.8%
5 to 14	4,992	14.6%	4,420	13.5%	4,804	14.3%	4,691	14.4%	-11.5%	-2.3%
15 to 19	2,457	7.2%	2,497	7.6%	2,365	7.0%	2,304	7.1%	1.6%	-2.6%
20 to 24	3,128	9.2%	3,262	10.0%	3,085	9.2%	2,767	8.5%	4.3%	-10.3%
25 to 34	5,751	16.9%	5,369	16.4%	5,784	17.2%	5,553	17.0%	-6.6%	-4.0%
35 to 44	5,082	14.9%	4,075	12.5%	4,246	12.6%	4,363	13.4%	-19.8%	2.8%
45 to 54	4,091	12.0%	4,051	12.4%	3,757	11.2%	3,283	10.1%	-1.0%	-12.6%
55 to 64	2,226	6.5%	3,318	10.2%	3,529	10.5%	3,333	10.2%	49.0%	-5.6%
65 to 74	1,799	5.3%	1,433	4.4%	1,695	5.0%	2,067	6.3%	-20.3%	22.0%
75 to 84	1,285	3.8%	911	2.8%	913	2.7%	1,000	3.1%	-29.1%	9.6%
85+	590	1.7%	387	1.2%	377	1.1%	347	1.1%	-34.4%	-7.9%
Median Age:										
Total Population	31.2		30.6		30.9		31.7			

The median age within the watershed has changed very little since 2000 and is expected to remain about the same through 2022. However, as the population ages, the most notable change is the 22.0% jump in the 65 to 74 year age bracket expected to occur from 2017 to 2022. The percent of the population reaching retirement age and expected to leave the work force goes up and these retirees may have more free time to pursue other passions. Maybe watershed protection will interest some of these people and stream monitors and advocates will be easier to recruit.

Table 6: Households by Income										
	2000 Census	%	2010 Census	%	2017A Estimates	%	2022 Projections	%	Percent Change	
									2000 to 2010	2017 to 2022
$0 - $15,000	3,134	22.9%	2,524	19.6%	2,516	19.1%	2,178	16.6%	-19.5%	-13.4%
$15,000 - $24,999	2,568	18.8%	2,392	18.6%	2,249	17.1%	2,044	15.6%	-6.9%	-9.1%
$25,000 - $34,999	2,440	17.8%	2,167	16.8%	2,046	15.5%	1,909	14.5%	-11.2%	-6.7%
$35,000 - $49,999	2,725	19.9%	2,192	17.0%	2,313	17.6%	2,214	16.9%	-19.6%	-4.3%
$50,000 - $74,999	1,865	13.6%	1,962	15.3%	2,216	16.8%	2,275	17.3%	5.2%	2.7%
$75,000 - $99,999	566	4.1%	933	7.3%	1,045	7.9%	1,290	9.8%	64.9%	23.5%
$100,000 - $149,999	316	2.3%	491	3.8%	502	3.8%	793	6.0%	55.8%	57.9%
$150,000 +	112	0.8%	206	1.6%	287	2.2%	428	3.3%	84.5%	49.4%
Average Hhld Income	$36,133		$42,683		$44,823		$52,185		18.1%	16.4%
Median Hhld Income	$29,263		$32,164		$33,926		$37,619		9.9%	10.9%
Per Capita Income	$14,493		$17,040		$17,809		$21,260		17.6%	19.4%

Hhld = Household

Average household income, median household income and per capita income have steadily increased throughout the watershed.

Table 7: Employment										
	2000 Census	%	2010 Census	%	2017A Estimates	%	2022 Projections	%	Percent Change	
									2000 to 2010	2017 to 2022
Total Population 16+	26,076		24,940		25,391		24,638		-4.4%	-1.2%
Total Labor Force	17,035	65.3%	16,113	64.6%	15,636	61.6%	15,317	62.2%	-5.4%	-2.0%
Civilian, Employed	15,785	92.7%	14,180	88.0%	14,381	92.0%	14,304	93.4%	-10.2%	-0.5%
Civilian, Unemployed	1,224	7.2%	1,875	11.6%	1,197	7.7%	959	6.3%	53.2%	-19.9%
In Armed Forces	25	0.2%	57	0.4%	58	0.4%	54	0.4%	126.4%	-6.2%
Not In Labor Force	9,041	34.7%	8,827	35.4%	9,755	38.4%	9,321	37.8%	-2.4%	-4.4%
% Blue Collar	7,442	47.1%	6,944	49.0%	7,231	50.3%	7,194	50.0%	-6.7%	-0.5%
% White Collar	8,355	52.9%	7,236	51.0%	7,150	49.7%	7,110	49.4%	-13.4%	-0.6%

Table 8: Housing Units										
	2000 Census	%	2010 Census	%	2017A Estimates	%	2022 Projections	%	Percent Change	
									2000 to 2010	2017 to 2022
Total Housing Units	14,894		15,006		15,137		15,171		0.7%	0.2%
Total Occupied Housing Units	n/a	n/a	12,867	85.8%	13,174	87.0%	13,131	86.6%	n/a	-0.3%
Owner Occupied: Owned with a mortgage or loan	n/a	n/a	4,429	34.4%	4,122	31.3%	4,041	30.8%	n/a	-2.0%
Owner Occupied: Owned free and clear	n/a	n/a	2,482	19.3%	2,794	21.2%	2,799	21.3%	n/a	0.2%
Renter Occupied	n/a	n/a	5,956	46.3%	6,258	47.5%	6,291	47.9%	n/a	0.5%
Vacant	1,214	8.2%	2,139	14.3%	1,963	13.0%	2,040	13.4%	76.2%	3.9%

Total housing units have remained relatively constant from 2000 to 2010 and are not expected to change significantly through 2022 so residential development and residential construction related runoff pollutants are most likely not going to be a major concern.

Table 9: Vehicles Available										
	2000 Census	%	2010 Census	%	2017A Estimates	%	2022 Projections	%	Percent Change	
									2000 to 2010	2017 to 2022
0 Vehicles Available	1,261	9.2%	1,009	7.8%	1,078	8.2%	1,086	8.3%	-20.0%	0.7%
1 Vehicle Available	6,335	46.3%	5,803	45.1%	5,897	44.8%	5,884	44.8%	-8.4%	-0.2%
2+ Vehicles Available	6,084	44.5%	6,055	47.1%	6,200	47.1%	6,162	46.9%	-0.5%	-0.6%
Average Vehicles Per Household	1.40		1.69		1.70		1.70		22.9%	0.0%

There was a noticeable increase in the average number of vehicles per household from 2000 to 2010, then it leveled off and this figure is expected to remain constant through 2022. Vehicles can contribute a variety of pollutants, but unless traffic from outside the watershed increases or the average age of the local vehicles increases, transportation related pollutants might remain constant.

Table 10: Marital Status										
	2000 Census	%	2010 Census	%	2017A Estimates	%	2022 Projections	%	**Percent Change**	
									2000 to 2010	2017 to 2022
Married, Spouse Present	10,987	41.6%	8,447	33.4%	8,400	32.6%	8,180	32.7%	-23.1%	-2.6%
Married, Spouse Absent	1,469	5.6%	1,287	5.1%	1,392	5.4%	1,353	5.4%	-12.4%	-2.8%
Divorced	4,025	15.2%	4,238	16.8%	4,122	16.0%	3,939	15.8%	5.3%	-4.4%
Widowed	1,832	6.9%	1,350	5.3%	1,296	5.0%	1,229	4.9%	-26.3%	-5.1%
Never Married	8,119	30.7%	9,980	39.4%	10,541	40.9%	10,316	41.2%	22.9%	-2.1%
Age 15+ Population	26,408		25,302		25,751		25,018		-4.2%	-2.8%

Table 11: Educational Attainment										
	2000 Census	%	2010 Census	%	2017A Estimates	%	2022 Projections	%	**Percent Change**	
									2000 to 2010	2017 to 2022
Grade K - 8	1,510	7.3%	1,298	6.6%	1,496	7.4%	1,484	7.4%	-14.0%	-0.8%
Grade 9 - 11	3,606	17.3%	2,828	14.5%	2,743	13.5%	2,663	13.4%	-21.6%	-2.9%
High School Graduate	6,438	31.0%	6,259	32.0%	6,272	30.9%	6,113	30.7%	-2.8%	-2.5%
Some College, No Degree	4,832	23.2%	4,458	22.8%	4,657	22.9%	4,583	23.0%	-7.7%	-1.6%
Associates Degree	1,206	5.8%	1,096	5.6%	1,213	6.0%	1,201	6.0%	-9.1%	-0.9%
Bachelor's Degree	1,973	9.5%	2,249	11.5%	2,447	12.1%	2,438	12.2%	14.0%	-0.4%
Graduate Degree	964	4.6%	1,013	5.2%	1,048	5.2%	1,041	5.2%	5.1%	-0.7%
No Schooling Completed	274	1.3%	342	1.7%	425	2.1%	422	2.1%	24.8%	-0.9%
Age 25+ Population	20,802		19,544		20,301		19,946		-6.1%	-1.7%

Impaired Waters

Every two years the State of Oklahoma evaluates its waterbodies to determine which ones are not meeting minimum water quality standards and beneficial use criteria. The currently approved report is "Water Quality In Oklahoma, 2014 Integrated Report". The 2016 Integrated Report is still in draft form. In the 2014 Integrated Report, Coal Creek is the only waterbody listed as impaired (for Warm Water Aquatic Community and Primary Body Contact Recreation), or not meeting minimum water quality criteria in the Coal Creek watershed. Listings in the 2012 Integrated Report were the same as the 2014 Integrated Report. (See Table 12)

The Draft 2016 Integrated Report is the same as the 2014 Integrated Report other than a "Not Assessed X" was placed in the Public and Private Water Supply column for Yahola Lake, which was not addressed in the 2012 and 2014 versions.

Table 12: 2014 Oklahoma Integrated Report						
Water Body	Category	Aesthetic	Agriculture	Warm Water Aquatic Community (WWAC)	Fish Consumption	Primary Body Contact Recreation (PBCR)
Coal Creek	5c	I	I	N	X	N
Recreation Creek	3	X	X	X	X	X
Recreation Lake	3	X	X	X	X	X
Yahola Lake	3	X	X	X	X	X

F=Fully Supporting   I=Insufficient Information   N=Not Supporting   X=Not Assessed

The two causes of impairment are macroinvertebrate biology and the bacteria Escherichia coli. Table 13 lists some unconfirmed potential sources. Additional information concerning the impairment caused by Escherichia coli can be found in the Total Maximum Daily Load Report (TMDL) titled "Bacteria Total Maximum Daily Loads For The Lower Bird Creek Watershed Area (40582) prepared by the Indian Nations Council Of Governments (INCOG) and dated July 2011. A TMDL for the macroinvertebrate biology impairment will be completed when the additional necessary data has been collected.

Table 13: 2014 Oklahoma Integrated Report					
Water Body	Cause of Impairment	Impaired Use	Unconfirmed Potential Sources	Cause Category	TMDL ID (Completion Date)
Coal Creek	Macroinvertebrate Bio	WWAC	46, 49, 59, 87, 92, 102, 108, 111, 136, 140	5c	-----
	Escherichia coli	PBCR	TMDL Completed	4a	40582 (8/16/2011)

WWAC=Warm Water Aquatic Community   PBCR=Primary Body Contact Recreation

Table 14: 2014 Oklahoma Integrated Report (Legend of Potential Sources)	
Source ID	Source Description
46	Grazing in Riparian or Shoreline Zones
49	Highway/Road/Bridge Runoff (Non-construction Related
59	Impacts from Land Application of Wastes
87	Non-irrigated Crop Production
92	On-site Treatment systems (Septic Systems and Similar Decentralized Systems)
102	Petroleum/natural Gas Activities (Legacy)
108	Rangeland Grazing
111	Residential Districts
136	Wildlife Other than Waterfowl
140	Source Unknown

Once an impairment is determined, the waterbody is placed in one of five categories:

Category 1 - Attaining the water quality standard and no use is threatened. Waterbodies listed in this category are characterized by data and information that meet the requirements of the Continuing Planning Process (CPP) to support a determination that the water quality standard is attained and no use is threatened. Consideration will be given to scheduling these waterbodies for future monitoring to determine if the water quality standard continues to be attained.

Category 2 - Attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened. Waterbodies listed in this category are characterized by data and information which meet the requirements of the CPP to support a determination that some, but not all, uses are attained and none are threatened. Attainment status of the remaining uses is unknown because there is insufficient or no data or information. Monitoring shall be scheduled for these waterbodies to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information was previously insufficient to make a determination.

Category 3 - Insufficient or no data and information to determine if any designated use is attained. Waterbodies are listed in this category when the data or information to support an attainment determination for any use is not available or consistent with the requirements of the

CPP. To assess the attainment status of these waterbodies, supplementary data and information shall be obtained, or monitoring shall be scheduled as needed.

Category 4 - Impaired or threatened for one or more designated uses but does not require the development of a TMDL.

4A - TMDL has been completed. Waterbodies are listed in this subcategory once all TMDL(s) have been developed and approved by EPA that, when implemented, are expected to result in full attainment of the standard. Where more than one pollutant is associated with the impairment of a waterbody, the waterbody will remain in Category 5 until all TMDLs for each pollutant have been completed and approved by EPA. Monitoring shall be scheduled for these waterbodies to verify that the water quality standard is met when the water quality management actions needed to achieve all TMDLs are implemented.

4B - Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future. Consistent with the regulation under 130.7(b)(i),(ii), and (iii), waterbodies are listed in this subcategory when other pollution control requirements required by local, state, or federal authority are stringent enough to implement any water quality standard (WQS) applicable to such waters. These requirements must be specifically applicable to the particular water quality problem. Monitoring shall be scheduled for these waterbodies to verify that the water quality standard is attained as expected.

4C - Impairment is not caused by a pollutant. Waterbodies are listed in this subcategory if the impairment is not caused by a pollutant. Scheduling of these waterbodies for monitoring to confirm that there continues to be no pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment, shall be considered.

Category 5 - The water quality standard is not attained. The waterbody is impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL. This category constitutes the Section 303(d) list of waters impaired or threatened by a pollutant(s) for which one or more TMDL(s) are needed. A waterbody is listed in this category if it is determined, in accordance with the CPP, that a pollutant has caused, is suspected of causing, or is projected to cause an impairment. Where more than one pollutant is associated with the impairment of a single waterbody, the waterbody will remain in Category 5 until TMDLs for all pollutants have been completed and approved by EPA. For waterbodies listed in this category, monitoring schedules shall be provided that describe when data and information will be collected to support TMDL establishment and to determine if the standard is attained. While the waterbody is being monitored for a specific pollutant to develop a TMDL, the watershed shall also be monitored to assess the attainment status of other uses. A schedule for the establishment of TMDLs for all waters in Category 5 shall be submitted. This schedule shall reflect the priority ranking of the listed waters. Category 5 waterbodies are further divided into the following subcategories:

5A – TMDL is underway or will be scheduled.

5B – A review of the Water Quality Standards will be conducted before a TMDL is scheduled.

5C – Additional data and information will be collected before a TMDL or review of the Water Quality Standards is scheduled.

Aquifers

According to the Oklahoma Water Resources Board, there are no major or minor aquifers beneath this watershed. Major basins are distinct underground bodies of water overlain by contiguous land and having substantially the same geological and hydrological characteristics and from which groundwater wells yield at least fifty (50) gallons per minute on the average basinwide if from a bedrock aquifer and at least one hundred fifty (150) gallons per minute on the average basinwide if from an alluvium and terrace aquifer, or as otherwise designated by the Oklahoma Water Resources Board. (OWRB website, groundwater, 8-1-17)

Groundwater Wells

There are 293 groundwater wells within the watershed according to the Multi-Purpose Well Completion Reports filed by licensed well drillers with the Oklahoma Water Resources Board. These reports are required for each new well constructed. The uses vary and are shown in Table 15 with some of the information available. Improperly maintained wells, improperly plugged wells and abandoned wells are potential sources of groundwater pollution. Therefore, it is always advisable to consider the number, type and condition of wells in an area when looking for potential pollutant sources.

The Wellhead Protection program is part of a federal program geared to improving drinking water quality by protecting the area around a well. The goal of Oklahoma's Wellhead Protection program is to minimize the risk of pollution by limiting activities on the land around public water supply wells. DEQ rules state that public drinking water wells are not to be located within 300 feet horizontally from any existing or potential source of pollution.

Coal Creek at E. Apache St., 3-29-18

Table 15: Groundwater Wells in Coal Creek Watershed				
Number of Wells	Type of Well	Use Class	Depth Range	Comments
5	Cathodic Protection or Anode Well	Corrosion Protection	200 ft.	All 5 wells are owned by the University of Tulsa
1	Groundwater Well	Domestic	38 ft.	
1	Groundwater Well	Observation Well		
7	Geothermal or Heat Pump Well	Heat Exchange	250 to 400 ft.	
141	Monitoring Well	Site Assessment	0 to 48.5 ft.	
76	Geotechnical Boring	Soil Evaluation	0 to 40 ft.	
1	Groundwater Test Hole	Water Location	121 ft.	
61	Monitoring Well	Water Quality	4 to 203 ft.	

Map 2: Coal Creek Groundwater Wells

Watershed Aerial

An aerial photo of the Coal Creek watershed during the summer months shows vegetation and development. The lower portion of the watershed is primarily residential with some commercial and industrial properties. The upper portion is mostly commercial with undeveloped parcels.
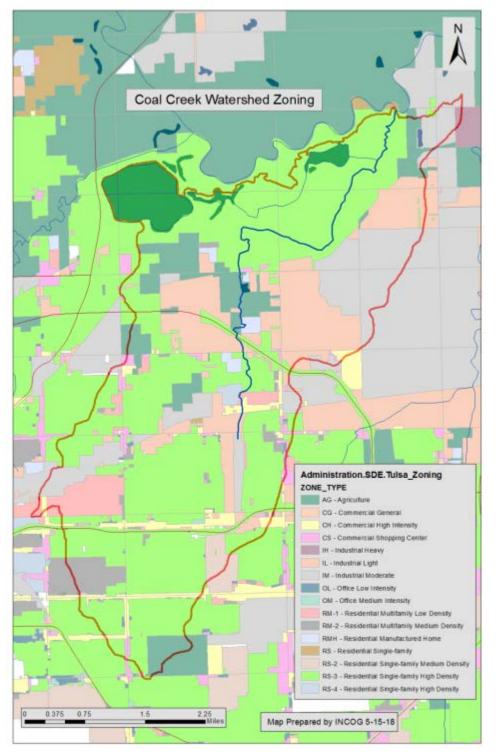
Map 3: Coal Creek Watershed Aerial

Zoning

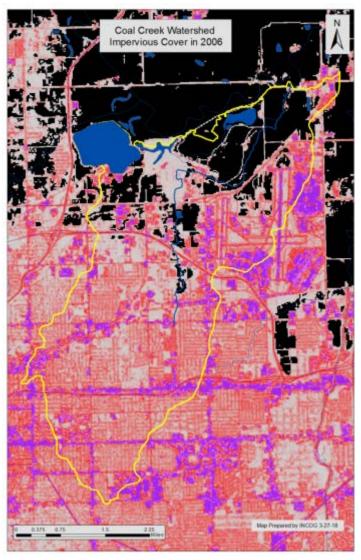Zoning within the watershed is highly variable. Most of the watershed is zoned residential single-family high density, industrial light or industrial moderate.

Map 4: Coal Creek Watershed Zoning

Impervious Cover

The National Land Cover Database products are created through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) and used to show how much and where impervious cover exists.

This type of information is helpful in determining where development may concentrate stormwater runoff. In the following maps, the darker the red the more impervious the surface. The purple areas indicate the densest portions and the black areas indicate the least impervious or less developed areas. Much of the Coal Creek watershed consists of impervious surfaces and therefore high runoff rates.

Map 5: Coal Creek Watershed Impervious Cover in 2006

By comparing the 2006 and 2011 impervious cover maps it becomes more obvious where growth and development are occurring.
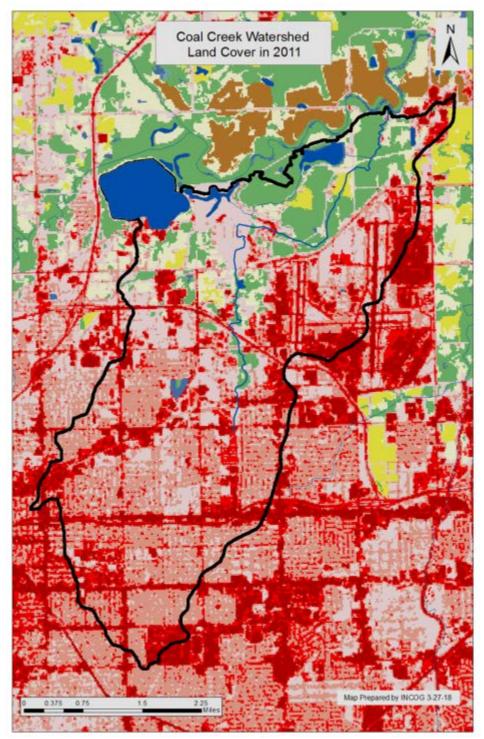
Map 6: Coal Creek Watershed Impervious Cover 2011

Land Cover

The National Land Cover Database products are created through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium. This data is used to depict how the land is being used.

Map 7: Coal Creek Watershed Land Cover 2011

Much of the undeveloped watershed is deciduous forest with a little pasture and a few hay fields. The developed areas are shown as "Low Intensity Residential", "High Intensity Residential" and "Commercial/Industrial/Transportation". See the legend for land cover below.

Legend

The classification system used by NLCD1992 is modified from the Anderson Land Cover Classification System*. Download the NLCD1992 land cover classification legend.
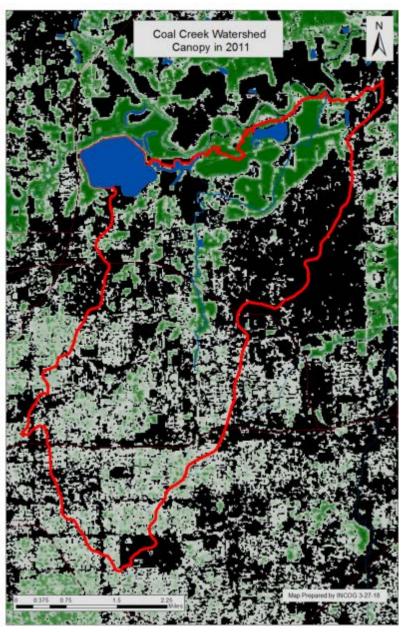
Class\ Value	Classification Description
Water	*areas of open water or permanent ice/snow cover.*
11	**Open Water** - areas of open water, generally with less than 25% cover of vegetation/land cover.
12	**Perennial Ice/Snow** - areas characterized by year-long surface cover of ice and/or snow.
Developed	*areas characterized by a high percentage (30 % or greater) of constructed materials (e.g. asphalt, concrete, buildings, etc.).*
21	**Low Intensity Residential** - areas with a mixture of constructed materials and vegetation. Constructed materials account for 30% to 80% of the cover. Vegetation may account for 20% to 70 % of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.
22	**High Intensity Residential** - areas highly developed where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20% of the cover. Constructed materials account for 80% to100% of the cover.
23	**Commercial/Industrial/Transportation** - areas of infrastructure (e.g. roads, railroads, etc.) and all highly developed areas not classified as High Intensity Residential
Barren	*areas characterized by bare rock, gravel, sand, silt, clay, or other earthen material, with little or no "green" vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the green vegetated categories; lichen cover may be extensive.*
31	**Bare Rock/Sand/Clay** - perennially barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, beaches, and other accumulations of earthen material.
32	**Quarries/Strip Mines/Gravel Pits** - areas of extractive mining activities with significant surface expression.
33	**Transitional** - areas of sparse vegetative cover (less than 25% of cover) that are dynamically changing from one land cover to another, often because of land use activities. Examples include forest clear cuts, a transition phase between forest and agricultural land, the temporary clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.).
Forest	*areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25% to 100% of the cover.*
41	**Deciduous Forest** - areas dominated by trees where 75% or more of the tree species shed foliage simultaneously in response to seasonal change.
42	**Evergreen Forest** - areas dominated by trees where 75% or more of the

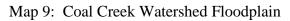|	
	tree species maintain their leaves all year. Canopy is never without green foliage.
43	**Mixed Forest** - areas dominated by trees where neither deciduous nor evergreen species represent more than 75% of the cover present.
Shrubland	*areas characterized by natural or semi-natural woody vegetation with aerial stems, generally less than 6 meters tall, with individuals or clumps not touching to interlocking. Both evergreen and deciduous species of true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions are included.*
51	**Shrubland** - areas dominated by shrubs; shrub canopy accounts for 25 to 100% of the cover. Shrub cover is generally greater than 25% when tree cover is less than 25%. Shrub cover may be less than 25% in cases when the cover of other life forms (e.g. herbaceous or tree) is less than 25% and shrubs cover exceeds the cover of the other life forms.
Non-natural woody	*areas dominated by non-natural woody vegetation; non-natural woody vegetative canopy accounts for 25% to 100% of the cover. The non-natural woody classification is subject to the availability of sufficient ancillary data to differentiate non-natural woody vegetation from natural woody vegetation.*
61	**Orchards/Vineyards/Other** - orchards, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.
Herbaceous Upland	*upland areas characterized by natural or semi-natural herbaceous vegetation; herbaceous vegetation accounts for 75% to 100% of the cover.*
71	**Grasslands/Herbaceous** - areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25%, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.
Planted/Cultivated	*areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75% to 100% of the cover.*
81	**Pasture/Hay** - areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.
82	**Row Crops** - areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.
83	**Small Grains** - areas used for the production of graminoid crops such as wheat, barley, oats, and rice.
84	**Fallow** - areas used for the production of crops that do not exhibit visible vegetation as a result of being tilled in a management practice that incorporates prescribed alternation between cropping and tillage.
85	**Urban/Recreational Grasses** - vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.
Wetlands	*areas where the soil or substrate is periodically saturated with or covered with water as defined by Cowardin et al., (1979).*
91	**Woody Wetlands** - areas where forest or shrubland vegetation accounts for 25% to 100 % of the cover and the soil or substrate is periodically saturated with or covered with water.
92	**Emergent Herbaceous Wetlands** - areas where perennial herbaceous vegetation accounts for 75% to 100% of the cover and the soil or substrate is periodically saturated with or covered with water.

Coal Creek Canopy

The National Land Cover Database 2011 (NLCD2011) USFS percent tree canopy product was produced through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium. The darker the green, the denser the tree canopy. A black background indicates zero percent tree canopy. Other than the lower reaches of Coal Creek, the canopy is sparse along much of the riparian corridor.
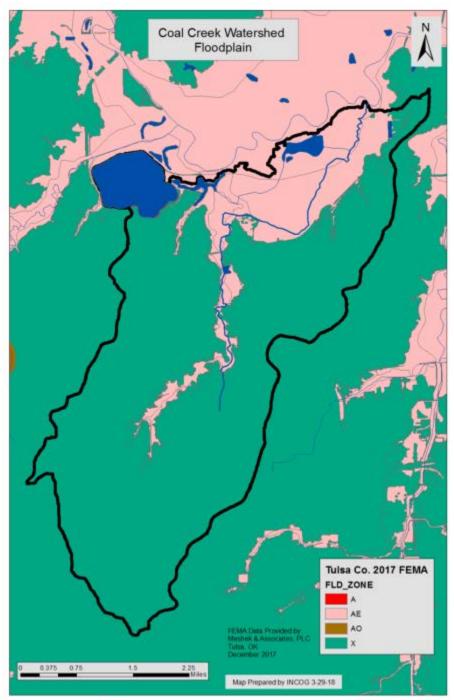
Map 8: Coal Creek Watershed Canopy 2011

Floodplain

The northern portion of the watershed that is still largely undeveloped is within the 100 year (Zone AE) floodplain which extends up the Coal Creek channel. The 100 year floodplain has a 1% chance of flooding each year. The rest of the watershed is in Zone X which is the 500 year floodplain or has a 0.2% chance of flooding each year.

Map 9: Coal Creek Watershed Floodplain

Zone A is the area with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas: no depths or base flood elevations are shown within these zones. There is no Zone A within the Coal Creek watershed.

Zone AE is the base floodplain where base flood elevations are provided.

Zone AO is a river or stream flood hazard area and an area with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage.
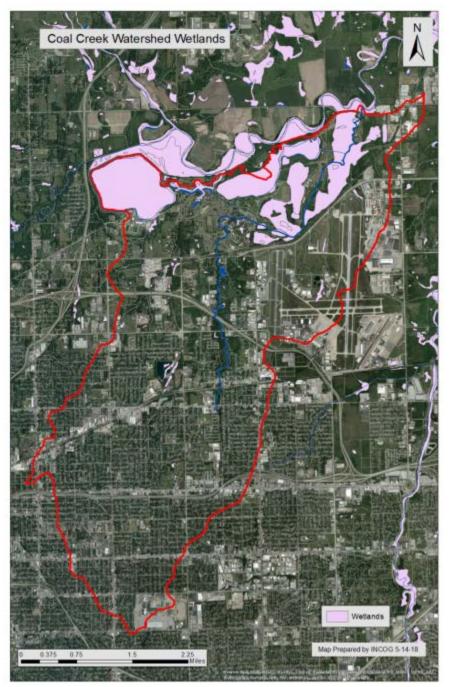
Zone X is the 500 year floodplain with a 0.2% annual chance of flooding.

Coal Creek near the confluence
with Bird Creek, 3-29-18

Wetlands

Map 10 shows wetlands and deep water habitats as reported by the National Wetlands Inventory (version 2) from the US Fish & Wildlife Service GIS Wetlands Data. There are numerous small wetlands scattered throughout the watershed with a concentration of larger wetlands located in the northern part of the watershed along Coal Creek and Bird Creek. These wetlands correlate well with areas prone to flooding shown on the floodplain map.
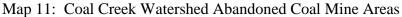
Map 10: Coal Creek Watershed Wetlands

Abandoned Coal Mine Features

Areas within this watershed that are listed in the Oklahoma Conservation Commission's Abandoned Mine Land Reclamation Program (AML) and potential problem areas are shown on Map 11. These are areas that contain abandoned coal mine features which may consist of dry or water-filled strip pits and underground mine related objects such as air shafts, portals, structures or areas of subsidence. Unknown AML features may exist outside of the areas shown. In addition to physical public health and safety concerns, acid mine drainage can have very low pH values and mobilize heavy metals negatively impacting receiving waters.

Map 11: Coal Creek Watershed Abandoned Coal Mine Areas

Remediation Sites

DEQ lists all properties associated with Brownfields, voluntary cleanup, Site Cleanup Assistance Program (SCAP), and Superfund sites that have had institutional controls placed on the property and all sites that have been awarded a Brownfield Certificate through the DEQ's Brownfields Program. This is handled by the Land Protection Division. This watershed has two Brownfield properties as shown in Map 12.

Map12: Coal Creek Watershed Remediation Sites

Hazardous Waste Facilities

DEQ permits hazardous waste landfill disposal sites, facilities that store hazardous wastes, hazardous waste transfer facilities, and certain types of recycling or treatment facilities, and Commercial Hazardous Waste Receiving Facilities. Permits allow these facilities to receive, store and transfer hazardous materials above threshold amounts. There are no permitted hazardous waste facilities within this watershed.

Coal Creek near 38 St. N., 3-29-18

Water Supply

The 1995 Oklahoma Comprehensive Water Plan (OCWP) was last updated (portions) in 2012. The purpose of this study was to determine the availability of water in Oklahoma and establish a

reliable supply of water for state users for at least the next 50 years. It provides information useful to water providers, policy makers and water users enabling informed decisions concerning the use and management of Oklahoma's water resources.

   The state was divided into 82 surface water basins within 13 Watershed Planning Regions. The Middle Arkansas Watershed Planning Region (MAWPR) includes eight basins numbered 49 and 73-79. Most water users in MAWPR rely on surface water supplies and to a lesser extent on alluvial and bedrock groundwater and will continue to do so in the future.

Map 13: Middle Arkansas Watershed Planning Region

Reservoirs in Oklahoma may serve multiple purposes, such as water supply, irrigation, recreation, hydropower generation, and flood control. Reservoirs designed for multiple purposes typically possess a specific volume of water storage assigned for each purpose.

(OCWP) Oklahoma Comprehensive Water Plan, Version 1.1, 2012 Update.

Currently surface water is used to meet about 95% of this regions demand. Conservation measures could reduce or eliminate some future shortages and surface water alternatives, such as bedrock groundwater supplies from major aquifers and/or developing new reservoirs could mitigate surface water gaps without major impacts to groundwater storage. No basins within this region have been identified as water availability "hot spots," or areas where severe deficits or gaps in supply are anticipated.

The Coal Creek watershed is in Basin 73. In this basin, water users are expected to continue to rely primarily on surface water supplies and major reservoirs. By 2050 there is a low probability of surface water gaps from increased demands on existing supplies during low flow periods. There are currently no groundwater rights in Basin 73. However, it is assumed that non-delineated minor alluvial groundwater sources will supply a small amount of domestic (self-supplied residential) water use, which does not require a permit. The use of groundwater to meet in-basin demand is not expected to be limited by the availability of permits through 2060. There are no significant groundwater quality issues in the basin.
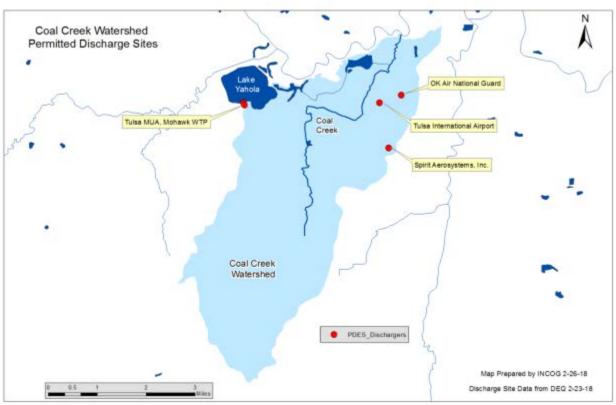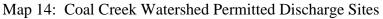
Land Application

There are no land application sites within this watershed.

Coal Creek confluence with Bird Creek, 3-29-18

Permitted Discharge Sites

The Tulsa Mohawk Water Treatment Plant discharges to Lake Yahola and the OK Air National Guard, Tulsa International Airport and Spirit Aerosystems, Inc. discharge to Coal Creek tributaries. See Map 14.

Map 14: Coal Creek Watershed Permitted Discharge Sites

Coal Creek at Apache St., 8-6-14